# Swami Vivekananda University

## School of Computer Science and Engineering

**Programme Name**

Bachelor of Technology in Computer Science and Engineering

**Swami Vivekananda University**

**School of Engineering**

**Programme: B. Tech in Computer Science and Engineering**

**(As per UGC CBCS Template)**

**2021**

**Semester-I**

| Course Code | Course Name | Course Type | L - T - P | Credits | Total Marks |
|---|---|---|---|---|---|
| BPHYC101 | Physics | CC-1 | 3 – 0 – 0 | 3 | 100 |
| BPHYC191 | Physics Lab | CC-1 | 0 – 0 – 3 | 2 | 100 |
| BMTMC101 | Mathematics –IA | CC-2 | 3 – 1 – 0 | 4 | 100 |
| BEEC101 | Basic Electrical Engineering | CC-3 | 3 – 0 – 0 | 3 | 100 |
| BEEC191 | Basic Electrical Engineering Lab | CC-3 | 0 – 0 – 3 | 2 | 100 |
| BMES181 | Workshop/Manufacturing Practices | SEC-1 | 3 – 1 – 0 | 4 | 100 |
| **Total** | | | | **18** | **600** |

**Semester-II**

| Course Code | Course Name | Course Type | L - T - P | Credits | Total Marks |
|---|---|---|---|---|---|
| BCHMC201 | Chemistry | CC-4 | 3 – 0 – 0 | 3 | 100 |
| BCHMC291 | Chemistry Lab | CC-4 | 0 – 0 – 3 | 2 | 100 |
| BMTMC201 | Mathematics –IIA | CC-5 | 3 – 1 – 0 | 4 | 100 |
| BTCSC201 | Programming forProblem Solving | CC-6 | 3 – 0 – 0 | 3 | 100 |
| BTCSC291 | Programming forProblem Solving Lab | CC-6 | 0 – 0 – 3 | 2 | 100 |
| HU201 | Communicative English | AECC-1 | 3 – 0 – 0 | 3 | 100 |
| HU291 | Language Laboratory | AECC-1 | 0 – 0 – 3 | 2 | 100 |
| BCES281 | Engineering Graphics & Design | SEC-2 | 3 – 1 – 0 | 4 | 100 |
| **Total** | | | | **23** | **800** |

**Semester-III**

| Course Code | Course Name | Course Type | L - T - P | Credits | Total Marks |
|---|---|---|---|---|---|
| HU301 | Economics for Engineers(Humanities-II) | AECC-2 | 3 – 0 – 0 | 3 | 100 |
| BTCSC301 | Analog and DigitalElectronics | CC-7 | 3 – 0 – 0 | 3 | 100 |
| BTCSC391 | Analog and Digital Electronics Lab | CC-7 | 0 – 0 – 3 | 2 | 100 |
| BTCSC302 | Data Structure &Algorithms | CC-8 | 3 – 0 – 0 | 3 | 100 |
| BTCSC392 | Data Structure &Algorithms Lab | CC-8 | 0 – 0 – 3 | 2 | 100 |
| BTCSC303 | Computer Organization | CC-9 | 3 – 0 – 0 | 3 | 100 |
| BTCSC393 | Computer Organization Lab | CC-9 | 0 – 0 – 3 | 2 | 100 |
| BTCSG301 | Mathematics – III | GE-1 | 3 – 1 – 0 | 4 | 100 |
| BTCSS381 | IT Workshop (Sci Lab/MATLAB/Python/R) | SEC-3 | 0 – 0 – 3 | 2 | 100 |
| **Total** | | | | **24** | **900** |

**Semester-IV**

| Course Code | Course Name | Course Type | L - T - P | Credits | Total Marks |
|---|---|---|---|---|---|
| BTCSC401 | Computer Architecture | CC-10 | 3 – 0 – 0 | 3 | 100 |
| BTCSC491 | Computer Architecture Lab | CC-10 | 0 – 0 – 3 | 2 | 100 |
| BTCSC402 | Design & Analysis of Algorithms | CC-11 | 3 – 0 – 0 | 3 | 100 |
| BTCSC492 | Design & Analysis ofAlgorithms Lab | CC-11 | 0 – 0 – 3 | 2 | 100 |
| BTCSC403 | Discrete Mathematics | CC-12 | 3 – 1 – 0 | 4 | 100 |
| BTCSC404 | Formal Language &Automata Theory | CC-13 | 3 – 1 – 0 | 4 | 100 |
| BTCSG401 | Biology | GE-2 | 2 – 0 – 0 | 2 | 100 |
| EVS401 | Environmental Science | AECC-3 | 2 – 0 – 0 | 2 | 100 |
| **Total** | | | | **22** | **800** |

**Semester-V**

| Course Code | Course Name | Course Type | L - T - P | Credits | Total Marks |
|---|---|---|---|---|---|
| BTCSC501 | Software Engineering | CC-14 | 3 – 0 – 0 | 3 | 100 |
| BTCSC591 | Software Engineering Lab | CC-14 | 0 – 0 – 3 | 2 | 100 |
| BTCSC502 | Operating Systems | CC-15 | 3 – 0 – 0 | 3 | 100 |
| BTCSC592 | Operating Systems Lab | CC-15 | 0 – 0 – 3 | 2 | 100 |
| BTCSC503 | Object Oriented Programming | CC-16 | 3 – 0 – 0 | 3 | 100 |
| BTCSC593 | Object Oriented Programming Lab | CC-16 | 0 – 0 – 3 | 2 | 100 |
| BTCSC504 | Compiler Design | CC-17 | 3 – 0 – 0 | 3 | 100 |
| BTCSS501 | Introduction to Industrial Management | SEC-4 | 3 – 0 – 0 | 3 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| BTCSE501 | **Elective - I**<br>A. Theory of Computation<br>B. Artificial Intelligence<br>C. Advanced Computer Architecture<br>D. Computer Graphics | DSE-1 | 3 – 0 – 0 | 3 | 100 |
| **Total** | | | | **24** | **900** |

**Semester-VI**

| Course Code | Course Name | Course Type | L - T - P | Credits | Total Marks |
|---|---|---|---|---|---|
| BTCSC601 | Database Management Systems | CC-18 | 3 – 0 – 0 | 3 | 100 |
| BTCSC691 | Database Management Systems Lab | CC-18 | 0 – 0 – 3 | 2 | 100 |
| BTCSC602 | Computer Networks | CC-19 | 3 – 0 – 0 | 3 | 100 |
| BTCSC692 | Computer Networks Lab | CC-19 | 0 – 0 – 3 | 2 | 100 |
| BTCSE603 | **Elective-II**<br>A. AdvancedAlgorithms<br>B. Distributed Systems<br>C. Signals & Systems<br>D. Image Processing | DSE-2 | 3 – 0 – 0 | 3 | 100 |
| BTCSE604 | **Elective-III**<br>A. Parallel and Distributed Algorithms<br>B. Data Warehousing & Data Mining<br>C. Human Computer Interaction<br>D. Pattern Recognition | DSE-3 | 3 – 0 – 0 | 3 | 100 |
| BTCSG605 | **Open Elective - I**<br>A. Numerical Methods<br>B. Human Resource Development and Organizational Behavior | SEC-5 | 3 – 0 – 0 | 3 | 100 |
| BTCSS681 | Research Methodology | SEC-6 | 3 – 0 – 0 | 3 | 100 |
| **Total** | | | | **22** | **800** |

**Semester-VII**

| Course Code | Course Name | Course Type | L - T - P | Credits | Total Marks |
|---|---|---|---|---|---|
| BTCSE701 | **Elective-IV**<br>A. Quantum Computing<br>B. Cloud Computing<br>C. Digital Signal Processing<br>D. Multi-agent Intelligent Systems<br>Machine learning | DSE-4 | 3 – 0 – 0 | 3 | 100 |
| BTCSE702 | **Elective-V** | | | | 100 |

| | | | | | |
|---|---|---|---|---|---|
| | A. Neural Networks and Deep Learning | DSE-5 | 3 – 0 – 0 | 3 | |
| | B. Soft Computing | | | | |
| | C. Ad-Hoc and Sensor Networks | | | | |
| | D. Information Theory and Coding | | | | |
| | E. Cyber Security | | | | |
| BTCSG703 | **Open Elective-II** | SEC-7 | 3 – 0 – 0 | 3 | 100 |
| | Operations Research | | | | |
| | Multimedia Systems | | | | |
| | Introduction to Philosophical Thoughts | | | | |
| BTCSS704 | Project Management and Entrepreneurship | SEC-8 | 3 – 0 – 0 | 3 | 100 |
| BTCSS781 | Project-I | SEC-9 | 0 – 0 – 3 | 3 | 100 |
| **Total** | | | | **15** | **500** |

**Semester-VIII**

| Course Code | Course Name | Course Type | L - T - P | Credits | Total Marks |
|---|---|---|---|---|---|
| BTCSE801 | **Elective-VI** | DSE-6 | 3 – 0 – 0 | 3 | 100 |
| | A. Signals and Networks | | | | |
| | B. Cryptograph y & Network Security | | | | |
| | C. Speech and Natural Language Processing | | | | |
| | D. Web and Internet Technology | | | | |
| | E. Internet of Things | | | | |
| BTCSG802 | **Open Elective-III** | DSE-7 | 3 – 0 – 0 | 3 | 100 |
| | A. Big Data Analysis | | | | |
| | B. Cyber Law and Ethics | | | | |
| | C. Mobile Computing | | | | |
| | D. Robotics | | | | |
| | E. Soft Skill & Interpersonal Communication | | | | |
| BTCSG803 | **Open Elective-IV** | DSE-8 | 3 – 0 – 0 | 3 | 100 |
| | A. E-Commerce and ERP | | | | |
| | B. Micro-electronics and VLSI Design | | | | |
| | C. Economic Policies in India | | | | |
| BTCSS881 | Project -II | SEC-10 | 0 – 0 – 3 | 3 | 100 |
| **Total** | | | | **12** | **400** |

## Semester-I

| Course Code | Course Name | Course Type | L - T - P | Credits | Total Marks |
|---|---|---|---|---|---|
| BPHYC101 | Physics-I (Gr-A) | CC-1 | 3 – 1 – 0 | 4 | 100 |
| BPHYC191 | Physics-I Lab (Gr-A) | CC-1 | 0 – 0 – 3 | 1.5 | 100 |
| BMTMC101 | Mathematics –I (Gr-A) | CC-2 | 3 – 1 – 0 | 4 | 100 |
| BEEC101 | Basic Electrical Engineering | CC-3 | 3 – 0 – 0 | 3 | 100 |
| BEEC191 | Basic Electrical Engineering Lab | CC-3 | 0 – 0 – 3 | 2 | 100 |
| BMES181 | Workshop/Manufacturing Practices | SEC-1 | 3 – 1 – 0 | 4 | 100 |
| **Total** | | | | **18.5** | **600** |

| **Course Name: Physics-I (Gr-A)** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BPHYC101** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **1** | **0** | **4** | **4** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[12H]**

Mechanics: Problems including constraints & friction. Basic ideas of vector calculus and partial differential equations. Potential energy function F = -grad V, equipotential surfaces and meaning of gradient. Conservative and non-conservative forces. Conservation laws of energy & momentum. Non-inertial frames of reference. Harmonic oscillator; Damped harmonic motion forced oscillations and resonance. Motion of a rigid body in a plane and in 3D. Angular velocity vector. Moment of inertia.

**Module 2** **[12H]**

Optics: Distinction between interference and diffraction, Fraunhofer and Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits ( only the expressions for max;min, & intensity and qualitative discussion of fringes); diffraction grating(resolution formulac only), characteristics of diffration grating and its applications.

Polarisation: Introduction, polarisation by reflection, polarisation by double reflection, scattering of light, circular and elliptical polarisation, optical activity.

Lasers: Principles and working of laser: population inversion, pumping, various modes, threshold population inversion with examples.

**Module 3** **[12H]**

Electromagnetism and Dielectric Magnetic Properties of Materials

Maxwell's equations. Polarisation, permeability and dielectric constant, polar and non-polar dielecrrics, internal fields in a solid, Clausius- Mossotti equation(expression only), applications of dielectrics.

Magnetisation, permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.

**Module 4** **[12H]**

Quantum Mechanics: Introduction to quantum physics, black body radiation, explanation using the photon concept, Compton effect, de Broglie hypothesis, wave-particle duality, verification of matter waves, uncertainty principle, Schrodinger wave equation, particle in box, quantum harmonic oscillator, hydrogen atom.

**Module 5** **[12H]**

Statistical Mechanics: Macrostate, Microstate, Density of states, Qualitative treatment of Maxwell Boltzmann, Fermi-Dirac and Bose-Einstein statistics.

**Text Books**

1. Introduction to Electrodynamics, David J. Griffiths, Pearson Education India Learning Private Limited
2. Principles of Physics, 10ed, David Halliday, Robert Resnick Jearl Walker , Wiley

**Reference Books**

1. Electricity, Magnetism, and Light, Wayne M. Saslow, Academic Press
2. Engineering Mechanics (In SI Units) (SIE), S. Timoshenko, D.H. Young,

| **Course Name: Mathematics -1 (Gr-A)** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BMTMC101** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **1** | **0** | **4** | **4** |
| **Total Contact Hours: 60** | | | | | |

**Module 1** **[9H]**

Calculus (Integration): Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

**Module 2** **[9H]**

Calculus (Differentiation): Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin's theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.

**Module 3** **[9H]**

Matrices: Matrices, Vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.

**Module 4** **[9H]**

Vector Spaces: Vector Space, linear dependence of vectors, Basis, Dimension; Linear transformations (maps), Range and Kernel of a linear map, Rank and Nullity, Inverse of a linear transformation, Rank-Nullity theorem, composition of linear maps, Matrix associated with a linear map.

**Module 5** **[9H]**

Vector Spaces (Continued): Eigenvalues, Eigenvectors, Symmetric, Skew-symmetric, and Orthogonal Matrices, Eigenbases. Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.

**Text Books**

1. Reena Garg, Engineering Mathematics-I, Khanna Publishers.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.

**Reference Books**

1. Michael Greenberg, Advanced Engineering Mathematics, Pearson.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.

| **Course Name: Basic Electrical Engineering** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BEEC101** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[9H]**

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

**Module 2** **[8H]**

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

**Module 3** **[7H]**

Transformers: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

**Module 4** **[7H]**

Electrical Machines: Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

**Module 5** **[7H]**

Power Converters: DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

**Module 6** **[7H]**

Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

**Text Books**

1. Ritu Sahdev, Basic Electrical Engineering, Khanna Book Publishing Co. (P) Ltd., Delhi.
2. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.

**Reference Books**

1. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
2. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.

| **Course Name: Workshop/Manufacturing Practices** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BMES181** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **1** | **0** | **4** | **4** |
| **Total Contact Hours: 60** | | | | | |

**Module 1** **[15H]**

i) Lectures & videos:

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. CNC machining, Additive manufacturing
3. Fitting operations & power tools

4. Electrical &Electronics
5. Carpentry
6. Plastic moulding, glass cutting
7. Metal casting
8. Welding (arc welding & gas welding), brazing

**Module 2** **[45H]**

ii) Workshop Practice:

- Machine shop

Typical jobs that may be made in this practice module:
1. To make a pin from a mild steel rod in a lathe.
2. To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.

- Fitting shop

Typical jobs that may be made in this practice module:
1. To make a Gauge from MS plate.

- Carpentry

Typical jobs that may be made in this practice module:
1. To make wooden joints and/or a pattern or like.

- Welding shop (Arc welding + gas welding)

Typical jobs that may be made in this practice module:
1. ARC WELDING: To join two thick (approx 6mm) MS plates by manual metal arc welding.
2. GAS WELDING: To join two thin mild steel plates or sheets by gas welding.

- Casting

Typical jobs that may be made in this practice module:
1. One/ two green sand moulds to prepare, and a casting be demonstrated.

- Smithy

Typical jobs that may be made in this practice module:
1. A simple job of making a square rod from a round bar or like.

- Plastic moulding & Glass cutting

Typical jobs that may be made in this practice module:
1. For plastic moulding, making at least one simple plastic component should be made.
2. For glass cutting, three rectangular glass pieces may be cut to make a kaleidoscope using a black colour diamond cutter, or similar other components may be made.

- Electrical & Electronics

1. Familiarization with LT switchgear elements, making its sketches and noting down its specification. Kitkat fuse, Glass cartridge fuse, Plastic fuse holders (optional), Iron clad isolators, MCB style isolators, Single phase MCB, Single-phase wire, wiring cable.
2. Demonstration of domestic wiring involving two MCB, two piano key switches, one incandescent lamp, one LED lamp and plug point.
3. Simple wiring exercise to be executed to understand the basic electrical circuit. Simple soldering exercises to be executed to understand the basic process of soldering.
4. Fabrication of a single-phase full wave rectifier with a step down transformer using four diodes and electrolytic capacitor and to find its volt-ampere characteristics to understand basic electronic circuit fabrication.

**Text Books**

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.

**Reference Books**

1. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
2. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.

| **Course Name: Physics-I Lab (Gr-A)** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BPHYC191** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **0** | **0** | **3** | **3** | **1.5** |
| **Total Contact Hours: 23** | | | | | |

**Experiments in Optics**

1. Determination of dispersive power of the material of a prism
2. Determination of wavelength of a monochromatic light by Newton's ring
3. Determination of wavelength of a monochromatic light by Fresnel's bi-prism
4. Determination of wavelength of the given laser source by diffraction method

**Electricity & Magnetism experiments**

1. Determination of thermo electric power of a given thermocouple.
2. Determination of specific charge (e/m) of electron by J.J. Thompson's method.
3. Determination of dielectric constant of a given dielectric material.
4. Determination of Hall coefficient of a semiconductor by four probe method.
5. To study current voltage characteristics, load response, areal characteristic and spectral response of a photovoltaic solar cell.
6. Determination of resistance of ballistic galvanometer by half deflection method and study of variation of logarithmic decrement with series resistance.
7. Determination of unknown resistance using Carey Foster's bridge
8. Study of Transient Response in LR, RC and LCR circuits using expeyes

9. Generating sound from electrical energy using expeyes

**Experiments in Quantum Physics**

1. Determination of Stefan-Boltzmann constant.
2. Determination of Planck constant using photocell.
3. Determination of Lande-g factor using Electron spin resonance spectrometer.
4. Determination of Rydberg constant by studying Hydrogen spectrum.
5. Determination of Band gap of semiconductor.
6. To study current voltage characteristics, load response, areal characteristic and spectral response of a photovoltaic solar cell.

**Miscellaneous experiments**

1. Determination of Young's modulus of elasticity of the material of a bar by the method of flexure
2. Determination of bending moment and shear force of a rectangular beam of uniform cross-section
3. Determination of modulus of rigidity of the material of a rod by static method
4. Determination of rigidity modulus of the material of a wire by dynamic method
5. To determine the moment of inertia of a body about an axis passing through its centre of gravity and to determine the modulus of rigidity of the material of the suspended wire
6. Determination of coefficient of viscosity by Poiseulle's capillary flow method

| **Course Name: Basic Electrical Engineering Lab** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BEEC191** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **0** | **0** | **3** | **3** | **2** |
| **Total Contact Hours: 30** | | | | | |

**Choose 10 experiments from the following:**

1. First activity: Introduction to basic safety precautions and mentioning of the do's and Don'ts. Noting down list of experiments to be performed, and instruction for writing the laboratory reports by the students. Group formation. Students are to be informed about the modalities of evaluation.
2. Introduction and uses of following instruments :
    a) Voltmeter
    b) Ammeter
    c) Multimeter
    d) Oscilloscope

3. Demonstration of real life resistors, capacitors with color code , inductors and autotransformer.

4. Demonstration of cut-out sections of machines: DC machine, Induction machine, Synchronous machine and single phase induction machine.
5. Calibration of ammeter and Wattmeter.
6. Determination of steady state and transient response of R-L, R-C and R-L-C circuit to a step

change in voltage.

7. Determination of steady state response of R-L and R-C and R-L-C circuit and calculation of impedance and power factor.
8. Determination of resonance frequency and quality factor of series and parallel R-L-C circuit.
9.

a) Open circuit and short circuit test of a single-phase transformer
b) Load test of the transformer and determination of efficiency and regulation

10. Demonstration of three phase transformer connections. Voltage and current relationship, phase shifts between the primary and secondary side.
11. Measurement of power in a three phase unbalanced circuit by two wattmeter method.
12. Determination of Torque –Speed characteristics of separately excited DC motor.
13. Determination of Torque speed characteristics and observation of direction reversal by change of phase sequence of connection of Induction motor.
14. Determination of operating characteristics of Synchronous generator.
15. Demonstration of operation of (a) DC-DC converter (b) DC-AC converter (c) DC-AC converter for speed control of an Induction motor
16. Demonstration of components of LT switchgear.

**Semester-II**

| Course Code | Course Name | Course Type | L - T - P | Credits | Total Marks |
|---|---|---|---|---|---|
| BCHMC201 | Chemistry-I | CC-4 | 3 – 1 – 0 | 4 | 100 |
| BCHMC291 | Chemistry-I Lab | CC-4 | 0 – 0 – 3 | 1.5 | 100 |
| BMTMC201 | Mathematics –II (Gr-A) | CC-5 | 3 – 1 – 0 | 4 | 100 |
| BTCSC201 | Programming forProblem Solving | CC-6 | 3 – 0 – 0 | 3 | 100 |
| BTCSC291 | Programming forProblem Solving Lab | CC-6 | 0 – 0 – 3 | 2 | 100 |
| HU201 | Communicative English | AECC-1 | 3 – 0 – 0 | 3 | 100 |
| HU291 | Language Laboratory | AECC-1 | 0 – 0 – 3 | 2 | 100 |
| BCES281 | Engineering Graphics & Design | SEC-2 | 3 – 1 – 0 | 4 | 100 |
| **Total** | | | | **23.5** | **800** |

| **Course Name: Chemistry-I** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BCHMC201** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **1** | **0** | **4** | **4** |
| **Total Contact Hours: 60** | | | | | |

**Module 1** **[12H]**

Atomic and molecular structure: Schrodinger equation. Particle in a box solutions and their applications for simple sample. Molecular orbitals of diatomic molecules (e.g.H2). Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

**Module 2** **[9H]**

Spectroscopic techniques and applications: Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

**Module 3** **[5H]**

iii)Intermolecular forces and potential energy surfaces. Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena.

**Module 4** **[9H]**

Use of free energy in chemical equilibria: First and second laws of thermodynamics and thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

**Module 5** **[9H]**

Periodic properties: Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

**Module 6** **[8H]**

Stereochemistry: Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

**Module 7** **[8H]**

Organic reactions and synthesis of a drug molecule: Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

**Text Books**

1. Engineering Chemistry, Satyaprakash, Khanna Book Publishing, Delhi
2. University chemistry, by B. H. Mahan

**Reference Books**

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2. Fundamentals of Molecular Spectroscopy, by C. N. Banwell

| **Course Name: Mathematics –II (Gr-A)** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BMTMC201** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **1** | **0** | **4** | **4** |
| **Total Contact Hours: 60** | | | | | |

**Module 1** **[10H]**

Basic Probability: Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the Multinomial distribution, Poisson approximation to the Binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

**Module 2** **[10H]**

Continuous Probability Distributions: Continuous random variables and their properties, Distribution functions and densities, Normal, Exponential and Gamma densities.

**Module 3** **[10H]**

Bivariate Distributions: Bivariate distributions and their properties, distribution of sums and quotients, Conditional densities, Bayes' rule.

**Module 4** **[10H]**

Basic Statistics: Measures of Central tendency, Moments, Skewness and Kurtosis, Probability distributions: Binomial, Poisson and Normal and evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

**Module 5** **[10H]**

Applied Statistics: Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion,

difference of proportions, single mean, difference of means, and difference of standard deviations.

**Module 6** **[10H]**

Small samples: Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

**Text Books**

1. Reena Garg, Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishers.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.

**Reference Books**

1. Michael Greenberg, Advanced Engineering Mathematics, Pearson.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.

| **Course Name: Programming forProblem Solving** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC201** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[8H]**

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples.

From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code

**Module 2** **[3H]**

Arithmetic expressions and precedence

**Module 3** **[3H]**

Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops

**Module 4** **[6H]**

Arrays: Arrays (1-D, 2-D), Character arrays and Strings

**Module 5** **[6H]**

Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding

roots of equations, notion of order of complexity through example programs (no formal definition required)

**Module 6** **[5H]**

Function: Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference.

**Module 7** **[6H]**

Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

**Module 8** **[2H]**

Structure: Structures, Defining structures and Array of Structures

**Module 9** **[3H]**

Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

**Module 10** **[3H]**

File handling (only if time is available, otherwise should be done as part of the lab)

**Text Books**

1. R. S. Salaria, Computer Concepts and Programming in C, Khanna Publishers
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill

**Reference Books**

1. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
2. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

| **Course Name: Communicative English** | | | | | |
|---|---|---|---|---|---|
| **Course Code: HU201** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[9H]**

Vocabulary Building

- The concept of Word Formation: Compounding, Backformation, Clipping, Blending.
- Root words from foreign languages and their use in English
- Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.

- Synonyms, antonyms, and standard abbreviations: Acronyms

**Module 2** **[9H]**

Basic Writing Skills

- Sentence Structures & Types: Simple, Compound, Complex
- Use of phrases and clauses in sentences: Transformation of sentences, active, passive, narration
- Importance of proper punctuation
- Creating coherence: Arranging paragraphs & Sentences in logical order
- Creating Cohesion: Organizing principles of paragraphs in documents
- Techniques for writing precisely

**Module 3** **[9H]**

Identifying Common Errors in Writing

- Subject-verb agreement
- Noun-pronoun agreement
- Misplaced modifiers
- Articles
- Prepositions
- Redundancies
- Clichés

**Module 4** **[9H]**

Nature and Style of sensible Writing

- Describing
- Defining
- Classifying
- Providing examples or evidence
- Writing introduction and conclusion

**Module 5** **[9H]**

Writing Practices

- Comprehension
- Précis Writing
- Essay Writing
- Business Letter, Cover Letter & CV; E-mail

**Addendum**

Some examples of English words with foreign roots

| Greek Root/Affix | Examples |
|---|---|
| Anti | Antisocial, antiseptic |
| Auto | Automatic, autograph |
| Anthropos | Anthropology,philanthropy |
| Bio | Biography |
| Chronos | Time |
| Di | Dilemma |
| Bio | Biology |
| Biblio | Bibliography |

| | |
|---|---|
| Chron | Chronology |
| Cracy | Contradiction |
| Geo | Geology |
| Hyper | Hyperactive |
| Mania | Kleptomania |
| Mega | Megaserial |
| Eu | Eulogy, euphoria |
| Geo | Geology |
| Graph | autograph, photograph |
| Hetero | Heterogeneous |
| Hyper | Hyperactive |
| Hypo | hypodermic, hypoglycemia |
| Macro | Macrocosm |
| Mega | megalomania |
| Micro | Microcosm |
| Mono | Monarch |
| Pan | Panorama |
| Pathos | Pathetic |
| Phobia | Hydrophobia |
| Pod (Gk), ped (Latin) | Pseudopodia |
| Poly | polyglot |
| Tele | Telephone |
| Theo | Theology, theist |

| **Latin Root** | **Examples** |
|---|---|
| Aud | Audible |
| Bene | Beneficial |
| Brev | abbreviate, brief |
| Circum | Circulate |
| Contra | Contradict |
| Cred | Credible |
| Dict<br>Femina | Diction<br>Feminine |
| Inter | Internet, interval |
| Magna | Magnificient |
| Mal<br>Multi | Malnutrition<br>multinational |
| Nova | Novel |
| Multi | Multiple, multiplex |
| Non | Nonstop |
| Pre | Previous, predicate |
| Re | Redo, rewind |
| Scrib | Scripture |
| Spect | Spectator |
| Trans | Transport |
| Uni | Unity |
| Omni | Omnipotent |

| | |
|---|---|
| Semi | Semicircle |
| Sub | Subway |
| Somnus | Insomnia, |
| Super | Superman |
| Sym | Sympathy |
| Scribe | Describe, scribble(write illegibly), inscribe |
| Trans | Transform |
| Un | Unnecessary |
| Uni | Universal |

**Text Books**

1. Kulbushan Kumar, R S Salaria,Effective Communication Skills, Khanna Publishing House, Delhi.
2. Practical English Usage. Michael Swan. OUP. 1995.

**Reference Books**

1. Remedial English Grammar. F.T. Wood. Macmillan.2007
2. On Writing Well. William Zinsser. Harper Resource Book. 2001

| **Course Name: Engineering Graphics & Design** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BCES281** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **1** | **0** | **4** | **4** |
| **Total Contact Hours: 60** | | | | | |

**Module 1** **[6H]**

Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Different types of lines and their use; Drawing standards and codes.

**Module 2** **[5H]**

Lettering, Dimensioning, Scales: Plain scale, Diagonal scale and Vernier Scales.

**Module 3** **[6H]**

Geometrical Construction and Curves: Construction of polygons, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid, Involute, Archemedian Spiral.

**Module 4** **[5H]**

Projection of Points, Lines, Surfaces: Principles of Orthographic Projections-Conventions - 1st and 3rd angle projection, Projections of Points and lines inclined to both planes; Projections of planes (Rectangle, pentagon, Hexagon etc.) inclined Planes - Auxiliary Planes.

**Module 5** **[6H]**

Projection of Regular Solids: Regular solids inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale (Cube, Pyramid, Prism, Cylinder, Cone).

**Module 6** **[5H]**

Combination of Regular Solids, Floor Plans: Regular solids in mutual contact with each other like Spheres in contact with cones standing on their base. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

**Module 7** **[6H]**

Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

**Module 8** **[5H]**

Sections and Sectional Views of Right Angular Solids: Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

**Module 9** **[5H]**

Overview of Computer Graphics, Customisation & CAD Drawing: listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]; Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles

**Module 10** **[5H]**

Annotations, Layering & Other Functions: applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer- aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling.

**Module 11** **[6H]**

Demonstration of A Simple Team Design Project: Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Following is the list of drawing instruments that required for making engineering drawings on paper with perfection.

1. Drawing Board
2. Mini drafter/ Set-squares (45°–45° & 60°–90°), T-square 3. Protractor (180°, 360°)
3. Scales (Plain, Diagonal)
4. Compass (Small and Large)
5. Divider (Small and Large)
6. French Curves
7. Drawing paper (A1 Size)
8. Drawing pencil (H, HB, B)
9. Sharpener
10. Eraser
11. Drawing pins & clips
12. Duster or handkerchief etc.

**Text Books**

2. Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House
3. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House

**Reference Books**:

1. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education

| **Course Name: Chemistry Lab** | | | | | |
|---|---|---|---|---|---|
| **Course Code:** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **0** | **0** | **3** | **3** | **1.5** |
| **Total Contact Hours: 23** | | | | | |

**Choose 10 experiments from the following:**

1. Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.

2. pH- metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
3. Determination of dissolved oxygen present in a given water sample.
4. To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution)
5. Determination of surface tension and viscosity
6. Thin layer chromatography
7. Ion exchange column for removal of hardness of water
8. Determination of the rate constant of a reaction
9. Determination of cell constant and conductance of solutions
10. Potentiometry - determination of redox potentials and emfs
11. Saponification/acid value of an oil
12. Chemical analysis of a salt
13. Determination of the partition coefficient of a substance between two immiscible liquids
14. Adsorption of acetic acid by charcoal
15. Use of the capillary viscosimeters to the demonstrate of the isoelectric pointas
16. The pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

| **Course Name: Programming for Problem Solving Lab** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC291** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **2** |
| **Total Contact Hours: 30** | | | | | |

**Tutorial 1:** Problem solving using computers:
**Lab1:** Familiarization with programming environment

**Tutorial 2:** Variable types and type conversions:
**Lab 2:** Simple computational problems using arithmetic expressions

**Tutorial 3:** Branching and logical expressions:
**Lab 3:** Problems involving if-then-else structures

**Tutorial 4:** Loops, while and for loops:
**Lab 4:** Iterative problems e.g., sum of series

**Tutorial 5:** 1D Arrays: searching, sorting:
**Lab 5:** 1D Array manipulation

**Tutorial 6:** 2D arrays and Strings
**Lab 6:** Matrix problems, String operations

**Tutorial 7:** Functions, call by value:
**Lab 7:** Simple functions

**Tutorial 8 & 9:** Numerical methods (Root finding, numerical differentiation, numerical integration):
**Lab 8 and 9:** Programming for solving Numerical methods problems

**Tutorial 10:** Recursion, structure of recursive calls

**Lab 10:** Recursive functions

**Tutorial 11**: Pointers, structures and dynamic memory allocation
**Lab 11:** Pointers and structures

**Tutorial 12:** File handling
**Lab 12:** File operations

| **Course Name: Language Laboratory** | | | | | |
|---|---|---|---|---|---|
| **Course Code: HU291** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **0** | **0** | **3** | **3** | **2** |
| **Total Contact Hours: 30** | | | | | |

1. Honing 'Listening Skill' and its sub skills through Language Lab Audio device;
2. Honing 'Speaking Skill' and its sub skills
3. Helping them master Linguistic/Paralinguistic features (Pronunciation/Phonetics/
4. Voice modulation/ Stress/ Intonation/ Pitch &Accent) of connected speech
5. Honing 'Conversation Skill' using Language Lab Audio –Visual input; Conversational Practice Sessions (Face to Face / via Telephone, Mobile phone & Role Play Mode)
6. Introducing 'Group Discussion' through audio –Visual input and acquainting them with key strategies for success
7. G D Practice Sessions for helping them internalize basic Principles (turn- taking, creative intervention, by using correct body language, courtesies & other soft skills) of GD
8. Honing 'Reading Skills' and its sub skills using Visual / Graphics/ Diagrams /Chart Display/Technical/Non Technical Passages, Learning Global / Contextual / Inferential Comprehension;
9. Honing 'Writing Skill' and its sub skills by using Language Lab Audio –Visual input; Practice Sessions

## Semester III

| **Course Code** | **Course Name** | **Course Type** | **L - T - P** | **Credits** | **Total Marks** |
|---|---|---|---|---|---|
| HU301 | Economics for Engineers(Humanities-II) | AECC-1 | 3 – 0 – 0 | 3 | 100 |
| BTCSC301 | Analog and DigitalElectronics | CC-2 | 3 – 0 – 0 | 3 | 100 |
| BTCSC391 | Analog and Digital Electronics Lab | CC-2 | 0 – 0 – 3 | 2 | 100 |
| BTCSC302 | Data Structure &Algorithms | CC-3 | 3 – 0 – 0 | 3 | 100 |
| BTCSC392 | Data Structure &Algorithms Lab | CC-3 | 0 – 0 – 3 | 2 | 100 |
| BTCSC303 | Computer Organization | CC-4 | 3 – 0 – 0 | 3 | 100 |
| BTCSC393 | Computer Organization Lab | CC-4 | 0 – 0 – 3 | 2 | 100 |
| BMTMC301 | Mathematics – III | GE-1 | 3 – 1 – 0 | 4 | 100 |
| BTCSS381 | IT Workshop (Sci Lab/MATLAB/Python/R) | SEC-1 | 0 – 0 – 3 | 2 | 100 |
| **Total** | | | | **24** | **900** |

| **Course Name: Economics for Engineers (Humanities-II)** | | | | | |
|---|---|---|---|---|---|
| **Course Code: HU301** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[10H]**

Economic Decisions Making – Overview, Problems, Role, Decision making process. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.

**Module 2** **[10H]**

Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value of Money, Debt repayment, Nominal& Effective Interest. Cash Flow & Rate of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing an Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity and Breakeven Analysis. Economic Analysis In The Public Sector -Quantifying And Valuing Benefits & drawbacks.

**Module 3** **[10H]**

Inflation and Price Change – Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates. Present Worth Analysis: End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives. 7. Uncertainty In Future Events - Estimates and Their Use in Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic Decision Trees, Risk, Risk vs Return, Simulation, Real Options.

**Module 4** **[15H]**

Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances. Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life of a New Asset, Marginal Cost, Minimum Cost Life Problems. Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.

**Text book and Reference books:**

1. James L.Riggs, David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , Tata McGraw-Hill
2. Donald Newnan, Ted Eschembach, Jerome Lavelle: Engineering Economics Analysis, OUP
3. John A. White, Kenneth E. Case, David B. Pratt : Principle of Engineering Economic Analysis, John Wiley
4. Sullivan and Wicks: Engineering Economy, Pearson

5. R.Paneer Seelvan: Engineering Economics, PHI
6. Michael R Lindeburg : Engineering Economics Analysis, Professional Pub
7. Premvir Kapoor, Sociology & Economics for Engineers, Khanna Publishing House (AICTE Recommended Textbook – 2018)

| **Course Name: Analog and Digital Electronics** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC301** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[10H]**

Different Classes of Amplifiers - (Class-A, B, AB and C - basic concepts, power, efficiency; Recapitulation of basic concepts of Feedback and Oscillation, Phase Shift, Wein Bridge oscillators Astable & Monostable Multivibrators; Schimtt Trigger circuits, 555 Timer.

**Module 2** **[15H]**

Binary Number System & Boolean Algebra (recapitulation); BCD, ASCII, EBDIC, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic, Venn diagram, Boolean algebra (recapitulation); Representation in SOP and POS forms; Minimization of logic expressions by algebraic method. Combinational circuits - Adder and Subtractor circuits (half & full adder & subtractor); Encoder, Decoder, Comparator, Multiplexer, De- Multiplexer and Parity Generator

**Module 3** **[10H]**

Sequential Circuits - Basic Flip-flop & Latch, Flip-flops -SR, JK, D, T and JK Master-slave Flip Flops, Registers (SISO, SIPO, PIPO, PISO) Ring counter, Johnson counter Basic concept of Synchronous and Asynchronous counters (detail design of circuits excluded), Design of Mod N Counter

**Module 4** **[10H]**

A/D and D/A conversion techniques – Basic concepts (D/A :R-2-R only, A/D: successive approximation), Logic families- TTL, ECL, MOS and CMOS - basic concepts.

**Text book and Reference books:**

1. Microelectronics Engineering –Sedra & Smith-Oxford.
2. Analog Electronics, A.K. Maini, Khanna Publishing House (AICTE Recommended -2018)
3. Analog Electronics, L.K. Maheswari, Laxmi Publications (AICTE Recommended -2018)
4. Principles of Electronic Devices & circuits—B L Thereja & Sedha—S Chand
5. Digital Electronics – Kharate – Oxford
6. Digital Electronics – Logic & Systems by J.Bigmell & R.Donovan; Cambridge Learning.
7. Digital Logic and State Machine Design (3rd Edition) – D.J.Comer, OUP
8. Electronic Devices & Circuit Theory – Boyelstad & Nashelsky - PHI
9. Bell-Linear IC & OP AMP—Oxford
10. P.Raja- Digital Electronics- Scitech Publications
11. Morries Mano- Digital Logic Design- PHI
12. R.P.Jain—Modern Digital Electronics, 2/e ,McGraw Hill
13. H.Taub & D.Shilling, Digital Integrated Electronics- McGraw Hill.
14. D.RayChaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publishers
15. Tocci, Widmer, Moss- Digital Systems,9/e- Pearson
16. J.Bignell & R.Donovan-Digital Electronics-5/e- Cenage Learning.

17. Leach & Malvino—Digital Principles & Application, 5/e, McGraw Hill
18. Floyed & Jain- Digital Fundamentals-Pearson.

| Course Name: Data Structure & Algorithms | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC302** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module –I**
**Linear Data Structure Introduction [10H]**
Why we need data structure? Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type. Algorithms and programs, basic idea of pseudo-code. Algorithm efficiency and analysis, time and space analysis of algorithms – order notations. Array (2L): Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials. Linked List (4L): Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

**Module –II**
**Linear Data Structure [Stack and Queue [10H]**
Stack and its implementations (using array, using linked list), applications. Queue, circular queue, dequeue. Implementation of queue- both linear and circular (using array, using linked list), applications. Recursion (2L): Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi, Eight Queens Puzzle.

**Module -III.**
**Nonlinear Data structures Trees [15H]**
Basic terminologies, forest, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree, expression tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B- Trees – operations (insertion, deletion with examples only). Graphs (6L): Graph definitions and concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cutvertex/articulation point, pendant node, clique, complete graph, connected components – strongly connected component, weakly connected component, path, shortest path, isomorphism). Graph representations/storage implementations – adjacency matrix, adjacency list, adjacency multi-list. Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, forward-edge), applications. Minimal spanning tree – Prim's algorithm (basic idea of greedy methods).

**Module – IV**
**Searching, Sorting [10H]**
Sorting Algorithms (5L): Bubble sort and its optimizations, insertion sort, shell sort, selection sort, merge sort, quick sort, heap sort (concept of max heap, application – priority queue), radix sort. Searching (2L): Sequential search, binary search, interpolation search. Hashing (3L): Hashing functions, collision resolution techniques.

**Recommended books:**

1. "Data Structures And Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung.
2. "Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
3. "Data Structures in C" by Aaron M. Tenenbaum.
4. "Data Structures" by S. Lipschutz.
5. "Data Structures Using C" by Reema Thareja.
6. "Data Structure Using C", 2/e by A.K. Rath, A. K. Jagadev.
7. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

| **Course Name: Computer Organization** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC303** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module – 1:**
**[15H]**
Basic organization of the stored program computer and operation sequence for execution of a program. Role of operating systems and compiler/assembler. Fetch, decode and execute cycle, Concept of operator, operand, registers and storage, Instruction format. Instruction sets and addressing modes. Commonly used number systems. Fixed and floating point representation of numbers.

**Module – 2:**
**[10H]**
Overflow and underflow. Design of adders - ripple carry and carry look ahead principles. Design of ALU. Fixed point multiplication -Booth's algorithm. Fixed point division - Restoring and non-restoring algorithms. Floating point - IEEE 754 standard.

**Module – 3:**
**[10H]**
Memory unit design with special emphasis on implementation of CPU-memory interfacing. Memory organization, static and dynamic memory, memory hierarchy, associative memory. Cache memory, Virtual memory. Data path design for read/write access.

**Module – 4:**
**[10H]**
Design of control unit - hardwired and microprogrammed control. Introduction to instruction pipelining. Introduction to RISC architectures. RISC vs CISC architectures. I/O operations - Concept of handshaking, Polled I/O, interrupt and DMA.

**Text Book:**
1. Mano, M.M., “Computer System Architecture”, PHI.
2. Behrooz Parhami “ Computer Architecture”, Oxford University Press

**Reference Book:**
1. Hayes J. P., “Computer Architecture & Organisation”, McGraw Hill,
2. Hamacher, “Computer Organisation”, McGraw Hill,
3. N. senthil Kumar, M. Saravanan, S. Jeevananthan, “Microprocessors and Microcontrollers” OUP
4. Chaudhuri P. Pal, “Computer Organisation & Design”, PHI,
5. P N Basu- “Computer Organization & Architecture” , Vikas Pub

| **Course Name: Mathematics - III** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BMTMC301** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **1** | **0** | **4** | **4** |
| **Total Contact Hours: 60** | | | | | |

**Module 1** **[12H]**
Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions.

**Module 2** **[12H]**
Limit, continuity and partial derivatives, Chain rule, Implicit function, Jacobian, Directional derivatives, Total derivative; Maxima, minima and saddle points; Gradient, curl and divergence and related problems.

**Module 3** **[12H]**
Double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar). Theorems of Green, Gauss and Stokes (Statement only) and related problems.

**Module 4** **[12H]**
First Order Differential Equation, Exact, Linear and Bernoulli's equations, Equations of first order but not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's form, general & singular solution, Second order linear differential equations with constant coefficients, D-operator method, method of variation of parameters, Cauchy-Euler equation.

**Module 5** **[12H]**
Basic Concept of graph, Walk, Path Circuit, Euler and Hamiltonian graph, diagraph. Matrix Representation: Incidence & Adjacency matrix. Tree: Basic Concept of tree, Binary tree, Spanning Tree, KrusKal and Prim's algorithm for finding the minimal spanning tree.

**Text book and Reference books:**

1. Higher Algebra, S. K. Mapa, Levant Books.
2. Advanced Higher Algebra, Chakravorty and Ghosh, U N Dhar Pvt. Ltd.
3. Co-ordinate Geometry, S. L. Loney
4. Integral Calculus, Das and Mukherjee, U N Dhar Pvt. Ltd.
5. Differential Calculus, Das and Mukherjee, U N Dhar Pvt. Ltd.
6. Advanced Engineering Mathematics, E Kreyszig
7. Advanced Engineering Mathematics, Chandrika Prasad & Reena Garg, Khanna Publishing House (AICTE Recommended Textbook -2018)

| **Course Name: Analog and Digital Electronics Lab** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC391** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **0** | **0** | **3** | **3** | **2** |
| **Total Contact Hours: 30** | | | | | |

**Laboratory Experiments:**
**Analog Electronics**

1. Design a Class A amplifier
2. Design a Phase-Shift Oscillator

3. Design of a Schmitt Trigger using 555 timer

**Digital Electronics**

1. Design a Full Adder using basic gates and verify its output / Design a Full
2. Subtractor circuit using basic gates and verify its output.
3. Construction of simple Decoder & Multiplexer circuits using logic gates.
4. Realization of RS / JK / D flip flops using logic gates
5. Design of Shift Register using J-K / D Flip Flop
6. Realization of Synchronous Up/Down counter
7. Design of MOD- N Counter
8. Study of DAC

| **Course Name: Data Structure & Algorithms Lab** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC392** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **0** | **0** | **3** | **2** | **3** |
| **Total Contact Hours: 30** | | | | | |

**Laboratory Experiments:**

**Linear Data Structure**

1. Implementation of array operations
2. Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting
3. elements
4. Merging Problem: Evaluation of expressions operations on Multiple stacks &
5. queues:
6. 4 Implementation of linked lists: inserting, deleting, inverting a linked list.
7. Implementation of stacks & queues using linked lists
8. Polynomial addition, Polynomial multiplication

**Non Linear Data Structure**

1. Recursive and Non-recursive traversal of Trees
2. Threaded binary tree traversal. AVL tree implementation
3. Application of Trees. Application of sorting and searching algorithms
4. Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.

| **Course Name: Computer Organization Lab** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC393** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **0** | **0** | **3** | **3** | **2** |
| **Total Contact Hours: 30** | | | | | |

**Laboratory Experiments:**

1. Familiarity with IC-chips: a) Multiplexer, b) Decoder, c) Encoder b) Comparator, Truth Table verification and clarification from Data-book.
2. Design an Adder/Subtractor composite unit.
3. Design a BCD adder.
4. Design of a 'Carry-Look-Ahead' Adder circuit.
5. Use a multiplexer unit to design a composite ALU
6. Use ALU chip for multibit arithmetic operation
7. Implement read write operation using RAM IC
8. 8. (a) & (b) Cascade two RAM ICs for vertical and horizontal expansion.

| **Course Name: IT Workshop (Sci Lab/MATLAB/Python/R)** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSS381** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **0** | **0** | **3** | **3** | **2** |
| **Total Contact Hours: 30** | | | | | |

**Programming in R**

1. Introduction to mechanism for statistics, data analysis, and machine learning; Introduction of R Programming, How to install and run R, Use of R help files, R Sessions, R Objects – Vectors, Attributes, Matrices, Array, Class, List, Data Frames etc. Operators in R.

2. R Programming Structures, Control Statements, Loops, Repeat and Break, R-Function, R-Vector Function, Recursive Function in R.

3. R Packages (Install and Use), Input/Output Features in R, Reading or Writing in File. Data Manipulation in R. Rearranging data, Random Number and Simulation, Statistical methods like min, max, median, mean, length, Linear Regression, Normal Distribution, Decision tree

4. Graphics, Creating Graphs, The Workhorse of R Base Graphics, Graphical Functions – Customizing Graphs, Saving Graphs to Files, Pie chart, Bar Chart, Histogram.

5. Text book and Reference books:
6. Dr. Jeeva Jose, Begineer's Guide for Data Analysis Using R Programming, Khanna Publishing House, New Delhi

**Programming in MATLAB**

1. **Introduction**
   Why MATLAB?, History, Its strengths, Competitors, Starting MATLAB, Using MATLAB as a calculator, Quitting MATLAB

2. **Basics**
   Familiar with MATLAB windows, Basic Operations, MATLAB-Data types, Rules about variable names, Predefined variables

3. **Programming-I**
   Vector, Matrix, Array Addressing, Built-in functions, Mathematical Operations, Dealing with strings (Array of characters), Array of array (cell) concept

4. **Programming-II**
   Script file, Input commands, Output commands, Structure of function file, Inline functions, Feval command, Comparison between script file and function file

5. **Conditional statements and Loop**
   Relational and Logical Operators, If-else statements, Switch-case statements, For loop, While loop, Special commands (Break and continue), Import data from large database, Export data to own file or database

6. **2D Plotting**
   In-built functions for plotting, Multiple plotting with special graphics, Curve fitting, Interpolation, Basic fitting interface

7. **3D Plotting**

Use of meshgrid function, Mesh plot, Surface plot, Plots with special graphics

**Programming with Python Introduction**

1. History, Features, Setting up path, Working with Python, Basic Syntax, Variable and Data Types, Operator

2. **Conditional Statements**
   If, If- else, Nested if-else, Looping, For, While, Nested loops

3. **Control Statements**
   Break, Continue, Pass

4. **String Manipulation**
   Accessing Strings, Basic Operations, String slices, Function and Methods

5. **Lists**
   Introduction, Accessing list, Operations, Working with lists, Function and Methods

6. **Tuple**
   Introduction, Accessing tuples, Operations, Working, Functions and Methods

7. **Dictionaries**
   Introduction, Accessing values in dictionaries, Working with dictionaries, Properties

8. **Functions**
   Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables

9. **Modules**
   Importing module, Math module, Random module, Packages, Composition, Input-Output Printing on screen, Reading data from keyboard, Opening and closing file, Reading and writing files, Functions

10. **Exception Handling**
    Exception, Exception Handling, Except clause, Try? finally clause, User Defined Exceptions.

**Semester-IV**

| Course Code | Course Name | Course Type | L - T - P | Credits | Total Marks |
|---|---|---|---|---|---|
| BTCSC401 | Computer Architecture | CC-5 | 3 – 0 – 0 | 3 | 100 |
| BTCSC491 | Computer Architecture Lab | CC-5 | 0 – 0 – 3 | 2 | 100 |
| BTCSC402 | Design & Analysis of Algorithms | CC-6 | 3 – 0 – 0 | 3 | 100 |
| BTCSC492 | Design & Analysis of Algorithms Lab | CC-6 | 0 – 0 – 3 | 2 | 100 |
| BTCSC403 | Discrete Mathematics | CC-7 | 3 – 1 – 0 | 4 | 100 |
| BTCSC404 | Formal Language &Automata Theory | CC-8 | 3 – 1 – 0 | 4 | 100 |
| BTCSG401 | Biology | GE-2 | 2 – 0 – 0 | 2 | 100 |
| BEVSC401 | Environmental Science | AECC-2 | 2 – 0 – 0 | 2 | 100 |
| **Total** | | | | **22** | **800** |

| **Course Name: Computer Architecture** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC401** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[10H]**

Introduction: Review of basic computer architecture (Revisited), Quantitative techniques in computer design, measuring and reporting performance. Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards. Exception handling. Pipeline optimization techniques; Compiler techniques for improving performance.

**Module 2** **[10H]**

Hierarchical memory technology: Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies.

**Module 3** **[5H]**

Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, super-pipelined and VLIW processor architectures. Array and vector processors.

**Module 4** **[10H]**

Multiprocessor architecture: taxonomy of parallel architectures; Centralized shared- memory architecture: synchronization, memory consistency, interconnection networks. Distributed shared-memory architecture. Cluster computers. Non von Neumann architectures: data flow computers, reduction computer architectures, systolic architectures.

**Text/Reference Books:**

1. V. Carl, G. Zvonko and S. G. Zaky, “Computer organization”, McGraw Hill, 1978.
2. B. Brey and C. R. Sarma, “The Intel microprocessors”, Pearson Education, 2000.
3. J. L. Hennessy and D. A. Patterson, “Computer Architecture A Quantitative Approach”, Morgan Kauffman, 2011.
4. W. Stallings, “Computer organization”, PHI, 1987.
5. P. Barry and P. Crowley, “Modern Embedded Computing”, Morgan Kaufmann, 2012.
6. N. Mathivanan, “Microprocessors, PC Hardware and Interfacing”, Prentice Hall, 2004.
7. Y. C. Lieu and G. A. Gibson, “Microcomputer Systems: The 8086/8088 Family”, Prentice Hall India, 1986.
8. J. Uffenbeck, “The 8086/8088 Design, Programming, Interfacing”, Prentice Hall, 1987.
9. B. Govindarajalu, “IBM PC and Clones”, Tata McGraw Hill, 1991.
10. P. Able, “8086 Assembly Language Programming”, Prentice Hall India6. Winfried Karl Grassmann and Jean-Paul Tremblay, Logic and Discrete Mathematics, PEARSON.
11. Rajaraman – “Computer Organization & Architecture”, PHI

12. B.Ram – "Computer Organization & Architecture", Newage Publications

| Course Name: Design & Analysis of Algorithms | | | | | |
|---|---|---|---|---|---|
| Course Code: BTCSC402 | | | | | |
| Contact Hours Per Week | L | T | P | Total | Credit Points |
| | 3 | 0 | 0 | 3 | 3 |
| Total Contact Hours: 45 | | | | | |

**Module 1** **[10H]**

Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem

**Module 2** **[10H]**

Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch and Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics –characteristics and their application domains.

**Module 3** **[10H]**

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

**Module 4** **[10H]**

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P,NP, NP- complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.

**Module 5** **[5H]**

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE 4

**Text books/ reference books:**

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.
3. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
4. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
5. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA
6. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House (AICTE

Recommended Textbook – 2018)

7. Algorithms Design and Analysis, Udit Agarwal, Dhanpat Rai

| **Course Name: Discrete Mathematics** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC403** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **1** | **0** | **4** | **4** |
| **Total Contact Hours: 60** | | | | | |

**Module 1** **[15H]**

Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem.

Principles of Mathematical Induction: The Well- Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

**Module 2** **[5H]**

Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination

**Module 3** **[14H]**

Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

**Module 4** **[14L]**

Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

**Module 5** **[12L]**

Graphs and Trees: Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.

**Text book and Reference books:**

1. Russell Merris, Combinatorics, Wiley-Interscience series in Discrete Mathematics and Optimisation
2. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI

3. Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGE Learning
4. Gary Chartrand and Ping Zhang – Introduction to Graph Theory, TMH
5. J.K. Sharma, Discrete Mathematics, Macmillan
6. Winfried Karl Grassmann and Jean-Paul Tremblay, Logic and Discrete Mathematics, PEARSON.
7. S. K. Chakraborty and B. K. Sarkar, Discrete Mathematics, OXFORD University Press.
8. Douglas B. West, Introduction to graph Theory, PHI
9. C. L. Liu, Elements of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 2000.
10. R. C. Penner, Discrete Mathematics: Proof Techniques and Mathematical Structures, World Scientific, 1999.
11. R. L. Graham, D. E. Knuth, and O. Patashnik, Concrete Mathematics, 2nd Ed., Addison-Wesley, 1994.
12. N. Deo, Graph Theory, Prentice Hall of India, 1974.
13. S. Lipschutz and M. L. Lipson, Schaum's Outline of Theory and Problems of Discrete

14. Mathematics, 2nd Ed., Tata McGraw-Hill, 1999.
15. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997.
16. Russell Merris, Combinatorics, Wiley-Interscience series in Discrete Mathematics and Optimisation
17. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI
18. Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGE Learning
19. Gary Chartrand and Ping Zhang – Introduction to Graph Theory, TMH
20. S.B. Singh, Discrete Structures – Khanna Publishing House (AICTE Recommended Textbook – 2018)
21. S.B. Singh, Combinatorics and Graph Theory, Khanna Publishing House (AICTE Recommended Textbook – 2018)

| **Course Name: Formal Language & Automata Theory** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC404** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[5H]**

Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.

**Module 2** **[10H]**

Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata)

**Module 3** **[7H]**

Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence

with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic push down automata, closure properties of CFLs.

**Module 4** **[5H]**

Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.

**Module 5** **[8H]**

Turing machines: The basic model for Turing machines (TM), Turing recognizable(recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMsas enumerators

**Module 6** **[10H]**

Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages

**Text books/ reference books:**

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.
2. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.
3. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
4. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
5. John Martin, Introduction to Languages and The Theory of Computation, TataMcGraw Hill., PEARSON.
6. Dr. R.B.Patel, Theory of Computation, Khanna Publishing House

| **Course Name: Biology** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSG401** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **2** | **0** | **0** | **2** | **2** |
| **Total Contact Hours: 30** | | | | | |

**Module 1** **[4H]**

To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

**Module 2** **[4H]**

The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchyClassification.

Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

**Module 3** **[3H]**

To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

**Module 4** **[3H]**

Biomolecules: To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA.Two carbon units and lipids.

**Module 5** **[3H]**

Enzymes: To convey that without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

**Module 6** **[3H]**

Information Transfer: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA 4 structure from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

**Module 7** **[3H]**

Macromolecular analysis: How to analyse biological processes at the reductionist level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

**Module 8** **[4H]**

Metabolism: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keqand its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

**Module 9** **[3H]**

Microbiology Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms.

Sterilization and media compositions. Growth kinetics.

**Text books/ reference books:**

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

| **Course Name: Environmental Science** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BEVSC401** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **1** | **0** | **0** | **1** | **0** |
| **Total Contact Hours: 30** | | | | | |

**Module 1** **[4H]**

Basic ideas of environment, basic concepts, man, society & environment, their interrelationship, Mathematics of population growth and associated problems, Importance of population study in environmental, engineering, definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development. Materials balance: Steady state conservation system, steady state system with non-conservative pollutants, step function. Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering. (2L)

**Module 2** **[4H]**

Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem- components types and function. Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban); Food chain [definition and one example of each food chain], Food web. Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity.

**Module 3** **[6H]**

Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems. Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth's heat budget. Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model.

Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green-house gases, effect of ozone modification. Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP. cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference).

**Module 4** **[6H]**

Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. River/Lake/ground water pollution: River: DO, 5-day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH. Lake: Eutrophication [Definition, source and effect]. Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only) Standard and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic

**Module 5** **[4H]**

Lithosphere; Internal structure of earth, rock and soil Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes; Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling. Solid waste management and control (hazardous and biomedical waste).

**Module 6** **[4H]**

Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise] Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, (18hr Index) ,n Ld. Noise pollution control.

**Module 7** **[2H]**

Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/agreement/ protocol.

**Text books/ reference books:**

1. M.P. Poonia & S.C. Sharma, Environmental Studies, Khanna Publishing House (AICTE Recommended Textbook – 2018)
2. Masters, G. M., “Introduction to Environmental Engineering and Science”, Prentice-Hall of India Pvt. Ltd.,1991.
3. De, A. K., “Environmental Chemistry”, New Age International

| **Course Name: Computer Architecture Lab** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC491** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **0** | **0** | **3** | **3** | **2** |
| **Total Contact Hours: 30** | | | | | |

**Laboratory Experiments:**

1. HDL introduction.
2. Basic digital logic base programming with HDL
3. 8-bit Addition, Multiplication, Division
4. 8-bit Register design
5. Memory unit design and perform memory operations.
6. 8-bit simple ALU design
7. 8-bit simple CPU design
8. Interfacing of CPU and Memory.

| **Course Name: Design & Analysis of Algorithms Lab** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC492** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **0** | **0** | **3** | **3** | **2** |
| **Total Contact Hours: 30** | | | | | |

**Laboratory Experiments:**

**Divide and Conquer:**

1. Implement Binary Search using Divide and Conquer approach
2. Implement Merge Sort using Divide and Conquer approach
3. Implement Quick Sort using Divide and Conquer approach
4. Find Maximum and Minimum element from a array of integer using Divide and Conquer approach
5. Find the minimum number of scalar multiplication needed for chain of matrix
6. Implement all pair of Shortest path for a graph (Floyed- Warshall Algorithm) Implement Traveling Salesman Problem
7. Implement Single Source shortest Path for a graph ( Dijkstra , Bellman Ford Algorithm

**Brunch and Bound:**

8. Implement 15 Puzzle Problem

**Backtracking:**

9. Implement 8 Queen problem
10. Graph Coloring Problem Hamiltonian Problem

**Greedy method**

11. Knapsack Problem
12. Job sequencing with deadlines
13. Minimum Cost Spanning Tree by Prim's Algorithm
14. Minimum Cost Spanning Tree by Kruskal's Algorithm

**Graph Traversal Algorithm:**

15. Implement Breadth First Search (BFS)
16. Implement Depth First Search (DFS)

**Semester-V**

| Course Code | Course Name | Course Type | L - T - P | Credits | Total Marks |
|---|---|---|---|---|---|
| BTCSC501 | Software Engineering | CC-9 | 3 – 0 – 0 | 3 | 100 |
| BTCSC591 | Software Engineering Lab | CC-9 | 0 – 0 – 3 | 2 | 100 |
| BTCSC502 | Operating Systems | CC-10 | 3 – 0 – 0 | 3 | 100 |
| BTCSC592 | Operating Systems Lab | CC-10 | 0 – 0 – 3 | 2 | 100 |
| BTCSC503 | Object Oriented Programming | CC-11 | 3 – 0 – 0 | 3 | 100 |
| BTCSC593 | Object Oriented Programming Lab | CC-11 | 0 – 0 – 3 | 2 | 100 |
| BTCSC504 | Compiler Design | CC-12 | 3 – 0 – 0 | 3 | 100 |
| BTCSS501 | Introduction to Industrial Management | SEC-2 | 3 – 0 – 0 | 3 | 100 |
| BTCSE501 | **Elective - I**<br>A. Theory of Computation<br>B. Artificial Intelligence<br>C. Advanced Computer Architecture<br>D. Computer Graphics | DSE-1 | 3 – 0 – 0 | 3 | 100 |
| **Total** | | | | **24** | **900** |

| **Course Name: Software Engineering** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC501** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[9H]**

Overview of System Analysis & Design , Business System Concept, System Development Life Cycle, Waterfall Model , Spiral Model, Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model.

**Module 2** **[9H]**

System Design – Context diagram and DFD, Problem Partitioning, Top-Down And Bottom-Up design; Decision tree, decision table and structured English; Functional vs. Object- Oriented approach.

**Module 3** **[9H]**

Coding & Documentation – Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation. Testing – Levels of Testing, Integration Testing, Test case Specification,

Reliability Assessment, Validation & Verification, Metrics, Monitoring & Control.

**Module 4** **[9H]**

Software Project Management – Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring.

**Module 5** **[9H]**

Static and dynamic models, why modeling, UML diagrams: Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram, implementation diagram.

**Text book and Reference books:**

1. Pressman, Software Engineering : A practitioner's approach– (TMH)
2. Pankaj Jalote, Software Engineering- (Wiley-India)
3. N.S. Gill, Software Engineering – (Khanna Publishing House)
4. Rajib Mall, Software Engineering- (PHI)
5. Agarwal and Agarwal, Software Engineering – (PHI)
6. Sommerville, Software Engineering – Pearson
7. Martin L. Shooman, Software Engineering – TMH

| **Course Name: Operating Systems** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC502** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[5H]**
Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.

**Module 2** **[10H]**
Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPUutilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

**Module 3** **[5H]**
Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problematic.

**Module 4** **[5H]**
Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

**Module 5** **[10H]**
Memory Management: Basic concept, Logical and Physical address map, Memory allocation:

Contiguous Memory allocation–Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation –Page allocation Hardware support for paging, Protection and sharing, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory– Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used(LRU).

**Module 6** **[10H]**

I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks

**Text book and Reference books:**

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
3. Operating System Concepts, Ekta Walia, Khanna Publishing House (AICTE Recommended Textbook – 2018)
4. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
5. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison- Wesley
6. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
7. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

| **Course Name: Object Oriented Programming** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC503** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[9H]**

Abstract data types and their specification. How to implement an ADT. Concrete state space, concrete invariant, abstraction function. Implementing operations, illustrated by the Text example.

**Module 2** **[9H]**

Features of object-oriented programming. Encapsulation, object identity, polymorphism – but not inheritance.

**Module 3** **[9H]**

Inheritance in OO design. Design patterns. Introduction and classification. The iterator pattern.

**Module 4** **[9H]**

Model-view-controller pattern. Commands as methods and as objects. Implementing OO language features. Memory management.

**Module 5** **[9H]**

Generic types and collections, GUIs. Graphical programming with Scale and Swing. The software development process

**Text book and Reference books:**

1. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India
2. Ali Bahrami – "Object Oriented System Development" – Mc Graw Hill
3. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH
4. R.K Das – "Core Java For Beginners" – VIKAS PUBLISHING
5. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
6. Ivor Horton's Beginning Java 2 SDK – Wrox
7. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

| **Course Name: Compiler Design** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC504** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[3H]**
Introduction to Compiling, Compilers, Analysis of the source program, The phases of the compiler, Cousins of the compiler.

**Module 2** **[7H]**
Lexical Analysis, The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of a tokens, Finite automata, From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of a lexical analyzer generator (Lex).

**Module 3** **[7H]**
Syntax Analysis, The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Non- recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.

**Module 4** **[3H]**
Syntax directed translation, Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes.

**Module 5** **[3H]**
Type checking, Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions

**Module 6** **[7H]**
Run time environments, Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.

**Module 7** **[5H]**
Intermediate code generation, Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements, (Quadruples, Triples, Indirect triples).

**Module 8** **[5H]**
Code optimization, roduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The principle sources of optimization, Loops in flow graph, Peephole

optimization.

**Module 9** **[5H]**

Code generations, Issues in the design of code generator, a simple code generator, Register allocation & assignment.

**Text book and Reference books:**

1. Aho, Sethi, Ullman - "Compiler Principles, Techniques and Tools" - Pearson Education.
2. Holub - "Compiler Design in C" - PHI.

| **Course Name: Introduction to Industrial Management** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSS501** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1**

**Introduction:** **[10H]**

System- concept, definition, types, parameters, variables and behavior. Management – definition and functions.

Organization structure:

i. Definition.
ii. Goals.
iii. Factors considered in formulating structure.
iv. Types.
v. Advantages and disadvantages.
vi. Applications.

Concept, meaning and importance of division of labor, scalar & functional processes, span of control, delegation of authority, centralization and decentralization in industrial management.

Organizational culture and climate – meaning, differences and factors affecting them.

Moral-factors affecting moral. Relationship between moral and productivity.

Job satisfaction- factors influencing job satisfaction.

Important provisions of factory act and labor laws.

**Module 2**

**Critical Path Method (CPM) and Programme Evaluation Review Technique (PERT):** **[5H]**

CPM & PERT-meaning, features, difference, applications.

Understand different terms used in network diagram.

Draw network diagram for a real life project containing 10-15 activities, computation of LPO and EPO.(Take minimum three examples). Determination of critical path on network. Floats, its types and determination of floats. Crashing of network, updating and its applications.

**Module 3**

**Materials Management:** **[10H]**

Material management-definition, functions, importance, relationship with other departments.

Purchase - objectives, purchasing systems, purchase procedure, terms and forms used in purchase department.

Storekeeping- functions, classification of stores as centralized and decentralized with their advantages, disadvantages and application in actual practice.

Functions of store, types of records maintained by store, various types and applications of storage equipment, need and general methods for codification of stores.

Inventory control:

i. Definition.

ii. Objectives.
iii. Derivation for expression for Economic Order Quantity (EOQ) and numeric examples.
iv. ABC analysis and other modern methods of analysis.
v. Various types of inventory models such as Wilson's inventory model, replenishment model and two bin model. (Only sketch and understanding, no derivation.).
Material Requirement Planning (MRP)- concept, applications and brief details about software packages available in market.

**Module 4**

**Production planning and Control (PPC): [10H]**
Types and examples of production. PPC :
i. Need and importance.
ii. Functions.
iii. Forms used and their importance.
iv. General approach for each type of production.
Scheduling- meaning and need for productivity and utilisation.
Gantt chart- Format and method to prepare.
Critical ratio scheduling-method and numeric examples.
Scheduling using Gantt Chart (for at least 5-7 components having 5-6 machining operations, with processes, setting and operation time for each component and process, resources available, quantity and other necessary data), At least two examples. Bottlenecking- meaning, effect and ways to reduce.

**Module 5**

**Value Analysis (VA) and Cost Control: [5H]**
5.1 VA-definition, terms used, process and importance. 5.2 VA flow diagram. DARSIRI method of VA. Case study of VA-at least two. Waste-types, sources and ways to reduce them. Cost control-methods and important guide lines. 4

**Module 6**

**Recent Trends in IM: [5H]**
ERP (Enterprise resource planning) - concept, features and applications. Important features of MS Project. Logistics- concept, need and benefits. Just in Time (JIT)-concept and benefits. Supply chain management-concept and benefits.

**Text book and Reference books:**

1. L.S. Srinath– "CPM & PERT principles and Applications".
2. Buffa – "Modern Production Management".
3. N. Nair – "Materials Management".
4. O. P. Khanna – " Industrial Engineering & Management".
5. Mikes – "Value Analysis".
6. S.C. Sharma, "Engineering Management – Industrial Engineering & Management", Khanna Book Publishing Company, New Delhi

| **Course Name: Theory of Computation** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE501A** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1 [20H]**

Fundamentals: Basic definition of sequential circuit, block diagram, mathematical representation,

concept of transition table and transition diagram (Relating of Automata concept to sequential circuit concept) Design of sequence detector, Introduction to finite state model
Finite state machine: Definitions, capability & state equivalent, kth- equivalent concept, Merger graph, Merger table, Compatibility graph, Finite memory definiteness, testing table & testing graph. Deterministic finite automaton and non deterministic finite automaton. Transition diagrams and Language recognizers.
Finite Automata: NFA with Î transitions - Significance, acceptance of languages.
Conversions and Equivalence: Equivalence between NFA with and without Î transitions. NFA to DFA conversion. Minimization of FSM, Equivalence between two FSM's , Limitations of FSM, Application of finite automata, Finite Automata with output- Moore & Melay machine.

**Module 2** **[10H]**

Regular Languages : Regular sets. Regular expressions, identity rules. Arden's theorem state and prove Constructing finite Automata for a given regular expressions, Regular string accepted by NFA/DFA, Pumping lemma of regular sets. Closure properties of regular sets (proofs not required). Grammar Formalism: Regular grammars-right linear and left linear grammars. Equivalence between regular linear grammar and FA. [1L] Inter conversion, Context free grammar. Derivation trees, sentential forms. Right most and leftmost derivation of strings. (Concept only)

**Module 3** **[10H]**

Context Free Grammars, Ambiguity in context free grammars. Minimization of Context Free Grammars. Chomsky normal form and Greibach normal form. [1L] Pumping Lemma for Context Free Languages. Enumeration of properties of CFL (proofs omitted). Closure property of CFL, Ogden's lemma & its applications Push Down Automata: Push down automata, definition. Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, interconversion. (Proofs not required). Introduction to DCFL and DPDA.

**Module 4** **[5H]**

Turing Machine : Turing Machine, definition, model Design of TM, Computable functions, Church's hypothesis, counter machine Types of Turing machines (proofs not required) Universal Turing Machine, Halting problem

**Text book and Reference books:**

1. "Introduction to Automata Theory Language and Computation", Hopcroft H.E. and Ullman J. D., Pearson education.
2. "Theory of Computation", R.B Patel, Khanna Publishing House, New Delhi
3. "Theory of Computer Science ", Automata Languages and computation", Mishra and Chandra shekaran, 2nd edition, PHI.
4. "Formal Languages and Automata Theory", C.K.Nagpal, Oxford
5. "Switching & Finite Automata", ZVI Kohavi, 2nd Edn., Tata McGraw Hill
6. "Introduction to Computer Theory", Daniel I.A. Cohen, John Wiley
7. "Introduction to languages and the Theory of Computation", John C Martin, TMH
8. "Elements of Theory of Computation", Lewis H.P. & Papadimitrou C.H. Pearson, PHI.

| **Course Name: Artificial Intelligence** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE501B** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[9H]**

**Introduction to Intelligent Systems:**
Overview of Artificial intelligence- Problems of AI, AI technique, Tic – Tac – Toe problem.

**Module 2**

**Search Techniques:** **[10H]**
Problems, Problem Space & search. Heuristic Search Techniques, Game planning –Minimax search procedure, adding alpha beta cut-off's, Iterative Deepening.

**Module 3**

**Knowledge Representation Issues:** **[9H]**
Representing knowledge using rules. Weak slot & filler structures.
Strong slot & filler structures.
Implementation of Knowledge with Prolog Programs.
Basic knowledge of programming language like Prolog & Lisp.

**Module 4**

**Adoption of New Knowledge:** **[10H]**
Deep Learning: Introduction to Neural Networks, Convolution of New Knowledge Natural language processing, Understanding.
Learning – induction & explanation based learning.

**Module 5**

**Expert systems:** **[7H]**
Expert system shells, knowledge acquisition.

**Reference Books:**

1. Artificial Intelligence: A Modern Approach, Stuart Russell & Peter Norvig, Pearson Education.
2. Artificial Intelligence, Rich & Knight, TMH.
3. Reference Books
4. Artificial Intelligence & Intelligent Systems, N.P Padhy, Oxford University Press.
5. Introduction to Artificial Intelligence & Expert Systems, Dan W. Patterson, PHI.
6. Artificial Intelligence: A new Synthesis, Nils J. Nilsson, Morgan Kaufmann Publishers, Inc.
7. M.C. Trivedi, Artificial Intelligence, Khanna Publishing House, New Delhi

| **Course Name: Advanced Computer Architecture** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE501C** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[15H]**

Computer Architecture and Organization-Review, Fundamentals of Computer Design, Technology Trends Cost Performance Analysis, Parallel Processing Architectures-Taxonomy- SISD, MISD, SIMD, MIMD, PRAM models

**Module 2** **[10H]**

Data and Resource Dependencies, Program Partitioning and Scheduling, Control Flow vs. Data Flow, Network topologies-Static, Dynamic, Types of Networks (3L) RISC vs. CISC, Memory Hierarchy, Virtual Memory

**Module 3** **[10H]**

Concepts of Pipelining, Instruction Pipelining, dynamic pipelining, arithmetic pipelines. Multiprocessors- Multistage Networks, Cache Coherence, Synchronization, Message- passing Vector Processing Principles- Instruction types, Compound, Vector Loops, Chaining

**Module 4** **[10H]**

Array Processors- Structure, Algorithms, Data Flow Architecture- Graphs. Petri Nets, Static and Dynamic DFA, VLSI Computations, Parallel Programming Models, Languages, Compilers

**Text book and Reference books:**

1. Computer Architecture and Parallel Processing- Kai Hwang and A. .Brigggs International Edition, McGraw Hill
2. Advanced Computer Architecture: D. Sima, T. fountain, P. Kacsuk, Pearson
3. Parallel Computer Architecture: D. Culler, J.P.Singh, A.Gupta, Elsevier

| **Course Name: Computer Graphics** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE501D** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[15H]**

Introduction to computer graphics & graphics systems [6L]: Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software. Scan conversion [8L]: Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.

**Module 2** **[20H]**

2D transformation & viewing: Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines. Viewing pipeline, Window to view port co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse. Cohenand Sutherland line clipping, Sutherland-Hodgeman Polygon clipping, Cyrus-beck clipping method 3D transformation & viewing: 3D transformations: translation, rotation, scaling & other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, view port clipping, 3D viewing. Curves: Curve representation, surfaces, designs, Bezier curves,

**Module 3** **[10H]**

B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves. Hidden surfaces: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods , fractal - geometry.
Color & shading models: Light & color model; interpolative shading model; Texture. Introduction to Ray-tracing: Human vision and color, Lighting, Reflection and transmission models.

**Text book and Reference books:**

1. Hearn, Baker – "Computer Graphics (C version 2nd Ed.)" – Pearson education
2. Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH
3. D. F. Rogers, J. A. Adams – "Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH

| **Course Name: Software Engineering Lab** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC591** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **0** | **0** | **3** | **3** | **2** |
| **Total Contact Hours: 30** | | | | | |

**Laboratory Experiments:**

1. Problem Analysis and Project Planning -Thorough study of the problem – Identify Project scope, Objectives and Infrastructure.
2. Software Requirement Analysis – Describe the individual Phases/modules of the project and Identify deliverables. Identify functional and non-functional requirements.
3. Data Modeling – Use work products – data dictionary.
4. Software Designing - Develop use case diagrams and activity diagrams, build and testclass diagrams, sequence diagrams and add interface to class diagrams.
5. Prototype model – Develop the prototype of the product.
6. The SRS and prototype model should be submitted for end semester examination.

| **Course Name: Operating System Lab** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC592** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **0** | **0** | **3** | **3** | **2** |
| **Total Contact Hours: 30** | | | | | |

**1. Managing Unix/Linux Operating System:**
Creating a bash shell script, making a script executable, shell syntax (variables, conditions, control structures, functions, commands). Partitions, Swap space, Device files, Raw and Block files, Formatting disks, Making file systems, Superblock, I-nodes, File system checker, Mounting file systems, Logical Volumes, Network File systems, Backup schedules and methods Kernel loading, init and the inittab file, Run-levels, Run level scripts. Password file management, Password security, Shadow file, Groups and the group file, Shells, restricted shells, user-management commands, homes and permissions, default files, profiles, locking accounts, setting passwords, Switching user, Switching group, Removing users &user groups.

**2. Process:**
Starting new process, replacing a process image, duplicating aprocess image, waiting for a process, zombie process.

**3. Signal:**
signal handling, sending signals, signal interface, signal sets.

**4. Semaphore:**
programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).

**5. POSIX Threads:**
programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)

**6. Inter-process communication:** pipes(use functions pipe, popen, pclose), named pipes(FIFOs, accessing FIFO), message passing & shared memory(IPC version V).

| **Course Name: Object Oriented Programming Lab** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC593** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **0** | **0** | **3** | **3** | **2** |
| **Total Contact Hours: 30** | | | | | |

## Laboratory Experiments:

1. Assignments on class, constructor, overloading, inheritance, overriding
2. Assignments on wrapper class, arrays
3. Assignments on developing interfaces- multiple inheritance, extending interfaces
4. Assignments on creating and accessing packages
5. Assignments on multithreaded programming
6. Assignments on applet programming

7. Note: Use Java for programming

**Semester VI**

| Course Code | Course Name | Course Type | L - T - P | Credits | Total Marks |
|---|---|---|---|---|---|
| BTCSC601 | Database Management Systems | CC-13 | 3 – 0 – 0 | 3 | 100 |
| BTCSC691 | Database Management Systems Lab | CC-13 | 0 – 0 – 3 | 2 | 100 |
| BTCSC602 | Computer Networks | CC-14 | 3 – 0 – 0 | 3 | 100 |
| BTCSC692 | Computer Networks Lab | CC-14 | 0 – 0 – 3 | 2 | 100 |
| BTCSE603 | **Elective-II**<br>A. AdvancedAlgorithms<br>B. Distributed Systems<br>C. Signals & Systems<br>D. Image Processing | DSE-2 | 3 – 0 – 0 | 3 | 100 |
| BTCSE604 | **Elective-III**<br>A. Parallel and Distributed Algorithms<br>B. Data Warehousing & Data Mining<br>C. Social Media & Analytics<br>D. Pattern Recognition | DSE-3 | 3 – 0 – 0 | 3 | 100 |
| BTCSG605 | **Open Elective - I**<br>A. Numerical Methods<br>B. Human Resource Development and Organizational Behavior | SEC-3 | 3 – 0 – 0 | 3 | 100 |
| BTCSS681 | Research Methodology | SEC-4 | 3 – 0 – 0 | 3 | 100 |
| **Total** | | | | **22** | **800** |

| **Course Name: Database Management Systems** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC601** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[7H]**
Database system architecture: Data Abstraction, Data Independence, Data Definition Language(DDL), Data Manipulation Language(DML). Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.

**Module 2** **[8H]**
Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server. Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Loss less design. Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

**Module 3** **[5H]**
Storage strategies: Indices, B-trees, hashing.

**Module 4** **[10H]**
Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi- version and optimistic Concurrency Control schemes, Database recovery.

**Module 5** **[8H]**
Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.

**Module 6** **[7H]**
Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

**Text book and Reference books:**

1. "Database System Concepts" , 6th Edition by Abraham Silberschatz, Henry
2. Korth, S. Sudarshan,McGraw-Hill.
3. "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.
4. Database Management Systems, R.P. Mahapatra, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)

| **Course Name: Computer Network** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSC602** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1**

**Introduction** **[4L]**
Direction of data flow (simplex, half duplex, full duplex), Network topology, categories of network (LAN, MAN, WAN).

**Module 2**

**Protocol and Standard** **[6L]**
Layered Task, The OSI model, TCP/IP protocol suite, Addressing

**Module 3**

**Internetworking** **[8L]**
Internetworking concept, IPv4 and IPv6 Addressing, IPv4 protocol, IPv6 protocol, transition from IPV4 to IPV6, transition from IPv4 to IPv6, Address Mapping, Error Reporting, Multicasting, Unicast Routing Protocols, Distance Vector routing, Link state routing, Path vector routing, Multicasting Routing Protocols, Transmission Control
Protocol(TCP), User Datagram Protocol(UDP)

**Module 4**

**Quality of Service** **[9L]**
Data traffic, Congestion, congestion control, Quality of service, Techniques to improve QoS,

Integrated services, Differentiated service, QoS in Frame Relay, QoS in ATM

**Module 5**

**DNS and Web** **[9L]**

Name Space, Domain Name System, Distribution of Name Space, Remote Logging, Electronic Mail and File Transfer, WWW, Web document and HTTP, Network Management, Simple Network Management Protocol (SNMP)

**Module 6**

**Network Security** **[9L]**

Symmetric Key Cryptography, DES, AES, Asymmetric Key Cryptography, RSA, Diffie-Hellman, Security Services, Digital Signature, Key Management, IP Security, SSL/TLS, PGP, Firewalls

**Reference Books:**


- Computer Networks, Andrew S. Tanenbaum, Pearson Education, Fourth edition.
- Data and Computer Communication, William Stallings, Prentice hall, Seventh edition.
- High speed Networks and Internets, William Stallings, Pearson education, Second edition.
- Behrouz A Forouzan, - Data communication & Networking , TMH
- Behrouz A Forouzan, - TCP/IP Protocol Suite , TMH
- Kelvin R Fall, W. Richard Stevens- TCP/IP Illustrated Volume 1, Addison Wesley


| **Course Name: Advanced Algorithms** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE603A** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[8H]**

**Sorting:** Review of various sorting algorithms, topological sorting
**Graph:** Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

**Module 2** **[15H]**

**Matroids:** Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
**Graph Matching:** Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.
**Flow-Networks:** Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.
**Matrix Computations:** Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

**Module 3** **[7H]**

**Shortest Path in Graphs:** Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.
**Modulo Representation of integers/polynomials:** Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.
**Discrete Fourier Transform (DFT**): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm.

**Module 4** **[10H]**

**Linear Programming:** Geometry of the feasibility region and Simplex algorithm, NP-completeness: Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm

**Module 5** **[5H]**

Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

**Text book and Reference books:**

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos.
4. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi

| **Course Name: Distributed System** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE603B** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1**

**Introduction** **[7H]**
Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts DISTRIBUTED DATABASE MANAGEMENT SYSTEM ARCHITECTURE Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues

**Module 2**
**Distributed Database Design** **[8H]**
Alternative design strategies; Distributed design issues; Fragmentation; Data allocation SEMANTICS DATA CONTROL View management; Data security; Semantic Integrity Control QUERY PROCESSING ISSUES Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data

**Module 3**
**Distributed Query Optimization** **[10H]**
Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms TRANSACTION MANAGEMENT The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models CONCURRENCY CONTROL Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management

**Module 4** **[8H]**
Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols Algorithm

**Module 5**
**Parallel Database Systems** **[7H]**
Parallel architectures; parallel query processing and 6

**Module 6**

**Advanced Topics** **[5H]**
Mobile Databases, Distributed Object Management, Multi-databases

**Text book and Reference books:**

1. Principles of Distributed Database Systems, M.T. Ozsu and PValduriez, Prentice-Hall, 1991.
2. Distributed Database Systems, D. Bell and J. Grimson, Addison- Wesley, 1992.

| **Course Name: Signals & Systems** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE603C** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[10H]**

**Introduction to Signals and Systems**
Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.Examples.

**Module 2**

**Behavior of continuous and discrete-time LTI systems** **[10H]**
Impulse response and step response, convolution, input-output behavior with periodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi- output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

**Module 3**

**Fourier, Laplace and z- Transforms** **[15H]**
Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

**Module 4** **[10H]**

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero- order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

**Text book and Reference books:**

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, " Signalsand systems", Prentice Hall India,1997.
2. J. G. Proakis and D. G. Manolakis, " Digital Signal Processing: Principles, Algorithms, and Applications" , Pearson,2006.
3. H. P. Hsu, " Signals and systems", Schaum'sseries, McGraw Hill Education,2010.
4. S. Haykinand B. V. Veen, " Signals and Systems", John Wiley and Sons,2007.
5. A. V. Oppenheim and R. W. Schafer, " Discrete-Time Signal Processing", Prentice Hall,2009.
6. M. J. Robert " Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
7. B. P. Lathi, " LinearSystems and Signals", Oxford University Press,2009.
8. A. V. Oppenheim and R. W. Schafer, " Discrete-Time Signal Processing", Prentice Hall,2009.
9. M. J. Robert " Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
10. B. P. Lathi, " LinearSystems and Signals", Oxford University Press,2009.
11. R. Anand, "Signals and Sys**tems, Khanna Publishing House, 2018.**

| **Course Name: Image Processing** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE603D** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1**

**Introduction** **[6H]**
Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.

**Module 2**

**Digital Image Formation** **[6H]**
A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.

**Module 3**

**Mathematical Preliminaries** **[10H]**
Neighbor of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine & Sine Transform

**Module 4**

**Image Enhancement** **[9H]**
Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High-pass Filtering, High-boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.

**Module 5**

**Image Restoration** **[7H]**

Degradation Model, Discrete Formulation, Algebraic Approach to Restoration - Unconstrained & Constrained; Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation – Spatial Transformation, Gray Level Interpolation.

**Module 6**

**Image Segmentation** **[7H]**

Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection – Local Processing, Global Processing via The Hough Transform; Thresholding - Foundation, Simple Global Thresholding, Optimal Thresholding; Region Oriented Segmentation - Basic Formulation, Region Growing by
Pixel Aggregation, Region Splitting & Merging.

**Reference Books:**

1. Digital Image Processing, Rafael C.Gonzalez& Richard E.Woods, Pearson
2. Fundamentals of Digital Image Processing, Anil K. Jain, Pearson Education-2003.
3. Digital Image Processing, Jahne, Springer India
4. Digital Image Processing & Analysis, Chanda &Majumder, PHI
5. Fundamentals of Digital Image Processing, Jain, PHI

| **Course Name: Introduction to Big Data Analytics** | | | | | |
|---|---|---|---|---|---|
| **Course Code: MCA303** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1**

**Introduction to big data** **[6H]**

Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting.

**Module 2**

**Mining data streams** **[10H]**

Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams –Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real Time Analytics Platform(RTAP) Applications – Case Studies - Real Time Sentiment Analysis- Stock Market Predictions.

**Module 3**

**Hadoop** **[12H]**

History of Hadoop, Hadoop Distributed File System, Components of Hadoop Analyzing the Data with Hadoop, Scaling Out, Hadoop Streaming- Design of HDFS-Java interfaces to HDFS Basics-Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job Run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats-Map Reduce Features Hadoop environment.

**Module 4**

**Frameworks** **[9H]**

Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - fundamentals of H Base and Zoo Keeper - IBM Info Sphere Big Insights and Streams.

**Module 5**

**Predictive Analytics** **[8H]**
Simple linear regression, Multiple linear regression, Interpretation of regression coefficients. Visualizations - Visual data analysis techniques- interaction techniques - Systems and applications.

**Reference Books:**

1. Hadoop: The Definitive Guide, Tom White Third Edition, O'reilly Media, 2012.
2. Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, McGrawHill Publishing, 2012.
3. Mining of Massive Datasets, Anand Rajaraman and Jeffrey David Ullman, CUP,2012.
4. Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, Bill Franks, John Wiley& sons, 2012.
5. Making Sense of Data, Glenn J. Myatt, John Wiley & Sons, 2007.

| **Course Name: Parallel and Distributed Algorithms** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE604A** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[6H]**
Basic Techniques, Parallel Computers for increase Computation speed, Parallel & Cluster Computing

**Module 2** **[10H]**

Message Passing Technique- Evaluating Parallel programs and debugging, Portioning and Divide and Conquer strategies examples

**Module 3** **[4H]**

Pipelining- Techniques computing platform, pipeline programs examples

**Module 4** **[15H]**
Synchronous Computations, load balancing, distributed termination examples, programming with shared memory, shared memory multiprocessor constructs for specifying parallelist sharing data parallel programming languages and constructs, open MP

**Module 5** **[10H]**

Distributed shared memory systems and programming achieving constant memory distributed shared memory programming primitives, algorithms – sorting and numerical algorithms.

**Text book and Reference books:**

1. Parallel Programming, Barry Wilkinson, Michael Allen, Pearson Education, 2nd Edition.
2. Introduction to Parallel algorithms by Jaja from Pearson, 1992.

| **Course Name: Data Warehousing & Data Mining** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE604B** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[8H]**
Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods;

**Module 2** **[7H]**
Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns,

**Module 3** **[5H]**
Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis;

**Module 4** **[10H]**
Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis; modulation for communication, filtering, feedback control systems.

**Module 5** **[8H]**
Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.

**Module 6** **[7H]**
Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis

**Text book and Reference books:**

1. Data Warehousing Fundamentals for IT Professionals, Second Edition by Paulraj Ponniah, Wiley India.
2. Data Warehousing, Data Mining, & OLAP – Second Edition by Alex Berson and Stephen J. Smith, Tata McGraw Hill Education
3. Data warehouse Toolkit by Ralph Kimball, Wiley India
4. Data Mining & Warehousing by Ikvinderpal Singh, Khanna Publishing House
5. Jiawei Han and M Kamber, Data Mining Concepts and Techniques,, Second Edition, Elsevier Publication, 2011.
6. Vipin Kumar, Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley,2006.
7. G Dong and J Pei, Sequence Data Mining, Springer, 2007.

| **Course Name: Social Media & Analytics** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE604C** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[9H]**
Overview and goals, Introduction, History of Social media, Basics of Social Media and Business Models, Basics of Web Search Engines and Digital Advertising. Types of social networks: friend, user-generated, content, affiliation, etc.

**Module 2** **[9H]**
Graph visualization: nodes, edges, Paths, centrality, cliques. Network relationships: ties, social capital, structural holes, Structural balance.

**Module 3** **[9H]**
Network structures: equivalence, homophile, clustering, small world, Network evolution: random graphs, preferential attachment, reciprocity.

**Module 4** **[9H]**
Diffusion in networks: information cascades, social influence, market experiments, Descriptive modeling: community/anomaly detection. Predictive modeling: link/attribute prediction.

**Module 5** **[9H]**
Marketing research: network data collection, sampling, hypothesis testing, research design. Customer profiling: classification, predictive analysis using network data. Trend: social influences on judgments, opinion spread, sentiment. Network targeting: product diffusion, recommendation, segmentation, positioning.

**Text Books:**

1. Wasserman, S., & Faust, K. (1994). Social network analysis: Methods and applications.
2. Easley, D., & Kleinberg, J. (2010). Networks, crowds, and Markets; reasoning about a highly connected world.

| **Course Name: Pattern Recognition** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE604D** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[5H]**
Basics of pattern recognition

**Module 2** **[5H]**
**Bayesian decision theory**
Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions Discrete features

**Module 3** **[5H]**
**Parameter estimation methods**
Maximum-Likelihood estimation Gaussian mixture models Expectation-maximization method Bayesian estimation

**Module 4** **[5H]**
**Hidden Markov models for sequential pattern classification**
Discrete hidden Markov models, Continuous density hidden Markov models

**Module 5** **[5H]**
**Dimension reduction methods**
Fisher discriminant analysis, Principal component analysis. Parzen-window method K-Nearest Neighbour method

**Module 6** **[5H]**
Non-parametric techniques for density estimation

**Module 7** **[5H]**
**Linear discriminant function based classifier**
Perceptron, Support vector machines

**Module 8** **[5H]**
**Non-metric methods for pattern classification**
Non-numeric data or nominal data Decision trees

**Module 9** **[5H]**
**Unsupervised learning and clustering**
Criterion functions for clustering Algorithms for clustering: K-means, Hierarchical and other methods

**Text book and Reference books:**

1. R. O. Duda, P. E. Hart and D. G. Stork: Pattern Classification, John Wiley, 2001.
2. S. Theodoridis and K. Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009.
3. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

| **Course Name: Numerical Methods** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSG605A** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[7H]**
Approximation in numerical computation:
Truncation and rounding errors, Fixed and floating- point arithmetic, Propagation of errors.

**Module 2** **[8H]**
Interpolation:
Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation.

**Module 3** **[7H]**
Numerical integration:
Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms.

**Module 4** **[8H]**
Numerical solution of a system of linear equations:
Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method.

**Module 5**
Numerical solution of Algebraic equation: **[7H]**

Bisection method, Regula-Falsi method, Newton-Raphson method.

**Module 6** **[8H]**

Numerical solution of ordinary differential equation:
Euler's method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference method.
2

**Text book and Reference books:**

1. R.S. Salaria: Computer Oriented Numerical Methods, Khanna Publishing House
2. C.Xavier: C Language and Numerical Methods.
3. Dutta & Jana: Introductory Numerical Analysis.
4. J.B.Scarborough: Numerical Mathematical Analysis.
5. Jain, Iyengar , & Jain: Numerical Methods (Problems and Solution).
6. Balagurusamy: Numerical Methods, Scitech.
7. Baburam: Numerical Methods, Pearson Education.
8. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.

| **Course Name: Human Resource Development and Organizational Behavior** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSG605B** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[10H]**

Organizational Behaviour: Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities for OB. Personality and Attitudes: Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes, Job Satisfaction.

**Module 2** **[10H]**

Perception: Definition, Nature and Importance, Factors influencing Perception, Perceptual Selectivity, Link between Perception and Decision Making.
Motivation: Definition, Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory, McClelland's Theory of Needs, Vroom's Expectancy Theory.

**Module 3** **[10H]**

Group Behaviour: Characteristics of Group, Types of Groups, Stages of Group Development, Group Decision, Making.
Communication: Communication Process, Direction of Communication, Barriers to Effective Communication.
Leadership: Definition, Importance, Theories of Leadership Styles.

**Module 4** **[15H]**

Organizational Politics: Definition, Factors contributing to Political Behaviour.
Conflict Management: Traditional vis-a-vis Modern View of Conflict, Functional and Dysfunctional Conflict, Conflict Process, Negotiation – Bargaining Strategies, Negotiation Process. [2]
Organizational Design: Various Organizational Structures and their Effects on Human Behaviour, Concepts of Organizational Climate and Organizational Culture.

**Text book and Reference books**:

1. Robbins, S. P. & Judge, T.A.: Organizational Behavior, Pearson Education, 15th Edn.
2. Luthans, Fred: Organizational Behavior, McGraw Hill, 12th Edn.

3. Shukla, Madhukar: Understanding Organizations – Organizational Theory & Practice in India, PHI
4. Fincham, R. & Rhodes, P.: Principles of Organizational Behaviour, OUP, 4th Edn.
5. Hersey, P., Blanchard, K.H., Johnson, D.E.- Management of Organizational Behavior Leading Human Resources,
6. PHI, 10th Edn.

| **Course Name: Research Methodology** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSS681** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[15H]**

**Research Formulation and Design**
Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

**Module 2** **[10H]**

**Data Collection and Analysis**
Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma, STAT, SPSS for student t-test, ANOVA, etc.), hypothesis testing.

**Module 3** **[10H]**
Research Ethics, IPR and Scholary Publishing, Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

**Module 4**

**Interpretation and Report Writing** **[10H]**
Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Project Report, Layout of the Project/Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Project/Research Report, Precautions for Writing Research Reports, Conclusions.

**Text book and Reference books:**

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog

Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

**Semester VII**

| Course Code | Course Name | Course Type | L - T - P | Credits | Total Marks |
|---|---|---|---|---|---|
| BTCSE701 | **Elective-IV**<br>A. Quantum Computing<br>B. Cloud Computing<br>C. Digital Signal Processing<br>D. Multi-agent Intelligent Systems<br>E. Machine learning | DSE-4 | 3 – 0 – 0 | 3 | 100 |
| BTCSE702 | **Elective-V**<br>A. Neural Networks and Deep Learning<br>B. Soft Computing<br>C. Ad-Hoc and Sensor Networks<br>D. Information Theory and Coding<br>E. Cyber Security | DSE-5 | 3 – 0 – 0 | 3 | 100 |
| BTCSG703 | **Open Elective-II**<br>A. Operations Research<br>B. Multimedia Systems<br>C. Introduction to Philosophical Thoughts | SEC-5 | 3 – 0 – 0 | 3 | 100 |
| BTCSS704 | Project Management and Entrepreneurship | SEC-6 | 3 – 0 – 0 | 3 | 100 |
| BTCSS781 | Project-I | SEC-7 | 0 – 0 – 3 | 3 | 100 |
| **Total** | | | | **15** | **500** |

| **Course Name: Quantum Computing** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE701A** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[8H**

Qubit & Quantum States: The Qubit, Vector Spaces. Linear Combination Of Vectors, Uniqueness of a spanning set, basis & dimensions, inner Products, orthonormality, gram-schmidt, orthogonalization, bra-ket formalism, the Cauchyschwarez and triangle Inequalities.

**Module 2** **[10H]**

Matrices & Operators: Observables, The Pauli Operators, Outer Products, The Closure Relation, Representation of operators using matrices, outer products & matrix representation, matrix

representation of operators in two dimensional spaces, Pauli Matrix, Hermitian unitary and normal operator, Eigen values & Eigen Vectors, Spectral Decomposition, Trace of an operator, important properties of Trace, Expectation Value of Operator, Projection Operator, Positive Operators,

**Module 3** **[5H]**

Commutator Algebra, Heisenberg uncertainty principle, polar decomposition &singular values, Postulates of Quantum Mechanics.

**Module 4** **[10H]**

Tensor Products: Representing Composite States in Quantum Mechanics, Computing inner products, Tensor products of column vectors, operators and tensor products of Matrices. Density Operator: Density Operator of Pure & Mix state, Key Properties, Characterizing Mixed State, Practical Trace & Reduce Density Operator, Density Operator & Bloch Vector.

**Module 5** **[7H]**

Quantum Measurement Theory: Distinguishing Quantum states & Measures, Projective Measurements, Measurement on Composite systems, Generalized Measurements, Positive Operator-Valued Measures.

**Module 6** **[5H]**

Recent trends in Quantum Computing Research, Quantum Computing Applications of Genetic Programming.

**Text book and Reference books:**

1. Quantum Computing without Magic by Zdzislaw Meglicki
2. Quantum Computing Explained By DAVID Mc MAHON
3. Quantum Computer Science By Marco Lanzagorta, Jeffrey Uhlmann
4. An Introduction to Quantum Computing Phillip Kaye, Raymond Laflamme, Michele Mosca.

| **Course Name: Cloud Computing** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE701B** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[10H]**

Definition of Cloud Computing and its Basics (Lectures). Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Deployment models (Public , Private, Hybrid and Community Clouds), Service Platform as a Service, Software as a Service with examples of services/ service providers, models – Infrastructure as a Service, Cloud Reference model, Characteristics of Cloud Computing – a shift in paradigm Benefits and advantages of Cloud Computing, A brief introduction on Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications, Connecting to the Cloud by Clients, IaaS – Basic concept, Workload, partitioning of virtual private server instances, Pods, aggregations, silos PaaS – Basic concept, tools and development environment with examples SaaS - Basic concept and characteristics, Open SaaS and SOA, examples of SaaS platform Identity as a Service (IDaaS) Compliance as a Service (CaaS)

**Module 2** **[15H]**

Use of Platforms in Cloud Computing Concepts of Abstraction and Virtualization Virtualization technologies Types of virtualization (access, application, CPU, storage), Mobility patterns (P2V,

V2V, V2P, P2P, D2C, C2C, C2D, D2D) Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing, Advanced load balancing (including ApplicationDelivery Controller and Application Delivery Network), Mention of The Google Cloud as an example of use of load balancing Hypervisors: Virtual machine technology and types, VMware vSphere Machine Imaging (including mention of Open Virtualization Format – OVF) Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance,Concepts of Platform as a Service, Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development Use of PaaS Application frameworks,

Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service., Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service, Windows Azure platform: Microsoft's approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services,

**Module 3** **[10H]**

Cloud Infrastructure:
Cloud Management: An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle).
Concepts of Cloud Security: Cloud security concerns, Security boundary, Security service boundary Overview of security mapping Security of data: Brokered cloud storage access, Storage location and tenancy, encryption, and auditing and compliance Identity management (awareness of Identity protocol standards)

**Module 4** **[10H]**

Concepts of Services and Applications:
Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs,
Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs
Cloud-based Storage: Cloud storage definition – Manned and Unmanned
Webmail Services: Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail, concepts of Syndication services

**Text book and Reference books:**

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013
2. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola,
3. S. Thamarai Selvi, McGraw Hill Education (India) Private Limited, 2013
4. Cloud computing: A practical approach, Anthony T. Velte, Tata Mcgraw-Hill
5. Cloud Computing, Miller, Pearson
6. Building applications in cloud:Concept, Patterns and Projects, Moyer, Pearson
7. Cloud Computing – Second Edition by Dr. Kumar Saurabh, Wiley India

| **Course Name: Digital Signal Processing** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE701C** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[9H]**
Discrete-time signals and systems (6 hours) Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

**Module 2** **[9H]**
Z-transform (6 hours) z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

**Module 3** **[9H]**
Discrete Fourier Transform (10 hours) Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

**Module 4** **[9H]**
Design of Digital filters (12 hours) Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band stop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

**Module 5** **[9H]**
Applications of Digital Signal Processing (6 hours) Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

**Text book and Reference books:**

1. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill, 2011.
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall, 1997.
4. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall, 1992.
5. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas andW. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons, 1988.

| **Course Name: Multi-agent Intelligent Systems** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE701D** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[5H]**
Introduction: what is an agent? agents and objects; agents and expert systems; agents and distributed

systems; typical application areas for agent systems.

**Module 2** **[15H]**
Intelligent Agents: the design of intelligent agents - reasoning agents (eg AgentO), agents as reactive systems (eg subsumption architecture); hybrid agents (eg PRS); layered agents (eg Interrap) a contemporary (Java-based) framework for programming agents (eg the Jack language, the JAM! system).

**Module 3** **[20H]**

Multi-Agent Systems: Classifying multi-agent interactions - cooperative versus non-cooperative; zero-sum and other interactions; what is cooperation? how cooperation occurs - the Prisoner's dilemma and Axelrod's experiments; Interactions between self- interested agents: auctions & voting systems: negotiation; Interactions between benevolent agents: cooperative distributed problem solving (CDPS), partial global planning; coherence and coordination; Interaction languages and protocols: speech acts, KQML/KIF, the FIPA framework.

**Module 4** **[5H]**
Advanced topics: One issue selected from the contemporary research literature, perhaps by guest lecturer.

**Text book and Reference books:**

1. An Introduction to Multi Agent Systems - Second Edition. Michael Wooldridge (Wiley, 2009)

2. Programming Multi-agent Systems in Agent Speak Using Jason. Rafael H. Bordini, Jomi Fred Hubner and Michael Wooldridge (Wiley, 2007)

| **Course Name: Machine learning** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE701E** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[8H]**
Supervised Learning (Regression/Classification)
Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes
Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods
Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

**Module 2** **[8H]**
Unsupervised Learning
Clustering: K-means/Kernel K-means
Dimensionality Reduction: PCA and kernel PCA
Matrix Factorization and Matrix Completion
Generative Models (mixture models and latent factor models)

**Module 3** **[7H]**
Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

**Module 4** **[7H]**
Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

**Module 5** **[8H]**
Scalable Machine Learning (Online and Distributed Learning)
A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

**Module 6** **[7H]**
Recent trends in various learning techniques of machine learning and classification methods

**References:**
1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
4. Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018

| **Course Name: Neural Networks and Deep Learning** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE702A** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[8H]**
Introduction: Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.

**Module 2** **[7H]**
Feed forward neural network: Artificial Neural Network, activation function, multi-layer neural network. cardinality, operations, and properties of fuzzy relations. 6

**Module 3** **[7H]**
Training Neural Network: Risk minimization, loss function, back propagation, regularization, model selection, and optimization.

**Module 4** **[8H]**
Conditional Random Fields: Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.

**Module 5** **[8H]**
Deep Learning: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.

**Module 6** **[7H]**
Deep Learning research: Object recognition, sparse coding, computer vision, natural language

**Text book and Reference books:**

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
3. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
4. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
5. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.
6. Dr. Rajiv Chopra, Deep Learning, Khanna Publishing House, New Delhi (AICTE

| **Course Name: Soft Computing** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE702B** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[7H]**
Introduction: Introduction to soft computing; introduction to fuzzy sets and fuzzy logic systems; introduction to biological and artificial neural network; introduction to Genetic Algorithm

**Module 2** **[15H]**
Fuzzy sets and Fuzzy logic systems:
Classical Sets and Fuzzy Sets and Fuzzy relations : Operations on Classical sets, properties of classical sets, Fuzzy set operations, properties of fuzzy sets, cardinality, operations, and properties of fuzzy relations.
Membership functions : Features of membership functions, standard forms and boundaries, different fuzzification methods.
Fuzzy to Crisp conversions: Lambda Cuts for fuzzy sets, fuzzy Relations, Defuzzification methods.
Classical Logic and Fuzzy Logic: Classical predicate logic, Fuzzy Logic, Approximate reasoning and Fuzzy Implication Fuzzy Rule based Systems: Linguistic Hedges, Fuzzy Rule based system – Aggregation of fuzzy Rules, Fuzzy Inference System- Mamdani Fuzzy Models – Sugeno Fuzzy Models.
Applications of Fuzzy Logic: How Fuzzy Logic is applied in Home Appliances, General Fuzzy Logic controllers, Basic Medical Diagnostic systems and Weather forecasting

**Module 3** **[10H]**
Neural Network:
Introduction to Neural Networks: Advent of Modern Neuroscience, Classical AI and Neural Networks, Biological Neurons and Artificial neural network; model of artificial neuron.
Learning Methods : Hebbian, competitive, Boltzman etc., Neural Network models: Perceptron, Adaline and Madaline networks; single layer network; Back- propagation and multi layer networks.
Competitive learning networks: Kohonen self organizing networks, Hebbian learning; Hopfield Networks.
Neuo-Fuzzy modelling: Applications of Neural Networks: Pattern Recognition and classification

**Module 4** **[8H]**
Genetic Algorithms: Simple GA, crossover and mutation, Multi-objective Genetic Algorithm (MOGA). Applications of Genetic Algorithm: genetic algorithms in search and optimization, GA based clustering Algorithm, Image processing and pattern Recognition

**Module 5** **[5H]**
PSO:Other Soft Computing techniques: Simulated Annealing, Tabu search, Ant colony optimization (ACO), Particle Swarm Optimization (PSO).

**Text book and Reference books:**

1. Fuzzy logic with engineering applications, Timothy J. Ross, John Wiley and Sons.
2. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI
3. Principles of Soft Computing , S N Sivanandam, S. Sumathi, John Wiley & Sons
4. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg
5. Neuro-Fuzzy and Soft computing, Jang, Sun, Mizutani, PHI
6. Neural Networks: A Classroom Approach,1/e by Kumar Satish, TMH,
7. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg, Pearson/PHI
8. A beginners approach to Soft Computing, Samir Roy & Udit Chakraborty, Pearson

9. Fuzzy Sets and Fuzzy Logic: Theory and Applications, George J. Klir and Bo Yuan, Prentice Hall
10. Neural Networks: A Comprehensive Foundation (2nd Edition), Simon Haykin, Prentice Hall.

| **Course Name: Ad-Hoc and Sensor Networks** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE702C** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[9H]**

Introduction and Overview: Overview of wireless networks, types, infrastructure-based and infrastructure-less, introduction to MANETs (Mobile Ad-hoc Networks), characteristics, reactive and proactive routing protocols with examples, introduction to sensor networks, commonalities and differences with MANETs, constraints and challenges, advantages, applications, enabling technologies for WSNs.

**Module 2** **[9H]**

Architectures Single-node architecture - hardware components, design constraints, energy consumption of sensor nodes , operating systems and execution environments, examples of sensor nodes, sensor network scenarios, types of sources and sinks – single hop vs. multi hop networks, multiple sources and sinks – mobility, optimization goals and figures of merit, gateway concepts, design princip

**Module 3** **[9H]**

Communication Protocols: Physical layer and transceiver design considerations, MAC protocols for wireless sensor networks, low duty cycle protocols and wakeup concepts - S-MAC , the mediation device protocol, wakeup radio concepts, address and name management, assignment of MAC addresses, routing protocols- classification, gossiping, flooding, energy- efficient routing, unicast protocols, multi- path routing, data-centric routing, data aggregation, SPIN, LEACH, Directed-Diffusion, geographic routing.

**Module 4** **[9H]**

Infrastructure Establishment: Topology control, flat network topologies, hierarchical networks by clustering, time synchronization, properties, protocols based on sender-receiver and receiver-receiver synchronization, LTS, TPSN, RBS, HRTS, localization and positioning, properties and approaches, single-hop localization, positioning in multi-hop environment, range based localization algorithms – location services, sensor tasking and control

**Module 5** **[9H]**

Sensor Network Platforms and Tools: Sensor node hardware, Berkeley motes, programming challenges, node- level software platforms, node-level simulators, state-centric programming, Tiny OS, nesC components, NS2 simulator, TOSSIM.

**Text book and Reference books:**

1. 1.Holger Karl & Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
3. REFERENCES
4. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks- Technology, Protocols, and Applications”, John Wiley, 2007.
5. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
6. Thomas Haenselmann, "Sensor Networks", available online for free, 2008.

| **Course Name: Information Theory and Coding** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE702D** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[7H]**
Source Coding:
Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes

**Module 2** **[7H]**
Channel Capacity And Coding
Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit

**Module 3** **[7H]**
Linear And Block Codes For Error Correction
Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block code, perfect codes, Hamming codes

**Module 4** **[7H]**
Cyclic Codes
Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Golay codes.

**Module 5** **[7H]**
BCH Codes
Primitive elements, minimal polynomials, generator polynomials in terms of minimal polynomials, examples of BCH codes.

**Module 6** **[10H]**
Convolutional Codes
Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes, distance and performance bounds for convolutional codes, examples of convolutional codes, Turbo codes, Turbo decoding

**Text book and Reference books:**

1. Information theory, coding and cryptography - Ranjan Bose; TMH.
2. Information and Coding - N Abramson; McGraw Hill.
3. Introduction to Information Theory - M Mansurpur; McGraw Hill.
4. Information Theory - R B Ash; Prentice Hall.
5. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.

| **Course Name: Cyber Security** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE702E** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[9H]**
Introduction: Introduction to Cyber Security, Importance and challenges in Cyber Security,

Cyberspace, Cyber threats, Cyberwarfare, CIA Triad, Cyber Terrorism, Cyber Security of Critical Infrastructure, Cybersecurity – Organizational Implications.

**Module 2** **[9H]**

Hackers and Cyber Crimes: Types of Hackers, Hackers and Crackers, Cyber-Attacks and Vulnerabilities, Malware threats, Sniffing, Gaining Access, Escalating Privileges, Executing Applications, Hiding Files, Covering Tracks, Worms, Trojans, Viruses, Backdoors.

**Module 3** **[9H]**

Ethical Hacking and Social Engineering: Ethical Hacking Concepts and Scopes, Threats and Attack Vectors, Information Assurance, Threat Modelling, Enterprise Information Security Architecture, Vulnerability Assessment and Penetration Testing, Types of Social Engineering, Insider Attack, Preventing Insider Threats, Social Engineering Targets and Defence Strategies.

**Module 4** **[9H]**

Cyber Forensics and Auditing: Introduction to Cyber Forensics, Computer Equipment and associated storage media, Role of forensics Investigator, Forensics Investigation Process, Collecting Network based Evidence, Writing Computer Forensics Reports, Auditing, Plan an audit against a set of audit criteria, Information Security Management System Management. Introduction to ISO 27001:2013

**Module 5** **[9H]**

Cyber Ethics and Laws: Introduction to Cyber Laws, E-Commerce and E-Governance, Certifying Authority and Controller, Offences under IT Act, Computer Offences and its penalty under IT Act 2000, Intellectual Property Rights in Cyberspace. at Network Layer-IPSec.5

**Text book and Reference books:**

1. Cyber security , Nina Gobole & Sunit Belapune; Pub: Wiley India.
2. Information Security and Cyber Laws, Pankaj Agarwal
3. Donaldson, S., Siegel, S., Williams, C.K., Aslam, A., Enterprise Cybersecurity -How to Build a Successful Cyberdefense Program Against Advanced Threats, A-press
4. Nina Godbole, SumitBelapure, Cyber Security, Willey
5. Hacking the Hacker, Roger Grimes, Wiley
6. Cyber Law By Bare Act, Govt Of india, It Act 2000.
7. Information Security & Cyber Laws, Gupta & Gupta, Khanna Publishing House, (AICTE Recommended Textbook- 2018)

| **Course Name: Operations Research** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSG703A** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[15H]**

Basic LPP and Applications; Various Components of LP Problem Formulation. Solution of Linear Programming Problems: Solution of LPP: Using Simultaneous Equations and Graphical Method; Definitions: Feasible Solution, Basic and non- basic Variables, Basic Feasible Solution, Degenerate and Non-degenerate Solution, Convex set and explanation with examples Solution of LPP by Simplex Method; Charnes' Big-M Method; Duality Theory. Transportation Problems and Assignment

Problems.

**Module 2** **[10H]**

Network Analysis:Shortest Path: Floyd Algorithm; Maximal Flow Problem (Ford-Fulkerson); PERT-CPM (Cost Analysis, Crashing, Resource Allocation excluded). Inventory Control: Introduction to EOQ Models of Deterministic and Probabilistic; Safety Stock; Buffer Stock.

**Module 3** **[10H]**

Game Theory:
Introduction; 2-Person Zero-sum Game; Saddle Point; Mini-Max and Maxi-Min Theorems (statement only) and problems; Games without Saddle Point; Graphical Method; Principle of Dominance

**Module 4** **[10H]**

Queuing Theory:
Introduction; Basic Definitions and Notations; Axiomatic Derivation of the Arrival & Departure (Poisson Queue). Poisson Queue Models: (M/M/1): (∞ / FIFO) and (M/M/1: N / FIFO) and problems.

**Text book and Reference books:**

1. H. A. Taha, "Operations Research", Pearson
2. P. M. Karak – "Linear Programming and Theory of Games", ABS Publishing House
3. Ghosh and Chakraborty, "Linear Programming and Theory of Games", Central Book Agency
4. Ravindran, Philips and Solberg - "Operations Research", WILEY INDIA

| **Course Name: Multimedia Systems** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSG703B** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[5H]**

Introduction: Multimedia today, Impact of Multimedia, Multimedia Systems, Components and Its Applications.

**Module 2** **[15H]**

Text and Audio, Image and Video
Text: Types of Text, Ways to Present Text, Aspects of Text Design, Character, Character Set, Codes, Unicode, Encryption; Audio: Basic Sound Concepts, Types of Sound, Digitizing Sound, Computer Representation of Sound (Sampling Rate, Sampling Size, Quantization), Audio Formats, Audio tools, MIDI
Image: Formats, Image Color Scheme, Image Enhancement; Video: Analogue and Digital Video, Recording Formats and Standards (JPEG, MPEG, H.261) Transmission of Video Signals, Video Capture, and Computer based Animation.

**Module 3** **[5H]**

Synchronization, Storage models and Access Techniques: Temporal relationships, synchronization accuracy specification factors, quality of service, Magnetic media, optical media, file systems

(traditional, multimedia) Multimedia devices – Output devices, CD-ROM, DVD, Scanner, CCD

**Module 4** **[15H]**

Image and Video Database, Document Architecture and Content Management: Image representation, segmentation, similarity based retrieval, image retrieval by color, shape and texture; indexing- k- d trees, R-trees, quad trees; Case studies- QBIC, Virage. Video Content, querying, video segmentation, indexing, Content Design and Development, General Design Principles

Hypertext: Concept, Open Document Architecture (ODA), Multimedia and Hypermedia Coding Expert Group (MHEG), Standard Generalized Markup Language (SGML), Document Type Definition (DTD), Hypertext Markup Language (HTML) in Web Publishing. Case study of Applications.

**Module 5** **[5H]**

Multimedia Applications: Interactive television, Video-on-demand, Video Conferencing, Educational Applications, Industrial Applications, Multimedia archives and digital libraries, media editors

**Text book and Reference books:**

1. Ralf Steinmetz and Klara Nahrstedt , Multimedia: Computing, Communications & Applications , Pearson Ed.
2. Nalin K. Sharda , Multimedia Information System , PHI.
3. Fred Halsall , Multimedia Communications , Pearson Ed.
4. Koegel Buford , Multimedia Systems , Pearson Ed.
5. Fred Hoffstetter , Multimedia Literacy , McGraw Hill.
6. Ralf Steinmetz and Klara Nahrstedt , Multimedia Fundamentals: Vol. 1- Media Coding and Content Processing , PHI.
7. J. Jeffcoate , Multimedia in Practice: Technology and Application , PHI.
8. V.K. Jain, Multimedia and Animation, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)

| **Course Name: Introduction to Philosophical Thoughts** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSG703C** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[9H]**

Nature of Indian Philosophy : Plurality as well as common concerns. 2. Basic concepts of the Vedic and Upanisadic views : Atman, Jagrata, Svapna, Susupti, Turiya, Brahman, Karma, Rta,Rna,

**Module 2** **[9H]**

Carvaka school : its epistemology, metaphysics and ethics. Mukti

**Module 3** **[9H]**

Jainism : Concepts of sat, dravya, guna, paryaya, jiva, ajiva, anekantavada, syadvada, and nayavada ; pramanas, ahimsa, bondage and liberation.

**Module 4** **[9H]**

Buddhism : theory of pramanas, theory of dependent origination, the four noble truths; doctrine of

momentaryness; theory of no soul. The interpretation of these theories in schools of Buddhism : Vaibhasika, Sautrantrika, Yogacara, Madhyamika.

**Module 5** **[9H]**

Nyaya : theory of Pramanas; the individual self and its liberation ; the idea of God and proofs for His existence.

**Text book and Reference books:**

1. M. Hiriyanna : Outlines of Indian Philosophy.
2. C.D.Sharma : A Critical Survey of Indian Philosophy.
3. S.N.Das Gupta : A History of Indian Philosophy Vol – I to V.
4. S.Radhakrishnan : Indian Philosophy Vol – I & II.
5. T.R.V.Murti : Central Philosophy of Buddhism.
6. J.N.Mahanty : Reason and Tradition of Indian Thought.
7. R.D.Ranade : A Constructive Survey of Upanisadic Philosophy.
8. P.T.Raju : Structural Depths of Indian Thought.
9. K.C.Bhattacharya : Studies in Philosophy Vol – 1.
10. Datta and Chatterjee : Introduction of Indian Philosophy

| **Course Name: Project Management and Entrepreneurship** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSS704** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[4H]**

Introduction: Meaning and Concept of Entrepreneurship, Innovation and entrepreneurship, Contributions of entrepreneurs to the society, risk-opportunities perspective and mitigation of risks

**Module 2** **[15H]**

Entrepreneurship – An Innovation: Challenges of Innovation, Steps of Innovation Management, Idea Management System, Divergent v/s Convergent Thinking, Qualities of a prospective Entrepreneur

Idea Incubation: Factors determining competitive advantage, Market segment, blue ocean strategy, Industry and Competitor Analysis (market structure, market size, growth potential), Demand-supply analysis

Entrepreneurial Motivation: Design Thinking - Driven Innovation, TRIZ (Theory of Inventive Problem Solving), Achievement motivation theory of entrepreneurship – Theory of McClelland, Harvesting Strategies

**Module 3** **[8H]**

Information: Government incentives for entrepreneurship, Incubation, acceleration. Funding new ventures – bootstrapping, crowd sourcing, angel investors, Government of India's efforts at promoting entrepreneurship and innovation – SISI, KVIC, DGFT, SIDBI, Defense and Railways

Closing the Window: Sustaining Competitiveness, Maintaining Competitive Advantage, the Changing Role of the Entrepreneur. Applications and Project Reports Preparation

**Module 4** **[7H]**

Project Management: Definitions of Project and Project Management, Issues and Problems in Project Management, Project Life Cycle - Initiation / Conceptualization Phase, Planning Phase, Implementation / Execution Phase, Closure / Termination Phase

Project Feasibility Studies – Pre-Feasibility and Feasibility Studies, Preparation of Detailed Project Report, Technical Appraisal, Economic/Commercial/Financial Appraisal including Capital Budgeting Process, Social Cost Benefit Analysis

**Module 5** **[6H]**

Project Planning – Importance of Project Planning, Steps of Project Planning, Project Scope, Work Breakdown Structure (WBS) and Organization Breakdown Structure (OBS), Phased Project Planning

Project Scheduling and Costing – Gantt chart, CPM and PERT Analysis, Identification of the Critical Path and its Significance, Calculation of Floats and Slacks, Crashing, Time Cost Trade-off Analysis, Project Cost Reduction Methods.

**Module 6** **[5H]**

Project Monitoring and Control – Role of Project Manager, MIS in Project Monitoring, Project Audit Case Studies with Hands-on Training on MS-Project [4L]

**Text Books and References**

1. Innovation and Entrepreneurship by Drucker, P.F.; Harper and Row
2. Business, Entrepreneurship and Management: Rao, V.S.P. ;Vikas
3. Entrepreneurship: Roy Rajeev; OUP.
4. Text Book of Project Management: Gopalkrishnan, P. and Ramamoorthy, V.E.; McMillan
5. Project Management for Engineering, Business and Technology: Nicholas, J.M., and Steyn, H.; PHI
6. Project Management: The Managerial Process: Gray, C.F., Larson, E.W. and Desai, G.V.; MGH

**Semester VIII**

| Course Code | Course Name | Course Type | L - T - P | Credits | Total Marks |
|---|---|---|---|---|---|
| BTCSE801 | **Elective-VI**<br>A. Signals and Networks<br>B. Cryptograph y & Network Security<br>C. Speech and Natural Language Processing<br>D. Web and Internet Technology<br>E. Internet of Things | DSE-6 | 3 – 0 – 0 | 3 | 100 |
| BTCSG802 | **Open Elective-III**<br>A. Big Data Analysis<br>B. Cyber Law and Ethics<br>C. Mobile Computing<br>D. Robotics<br>E. Soft Skill & Interpersonal Communication | DSE-7 | 3 – 0 – 0 | 3 | 100 |
| BTCSG803 | **Open Elective-IV**<br>A. E-Commerce and ERP<br>B. Micro-electronics and VLSI Design<br>C. Economic Policies in India | DSE-8 | 3 – 0 – 0 | 3 | 100 |
| BTCSS881 | Project -II | SEC-8 | 0 – 0 – 3 | 3 | 100 |
| **Total** | | | | **12** | **400** |

| **Course Name: Signals and Networks** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE801A** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[9H]**

Objective and overview, signal and system types and classifications, step response, impulse response and convolution integral

**Module 2** **[9H]**

Periodic signal analysis: Fourier series and properties;
Aperiodic signal analysis: Fourier Transform – its properties and sinusoidal steady state analysis of systems

**Module 3** **[9H]**

Elements of electrical network: dependent and independent sources, active and passive components; classical differential equations for description of transient conditions of Network;
Solutions of linear time invariant networks with initial conditions; Unilateral and Bilateral Laplace Transforms and properties; Transient solutions of networks using Laplace Transform; Network functions: poles, zeros, transfer function, Bode plot;

**Module 4** **[9H]**

One and two port network parameters and functions: Z, Y and ABCD parameters, driving point and transfer impedances and admittances; Network Theorems and Formulation of Network equations: generalized formulation of KCL, KVL, State Variable descriptions; Thevenin, Norton, Maximum Power Transfer, Tellegen and Reciprocity Theorems;

**Module 5** **[9H]**

Graph theory: Tree, Co-tree, fundamental cut-set, fundamental loop analysis of network; Analog filter design: Butterworth, Sallen Key, frequency transformation and scaling

**Text Books**

1. Signals and Systems by P. Ramesh Babu & R. Ananda Natarajan, Scitech Publications (India).
2. Signals & Systems by A. V. Oppenheim, A. S. Willsky and S. H. Nawab, Prentice-Hall India.

**Reference Books**

1. Networks & Systems by D Roy Choudhury.
2. Networks & Systems by Asfhaq Husain

| **Course Name: Cryptography & Network Security** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE801B** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[6H]**

Attacks on Computers & Computer Security - Introduction, Need for Security, Security approaches, Principles of Security, Types of attack.

**Module 2** **[7H]**

Cryptography: Concepts & Techniques Introduction, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, Symmetric & Asymmetric key Cryptography, Key Range & Key Size.

**Module 3** **[7H]**

Symmetric Key Algorithm - Introduction, Algorithm types & Modes, Overview of Symmetric Key Cryptography, DES(Data Encryption Standard) algorithm, IDEA(International Data Encryption Algorithm) algorithm, RC5 (Rivest Cipher 5) algorithm.

**Module 4** **[6H]**

Asymmetric Key Algorithm, Digital Signature and RSA - Introduction, Overview of Asymmetric key Cryptography, RSA algorithm, Symmetric & Asymmetric key Cryptography together, Digital Signature, Basic concepts of Message Digest and Hash Function (Algorithms on Message Digest and Hash function not required).

**Module 5** **[7H]**

Internet Security Protocols, User Authentication - Basic Concepts, SSL protocol, Authentication Basics, Password, Authentication Token, Certificate based Authentication, Biometric Authentication.

**Module 6** **[6H]**

Electronic Mail Security - Basics of mail security, Pretty Good Privacy, S/MIME.

**Module 7** **[6H]**

Firewall - Introduction, Types of firewall, Firewall Configurations, DMZ Network.

**Text Books**

1. Cryptography and Network Security, William Stallings, 2nd Edition, Pearson Education Asia
2. Cryptography and Network Security by V.K. Jain, Khanna Publishing House,

**Reference Books**

1. Network Security private communication in a public world, C. Kaufman, R. Perlman and M. Speciner, Pearson
2. Cryptography & Network Security: Atul Kahate, TMH.

| **Course Name: Speech and Natural Language Processing** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE801C** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[12H]**

Regular Expressions and AutomataRecap) - Introduction to NLP, Regular Expression, Finite State Automata Tokenization - Word Tokenization, Normalization, Sentence Segmentation, Named Entity Recognition, Multi Word Extraction, Spell Checking – Bayesian Approach, Minimum Edit Distance Morphology - Morphology – Inflectional and Derivational Morphology, Finite State Morphological Parsing, The Lexicon and Morphotactics, Morphological Parsing with Finite State Transducers, Orthographic Rules and Finite State Transducers, Porter Stemmer

**Module 2** **[11H]**

Language Modeling Introduction to N-grams, Chain Rule, Smoothing – Add-One Smoothing, Witten-Bell Discounting; Backoff, Deleted Interpolation, N-grams for Spelling and Word Prediction, Evaluation of language models. Hidden Markov Models and POS Tagging Markov
Chain, Hidden Markov Models, Forward Algorithm, Viterbi Algorithm, Part of Speech Tagging – Rule based and Machine Learning based approaches, Evaluation.

**Module 3** **[11H]**

Text Classification Text Classification, Naïve Bayes Text Classification, Evaluation, Sentiment Analysis – Opinion Mining and Emotion Analysis, Resources and Techniques. Context Free Grammar Context Free Grammar and Constituency, Some common CFG phenomena for English, Top-Down and Bottom-up parsing, Probabilistic Context Free Grammar, Dependency Parsing.

**Module 4** **[11H]**

Computational Lexical Semantics Introduction to Lexical Semantics – Homonymy, Polysemy, Synonymy, Thesaurus – WordNet, Computational Lexical Semantics – Thesaurus based and Distributional Word Similarity, Information Retrieval Boolean Retrieval, Termdocument incidence, The Inverted Index, Query Optimization, Phrase Queries, Ranked Retrieval – Term Frequency – Inverse Document Frequency based ranking, Zone Indexing, Query term proximity, Cosine ranking, Combining different features for ranking, Search Engine Evaluation, Relevance Feedback

**Text Books**

1. Speech and Language Processing, Jurafsky and Martin, Pearson Education
2. Multilingual Natural Language Processing Applications from Theory to Practice: Bikel, Pearson.

**Reference Books**

1. Foundation of Statistical Natural Language Processing, Manning and Schutze, MIT Press 3.

| **Course Name: Web and Internet Technology** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE801D** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[11H]**

Introduction: Overview, Network of Networks, Intranet, Extranet and Internet.
World Wide Web: Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP.
Review of TCP/IP: Features, Segment, Three -Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6.
IP Subnetting and addressing: Classful and Classless Addressing, Subnetting. NAT, IP masquerading, IP tables.
Internet Routing Protocol: Routing -Intra and Inter Domain Routing, Unicast and Multicast Routing, Broadcast.

Electronic Mail: POP3, SMTP.

**Module 2** **[11H]**

HTML: Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue.
Image Maps: map, area, attributes of image area.
Extensible Markup Language (XML): Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief.
CGI Scripts: Introduction, Environment Variable, GET and POST Methods.

**Module 3** **[11H]**

PERL: Introduction, Variable, Condition, Loop, Array, Implementing data structure, Hash, String, Regular Expression, File handling, I/O handling.
JavaScript: Basics, Statements, comments, variable, comparison, condition, switch, loop, break. Object – string, array, Boolean, regex. Function, Errors, Validation.
Cookies: Definition of cookies, Create and Store a cookie with example.
Java Applets: Container Class, Components, Applet Life Cycle, Update method; Parameter passing applet, Applications.
Client -Server programming In Java: Java Socket, Java RMI.

**Module 4** **[12H]**

Threats: Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks.
Network security techniques: Password and Authentication; VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH).
Firewall: Introduction, Packet filtering, Stateful, Application layer, Proxy.
Internet Telephony: Introduction, VoIP.
Multimedia Applications: Multimedia over IP: RSVP, RTP, RTCP and RTSP. Streaming media, Codec and Plugins, IPTV.
Search Engine and Web Crawler: Definition, Meta data, Web Crawler, Indexing, Page rank, overview of SEO.

**Text Books**

1. Web Technology: A Developer's Perspective, N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi,2013. (Chapters 1-5,7,8,9).

**Reference Books**

1. Internetworking Technologies, An Engineering Perspective, Rahul Banerjee, PHI Learning, Delhi, 2011. (Chapters 5,6,12)

| **Course Name: Internet of Things** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSE801E** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[8H]**

Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IOT

**Module 2** **[8H]**

Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc

**Module 3** **[8H]**

Important Characteristics of Sensors: Determination of the Characteristics Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality
Impedance Spectroscopy: Equivalent circuit of Sensors and Modelling of Sensors
Importance and Adoption of Smart Sensors

**Module 4** **[7H]**

Architecture of Smart Sensors: Important components, their features Fabrication of Sensor

Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical Vapor, Anodization, Solgel

**Module 5** **[7H]**

Interface Electronic Circuit for Smart Sensors and Challenges for Interfacing the Smart Sensor, Usefulness of Silicon Technology in Smart Sensor and Future scope of research in smart sensor

**Module 6** **[7H]**

Recent trends in smart sensor for day to day life, evolving sensors and their architecture

**Text Books**

1. Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing
2. Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing

**References Books**

1. Jeeva Jose, Internet of Things, Khanna Publishing House.
2. Internet of Things, Arsheep Bahga and Vijay Madisetti

| **Course Name: Big Data Analysis** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSG802A** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[8H]**

What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

**Module 2** **[8H]**

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peer-peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.

**Module 3** **[8H]**

Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures

**Module 4** **[7H]**

MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats

**Module 5** **[7H]**

Hbase, data model and implementations, Hbase clients, Hbase examples, praxis.Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration.

**Module 6** **[7H]**

Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.

**Text Books**

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging
2. V.K. Jain, Big Data and Hadoop, Khanna Publishing House, New Delhi (2017).

**Reference Books**

1. V.K. Jain, Data Analysis, Khanna Publishing House, New Delhi (2019).
2. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.

| **Course Name: Cyber Law and Ethics** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSG802B** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[12H]**

Introduction of Cybercrime: What is cybercrime?, Forgery, Hacking, Software Piracy, Computer Network intrusion.
Category of Cybercrime: how criminals plan attacks, passive attack, Active attacks, cyberstalking.

**Module 2** **[11H]**

Cybercrime Mobile & Wireless devices: Security challenges posted by mobile devices, cryptographic security for mobile devices, Attacks on mobile/cellphones, Theft, Virus, Hacking. Bluetooth; Different viruses on laptop

**Module 3** **[11H]**

Tools and Methods used in Cyber crime: Proxy servers, panword checking, Random checking, Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection: buffer over flow.

**Module 4** **[11H]**

Phishing & Identity Theft: Phising methods, ID Theft; Online identity method.
Cybercrime & Cybersecurity: Legal aspects, Indian laws, IT act, Public key certificate.

**Text Book**

1. Cyber security by Nina Gobole & Sunit Belapune; Pub: Wiley India.

**Reference Book**

1. Information Security & Cyber laws, Gupta & Gupta, Khanna Publishing House

| **Course Name: Mobile Computing** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSG802C** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module I** **[8H]**

Introduction to Personal Communications Services (PCS): PCS Architecture, Mobility management, Networks signalling.
Global System for Mobile Communication (GSM) system overview: GSM Architecture, Mobility management, Network signalling.

**Module 2** **[8H]**

General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes. Mobile Data Communication: WLANs (Wireless LANs) IEEE 802.11 standard, Mobile IP.

**Module 3** **[8H]**

Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, wireless mark up Languages (WML).
Wireless Local Loop(WLL): Introduction to WLL Architecture, wireless Local Loop Technologies.

**Module 4** **[7H]**

Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G

**Module 5** **[7H]**

Global Mobile Satellite Systems; case studies of the IRIDIUM and GLOBALSTAR systems. Wireless Enterprise Networks: Introduction to Virtual Networks, Blue tooth technology, Blue tooth Protocols.

**Module 6** **[7H]**

Server-side programming in Java, Pervasive web application architecture, Device independent example application

**Text Books**

1. Pervasive Computing, Burkhardt, Pearson
2. Mobile Communication, J. Schiller, Pearson

**Reference Books**

1. Wireless and Mobile Networks Architectures, Yi-Bing Lin & Imrich Chlamtac, John Wiley & Sons, 2001.
2. Mobile and Personal Communication systems and services, Raj Pandya, Prentice Hall of India, 2001.

| **Course Name: Robotics** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSG802D** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module I** **[4H]**

Introduction: Introduction -- brief history, types, classification and usage, Science and Technology of robots, Some useful websites, textbooks and research journals.

**Module 2** **[5H]**

Elements of robots – links, joints, actuators, and sensors Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D – H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force - torque sensors, proximity and distance measuring sensors, and vision.

**Module 3** **[5H]**

Kinematics of serial robots Introduction, Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi -body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general, serial manipulator

**Module 4** **[5H]**

Kinematics of parallel robots Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop -closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed -from and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough –Stewart platform.

**Module 5** **[5H]**

Velocity and static analysis of robot manipulators Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough-Stewart platform, Singularity analysis and statics.

**Module 6** **[6H]**

Dynamics of serial and parallel manipulators Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators, Generation of symbolic equations of motion usinga computer, Simulation (direct and inverse) of dynamic equations of motion, Examples of a planar 2R and four -bar mechanism, Recursive dynamics, Commercially available multi -body simulation software (ADAMS) and Computer algebra software Maple.

**Module 7** **[4H]**

Motion planning and control Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of asingle link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in nonlinear control of manipulators.

**Module 8** **[4H]**

Modeling and Modeling and control of flexible robots Models of flexible links and joints, Kinematic modeling of multilink flexible robots, Dynamics and control of flexible link manipulators, Numerical simulations results, Experiments with a planar two-link flexible manipulator.

**Module 9** **[4H]**

Modeling and analysis of wheeled mobile robots, Introduction and some well known wheeled mobile robots (WMR), two and three-wheeled WMR on flat surfaces, Slip and its modeling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics, dynamics and static stability of a threewheeled WMR's on uneven terrain, Simulations using Matlab and ADAMS.

**Module 10** **[4H]**

Selected advanced topics in robotics Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. GoughStewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform based sensors. Overconstrained mechanisms and deployable structures, Algorithm to obtain redundant links and joints, Kinematics and statics of deployable structures with pantographs or scissor-like elements (SLE's).

**Text Books**

1. Robotics Process Automation, Khanna Publishing House
2. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014

**Reference Books**

1. Ghosal, A., "Robotics", Oxford, New Delhi, 2006.

| **Course Name: Soft Skill & Interpersonal Communication** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSG802E** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[6H]**

Introduction: A New Approach To Learning, Planning And Goal-Setting, Human Perceptions: Understanding People, Types Of Soft Skills: Self-Management Skills,
Aiming For Excellence: Developing Potential And SelfActualization, Need Achievement And Spiritual Intelligence

**Module 2** **[6H]**

Conflict Resolution Skills: Seeking Win-Win Solution,
Inter-Personal Conflicts: Two Examples,
Inter-Personal Conflicts: Two Solutions,
Types Of Conflicts: Becoming A Conflict Resolution Expert
Types Of Stress: Self-Awareness About Stress,
Regulating Stress: Making The Best Out Of Stress

**Module 3** **[6H]**

Habits: Guiding Principles, Habits: Identifying Good And Bad Habits,
Habits: Habit Cycle, Breaking Bad Habits, Using The Zeigarnik Effect For Productivity And Personal Growth, Forming Habits Of Success

**Module 4** **[6H]**

Communication: Significance Of Listening, Communication: Active Listening,
Communication: Barriers To Active Listening,
Telephone Communication: Basic Telephone Skills ,
Telephone Communication: Advanced Telephone Skills,
Telephone Communication: Essential Telephone Skills

**Module 5** **[6H]**

Technology and Communication: Technological Personality,
Technology And Communication: Mobile Personality?,
Topic: Technology And Communication: E-Mail Principles,
Technology And Communication: How Not To Send E-Mails!,
Technology And Communication: Netiquette, Technology And
Communication: E-Mail Etiquette

**Module 6** **[5H]**

Communication Skills: Effective Communication,

Barriers To Communication: Arising Out Of Sender/Receiver's Personality,
Barriers To Communication: Interpersonal Transactions,
Barriers To Communication: Miscommunication,
Non-Verbal Communication: Pre-Thinking Assessment-1,
Non-Verbal Communication: Pre-Thinking Assessment-2

**Module 7** **[5H]**

Nonverbal Communication: Introduction And Importance,
Non-Verbal Communication: Issues And Types,
Non-Verbal Communication: Basics And Universals,
Non Verbal Communication: Interpreting NonVerbal Cues,
Body Language: For Interviews,
Body Language: For Group Discussions
Presentation Skills: Overcoming Fear

**Module 8** **[5H]**

Presentation Skills: Becoming A Professional,
Presentation Skills: The Role Of Body Language,
Presentation Skills: Using Visuals,
Reading Skills: Effective Reading,
Human Relations: Developing Trust And Integrity

**Text Books**

1. Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013.
2. Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers,Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.

**Reference Books**

1. Klaus, Peggy, Jane Rohman & Molly Hamaker. The Hard Truth about Soft Skills. London: HarperCollins E-books, 2007.
2. Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.

| **Course Name: E-Commerce and ERP** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSG803A** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[4H]**

Overview, Definitions, Advantages & Disadvantages of E – Commerce, Threats of E –Commerce, Managerial Prospective, Rules & Regulations For Controlling E – Commerce, Cyber Laws.

**Module 2** **[4H]**

Technologies: Relationship Between E – Commerce & Networking, Different Types of Networking Commerce, Internet, Intranet & Extranet, EDI Systems Wireless Application Protocol : Definition, Hand Held Devices, Mobility & Commerce, Mobile Computing, Wireless
Web, Web Security, Infrastructure Requirement For E – Commerce .

**Module 3** **[4H]**

Business Models of e – commerce : Model Based On Transaction Type, Model Based On Transaction Party - B2B, B2C, C2B, C2C, E – Governance.

**Module 4** **[4H]**

E – strategy : Overview, Strategic Methods for developing E – commerce.

**Module 5** **[4H]**

Four C's: ( Convergence, Collaborative Computing, Content Management & Call Center ).
Convergence: Technological Advances in Convergence – Types, Convergence and its implications, Convergence & Electronic Commerce.
Collaborative Computing: Collaborative product development, contract as per CAD, Simultaneous Collaboration, Security.
Content Management: Definition of content, Authoring Tools & Content Management, Content – partnership, repositories, convergence, providers, Web Traffic & Traffic Management ; Content Marketing.
Call Center: Definition, Need, Tasks Handled, Mode of Operation, Equipment, Strength & Weaknesses of Call Center, Customer Premises Equipment (CPE).

**Module 6** **[4H]**

Supply Chain Management : E – logistics, Supply Chain Portal, Supply Chain Planning Tools (SCP Tools), Supply Chain Execution (SCE), SCE - Framework, Internet's effect on Supply Chain Power.

**Module 7** **[4H]**

E – Payment Mechanism : Payment through card system, E – Cheque, E – Cash, E – Payment Threats & Protections.

**Module 8** **[4H]**

E – Marketing :. Home –shopping, E-Marketing, Tele-marketing

**Module 9** **[4H]**

Electronic Data Interchange (EDI) : Meaning, Benefits, Concepts, Application, EDI Model, Protocols (UN EDI FACT / GTDI, ANSI X – 12), Data Encryption (DES / RSA).

**Module 10** **[4H]**

Risk of E – Commerce : Overview, Security for E – Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digital signatures.

**Module 11** **[5H]**

Enterprise Resource Planning (ERP): Features, capabilities and Overview of Commercial Software, re-engineering work processes for IT applications, Business Process Redesign, Knowledge engineering and data warehouse.
Business Modules: Finance, Manufacturing (Production), Human Resources, Plant Maintenance, Materials Management, QualityManagement, Sales&Distribution ERPPackage, ERP Market: ERP Market Place, SAP AG, PeopleSoft, BAAN, JD Edwards, Oracle Corporation ERP-Present and Future: Enterprise Application Integration (EAI), ERP and E-Commerce, ERP and Internet, Future Directions in ERP

**Text Books**

1. E-Commerce,M.M. Oka, EPH
2. Kalakotia, Whinston : Frontiers of Electronic Commerce , Pearson Education.

**Reference Books**

1. Bhaskar Bharat: Electronic Commerce - Technologies & Applications.TMH
2. Loshin Pete, Murphy P.A. : Electronic Commerce , Jaico Publishing Housing.

| **Course Name: Micro-electronics and VLSI Design** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSG803B** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[9H]**

Introduction to CMOS circuits: MOS Transistors, MOS transistor switches, CMOS Logic, The inverter, Combinational Logic, NAND gate, NOT Gate, Compound Gates, Multiplexers, Memory-Latches and Registers.

**Module 2** **[9H]**

Processing Technology: Silicon Semiconductor Technology- An Overview, wafer processing, oxidation, epitaxy deposition, Ion-implantation and diffusion, The Silicon Gate Process- Basic CMOS Technology, basic n-well CMOS process, p-well CMOS process, Twin tub process, Silicon on insulator, CMOS process enhancement-Interconnect, circuit elements, 3-D CMOS. Layout Design Rule: Layer Representations, CMOS n-well Rules, Design Rule of background scribe line, Layer Assignment, SOI Rule.

**Module 3** **[9H]**

Power Dissipation: Static dissipation, Dynamic dissipation, short-circuit dissipation, total power dissipation. Programmable Logic, Programmable Logic structure, Programmable interconnect, and Reprogramable Gate Array: Xilinx Programmable Gate Array, Design Methods: Behavioural Synthesis, RTL synthesis

**Module 4** **[9H]**

Placement: placement: Mincut based placement – Iterative improvement placement simulated annealing. Routing: Segmented channel routing – maze routing – routability and routing resources – net delays.

**Module 5** **[9H]**

Verification and Testing: Verification Versus Testing, Verification: logic simulation design validation – timing verification – Testing concepts: failures – mechanisms and faults – fault coverage – ATPG methods – types of tests – FPGAs – programmability failures – design for testability. Overview of VHDL.

**Text Book**s

1. 1.Digital Integrated Circuit, J.M.Rabaey, Chandrasan, Nicolic, Pearson
2. CMOS Digital Integrated Circuit, S.M.Kang & Y.Leblebici, TMH

**Reference Book**s

1. Modern VLSI Design, Wayne Wolf, Pearson
2. Algorithm for VLSI Design & Automation, N.Sherwani, Kluwer

| **Course Name: Economic Policies in India** | | | | | |
|---|---|---|---|---|---|
| **Course Code: BTCSG803C** | | | | | |
| **Contact Hours Per Week** | **L** | **T** | **P** | **Total** | **Credit Points** |
| | **3** | **0** | **0** | **3** | **3** |
| **Total Contact Hours: 45** | | | | | |

**Module 1** **[6H]**

Economic Development and its Determinants: Approaches to economic development and its measurement – sustainable development; Role of State, market and other institutions; Indicators of development – PQLI, Human Development Index (HDI), gender development indices.

**Module 2** **[6H]**

Planning in India Objectives and strategy of planning; Failures and achievements of Plans; Developing grass-root organizations for development – Panchayats, NGOs and pressure groups.
Demographic Features, Poverty and Inequality Broad demographic features of Indian population; rural-urban migration; Urbanization and civic amenities; Poverty and Inequality.
Resource Base and Infrastructure Energy; social infrastructure – education and health; Environment; Regional imbalance; Issues and policies in financing infrastructure development.

**Module 3** **[6H]**

The Agricultural Sector Institutional Structure: land reforms in India; Technological change in agriculture – pricing of agricultural inputs and output; industry; Agricultural finance policy; Agricultural Marketing and Warehousing; Issues Terms of trade between agriculture and in food security – policies for sustainable agriculture.

**Module 4** **[9H]**

Industrial policy: Public Sector enterprises and their performance; Problem of sick units in India; Privatization and disinvestment debate; Growth and pattern of industrialization; Small-scale sector; Productivity in industrial sector; Exit policy – issues in labour market reforms; approaches for employment generation.

**Module 5** **[6H]**

Public Finances Fiscal federalis: Centre-State financial relations; Finances of central government; Finances of state governments; Parallel economy; Problems relating to fiscal policy; Fiscal sector reforms in India. Money, Banking and Prices Analysis of price behaviour in India; Financial sector reforms; Interest rate policy; Review of monetary policy of RBI; Money
and capital markets; Working of SEBI in India.

**Module 6** **[6H]**

External Sector: Structure and direction of foreign trade; Balance of payments; Issues in export-import policy and FEMA; Exchange rate policy; Foreign capital and MNCs in India; The progress of trade reforms in India.

**Module 7** **[6H]**

Economic Reforms Rationale of internal and external reforms; Globalization of Indian economy; WTO and its impact on the different sectors of the economy; Need for and issues in good governance; Issues in competition and safety nets in Indian economy.

**Text Books**

1. Ahluwalia, I. J. and I. M. D Little (Eds.) (1999), India's Economic Reforms and Development
2. (Essays in honour of Manmohan Singh), Oxford University Press, New Delhi.

**Reference Books**

1. Bardhan, P. K. (9th Edition) (1999), The Political Economy of Development in India, Oxford
2. University Press, New Delhi. Bawa, R. s. and P. S. Raikhy (Ed.) (1997), Structural Changes in Indian Economy, Guru Nanak Dev University Press, Amritsar.