GURU KASHI UNIVERSITY

B.Tech (Computer Science & Engineering-Bioinformatics)

Session: 2023-24

Department of Computer Science & Engineering

GRADUATE OUTCOME OF THE PROGRAMMEG

Graduates will be able to design and develop computer programs in the areas related to algorithm, networking, web design and cloud computing to understand, analyze, develop and efficiently solve problems related to computer-based systems.

PROGRAMME LEARNING OUTCOMES

After completion of the course, B.Tech (Computer Science and Engineering - Bioinformatics) graduates will have ability to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analysis complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability

to engage in independent and life-long learning in the broadest context of technological change.

Programme Structure

Semester: 1st						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BCB101	Basic Electrical Engineering	Engineering Science Course	3	0	0	3
BCB102	Engineering Physics	Basic Science Course	3	1	0	4
BCB103	Introduction to Biology	Basic Science Course	3	1	0	4
BCB104	Applied Mathematics-1	Basic Science Course				
BCB105	Engineering Graphics & Drawing	Engineering Science Course	1	0	4	3
BCB106	Engineering Physics Lab	Basic Science Course	0	0	4	2
BCB107	Basic Electrical Engineering Lab	Engineering Science Course	0	0	4	2
BCB108	Fundamental of Computer and Information Technology	Engineering Science Course	2	0	0	2
BCB109	Constitution of India	Mandatory Course	2	0	0	NC*
Total			**14**	**2**	**12**	**20**

Note: *-Non Credit(NC) Course Will be evaluated as Satisfactory/Unsatisfactory

Note: -

1. Course Title - Applied Mathematics with Course Code -BCB103 will be applied for Students who have covered Biology in Senior Secondary Examination.

1. Course Title - Advance Biology with Course Code -BCB104 will be applied for Students who have covered Mathematics in Senior Secondary Examination.

Semester: 2nd						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BCB201	Engineering Chemistry	Basic Science Course	3	0	0	3
BCB202	Applied Mathematics-II	Basic Science Course	3	1	0	4
BCB203	Advance Biology	Basic Science Course				
BCB204	Programming for Problem Solving	Engineering Science Course	3	0	0	3
BCB205	Communication Skills	Humanities Course	3	0	0	3
BCB206	Manufacturing Practices	Engineering Science Course	1	0	4	3
BCB207	Engineering Chemistry Lab	Basic Science Course	0	0	2	1
BCB208	Programming for Problem Solving Lab	Engineering Science Course	0	0	2	1
BCB209	Communication Skills Lab	Humanities Course	0	0	2	1
Value Added Course (**Any one of the following)**						
BCB210	Entrepreneurship Development	VAC	1	0	0	1
BCB211	Numerical Aptitude and Reasoning Ability					
BCB212	Stress Management					
Total			**14**	**1**	**10**	**20**

Note: -

1. Course Title - Applied Mathematics with Course Code -BCB202 will be applied for Students who have covered Biology in Senior Secondary Examination.

1. Course Title - Advance Biology with Course Code -BCB204 will be applied for Students who have covered Biology in Senior Secondary Examination.

Semester: 3rd						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BCB301	Object Oriented Programming Using C++	Core Course	3	0	0	3
BCB302	Data Structure & Algorithms	Core Course	3	0	0	3
BCB303	Basic Bioinformatics	Core Course	4	0	0	4
BCB304	Engineering Mathematics	Core Course	3	0	0	3
BCB305	Digital Electronics	Core Course	2	0	0	2
BCB306	Object Oriented Programming Using C++ Lab	Laboratory Course	0	0	4	2
BCB307	Data Structure & Algorithms Lab	Laboratory Course	0	0	4	2
BCB308	Human Value & Ethics	Humanities and Social Sciences including Management courses	2	0	0	2
BCB399	xxx	MOOC	-	-	-	2
Total			**17**	**0**	**08**	**23**

Semester: 4th						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BCB401	Cell Biology	Core Course	3	1	0	4
BCB402	Operating System	Core Course	3	0	0	3
BCB403	Design & Analysis of Algorithms	Core Course	3	1	0	4
BCB404	Computer Organization & Architecture	Engineering Science Course	3	0	0	3
BCB405	Operating System Lab	Laboratory Course	0	0	4	2
BCB406	Design & Analysis of Algorithms Lab	Laboratory Course	0	0	4	2
BCB407	Environmental Sciences	Mandatory Course	2	0	0	NC*
BCB408	Biostatistics	Core Course	4	0	0	4
Total			**18**	**2**	**8**	**22**

Note: *- Non Credit(NC) Course Will be evaluated as Satisfactory/Unsatisfactory

Semester: 5th						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BCB501	Molecular Biology	Core Course	4	0	0	4
BCB502	Advanced Java Programming for Biotechnology	Core Course	3	0	0	3
BCB503	Relational Database Management System	Core Course	3	0	0	3
BCB504	Web Designing & Development Lab	Core Course	3	0	0	3
BCB505	Relational Database Management System Lab	Laboratory Course	0	0	2	1
BCB506	Web Designing & Development Lab	Laboratory Course	0	0	2	1
BCB507	Advanced Java Programming for Biotechnology Lab	Laboratory Course	0	0	2	1
BCB508	Molecular Biology Lab	Humanities & Social Science Course	0	0	6	3
BCB599	xxx	MOOC	-	-	-	2
Total			**13**	**0**	**12**	**21**

Semester: 6th						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BCB601	Formal Language & Automata Theory	Core Course	3	1	0	4
BCB602	Computer Networks	Core Course	3	0	0	3
BCB603	Machine Learning	Core Course	3	0	0	3
BCB604	Computer Networks Lab	Core Course	0	0	2	1
BCB605	Project-1	Project Work	0	0	6	3
Elective-I (Any one of the following)						
BCB606	Molecular Modelling and Drug Design	Professional Elective Course	3	0	0	3
BCB607	Data Analytics in Bioinformatics					
BCB608	Biochemistry					
Elective-II(Any one of the following)						
BCB609	Data Ware Housing & Mining	Professional Elective Course	3	0	0	3
BCB610	Cloud Computing					
BCB611	Mobile Application Development					
Total			**15**	**1**	**8**	**20**

Semester: 7th						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BCB701	Python using R-Programming for Biologist	Core Course	3	0	0	3
BCB702	Analytical Bioinformatics	Core Course	4	0	0	4
BCB703	Artificial Intelligence	Core Course	3	0	0	3
BCB704	Python using R-Programming for Biologist	Laboratory Course	0	0	4	2
BCB705	Analytical Bioinformatics lab	Project Based	0	0	6	3
BCB799	xxx	MOOC	-	-	-	2
Elective-III (Any one of the following)						
BCB706	Block chain Architecture Design	Professional Elective Course	3	0	0	3
BCB707	Digital Forensics					
BCB708	Design & Development of Applications					
Open Elective –I						
xxx	xxx	Open Elective Course	3	0	0	3
Total			**16**	**0**	**10**	**23**
Open Elective –I(Open Elective Courses for other Departments)						
BCB709	Introduction to Big Data	Open Elective Course	3	0	0	3

Semester: 8th						
Course Code	**Course Title**	**Type of Course**	**L**	**T**	**P**	**Credits**
BCB801	Project-II	Project work Course	0	0	10	5
Elective-IV (Any one of the following)						
BCB802	Biological Databases	Professional Elective Course	3	0	0	3
BCB803	Big Data					
BCB804	Natural Language Processing.					
Open Elective –II						
xxx	xxx	Open Elective Course	3	0	0	3
Total			6	0	10	**11**
Grand Total			**113**	**06**	**80**	**160**
Open Elective –II(Open Elective Courses for other Department)						
BCB805	Introduction to Artificial Intelligence & Expert System architecture.	Open Elective Course	3	0	0	3

Evaluation Criteria for Theory Courses

A. Continuous Assessment: [25 Marks]
   CA1-Surprise Test (Two best out of Three) - (10 Marks)
   CA2-Assignment(s) (10 Marks)
   CA3-Term Paper/Quiz/Presentations (05 Marks)
B. Attendance: [05 marks]
C. Mid Semester Test: [30 Marks]
D. End-Term Exam: [40 Marks]

Evaluation Criteria for Practical Courses

Performance of each practical-(10 Marks)
Report- (5 Marks)
Practical Viva – (5 Marks)
Total - (20 Marks) (Each Practical)

SEMESTER-I

Course Title: Basic Electrical Engineering

Course Code: BCB101

3	**0**	**0**	**3**

Total Hours: 45

Learning Outcomes: On successful completion of this course, students will be able to:

1. Discuss the DC and AC electrical circuit elements with RLC in detail.
2. Analysis of simple circuits with dc excitation. Superposition, The venin and Norton Theorems.
3. Analyze Single Phase AC Circuits and representation of alternating quantities and determining the power in these circuits.
4. Classify the different types of Electrical machines.

Course Content

UNIT I **15 Hours**

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff's 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.

UNIT II **10 Hours**

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.

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

UNIT III **10 Hours**

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.

UNIT IV **10 Hours**

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.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Kothari, D. P. and Nagrath, I. J. (2010). Basic Electrical Engineering. Tata McGraw Hill.*
- *Kulshreshtha, D. C. (2009). Basic Electrical Engineering. McGraw Hill.*
- *Bobrow, L. S. (2011). Fundamentals of Electrical Engineering. Oxford University Press.*
- *Hughes, E. (2010). Electrical and Electronics Technology. Pearson.*

SEMESTER-I

Course Title: ENGINEERING PHYSICS

Course Code:BCB102

L	T	P	Credits
3	1	0	4

Total Hours: 60

Learning Outcomes: On successful completion of this course, students will be able to:

1. Apply knowledge of electricity and magnetism to explain natural physical processes and related technological advances.
2. Use the knowledge regarding calculus along with physical principles to effectively solve problems encountered in everyday life, further study in science, and in the professional world.
3. Design experiments and acquires data in order to explore physical principles, effectively communicate results, and evaluate related scientific studies.
4. Assess the contributions of physics to our evolving understanding of global change and sustainability while placing the development of physics in its historical and cultural context.

Course Content

UNIT I **15 Hours**

Electrostatics: Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential, Boundary conditions of electric field and electrostatic potential; method of images. Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; solving simple electrostatics problems in presence of dielectrics – Point charge at the center of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

UNIT II **15 Hours**

Magneto statics: Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; vector potential and its solution for given current densities. Properties of magnetic materials: magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials.

Time Varying Field and Maxwell's Equation: Laws of Electromagnetic Induction, Self and Mutual induction, Concept of Displacement Current, Difference between Conduction Current and Displacement Current, Eddy Current, Maxwell's Equations, Derivation of Maxwell's Equations, Propagation of Electromagnetic Waves in Free Space, Solution of propagation of Plane Electromagnetic Wave in free space.

UNIT III **15 Hours**

Semiconductors: Intrinsic and extrinsic semiconductors, Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Semiconductor materials of interest for optoelectronic devices.

Modern Physics: Particle properties of wave: Planck's hypothesis, Qualitative discussion of Photoelectric effect and Compton Effect. Wave properties of particle: De Broglie wave as mater waves, Heisenberg's uncertainty principle and its application. Quantum Mechanics: Interpretation of wave function, Schrödinger equation (time dependent and time independent), particle in a box,

UNIT IV **15 Hours**

Wave Optics: Interference due to division of wavefront, Young's double slit expt., Principle of Superposition, Interference from parallel thin films, Newton rings, Michelson interferometer. Diffraction: Fresnel Diffraction, Diffraction at a straight edge, Fraunhoffer diffraction due to N slits, Diffraction grating, dispersive and resolving power of Grating. Polarization**:** production of plane polarized light by different methods, Brewster and Malus Laws. Double refraction, Quarter & half wave plate, Nicol prism, specific rotation, Laurent's half shade polarimetry.

Laser: Introduction, principle of Laser, stimulated and spontaneous emission, Einstein's Coefficients, He-Ne Laser, Ruby Laser, Application of Lasers.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *David J Griffths, Introduction to Electrodynamics. Prentice Hall.*
- *Saslow, W.,Electricity, magnetism and light. e-book.*
- *Subramaniam N & BrijLal,Optics, S Chand & Co. Pvt. Ltd., New Delhi*
- *R Murugeshan, Kiruthiga, Sivaprasath, Modern Physics, S Chand & Co. Pvt. Ltd., New Delhi.*
- *M.N.Avadhanulu,Engineering Physics, S.Chand& Company Ltd.*
- *Arthur Beisser, Concepts of Modern Physics, McGraw Hill Publications.*

SEMESTER-I

Course Title: INTRODUCTION TO BIOLOGY
Course code: BCB103

L	T	P	Credits
3	1	0	4

Total Hours: 60

Learning Outcomes: On successful completion of this course, students would be able to:

1. List the defining characteristics of biological life.
2. Discuss the history of the study of life and the diversity of life on Earth.
3. Identify the main branches of biology.
4. Describe biology as a science and identify the key components of scientific inquiry.

Course Content

UNIT-I **15 Hours**

Biology and its branches. Evolution of life: Origin of Life; Darwin's concepts of evolution molecular perspective and classification, Phylogenetic trees, study of inter- and intra-species relationships, developmental Biology

UNIT-II **15 Hours**

Cell as structural and functional unit of life - discovery of cell, cell theory, cell types prokaryotic and eukaryotic cell; Ultrastructure of prokaryotic and eukaryotic cell - cell wall, cell membrane - unit membrane concept (Fluid-Mosaic model) cell organelles and their functions- nucleus, mitochondria, plastids, endoplasmic reticulum, Golgi complex, lysosomes, microtubules, centriole, vacuole, cytoskeleton, cilia and flagella, ribosomes.

UNIT-III **15 Hours**

Molecules of cell; inorganic and organic materials Essential nutrients to sustain life; water, salt, mineral ions, carbohydrates, lipids, amino acids, proteins, nucleic acids, (DNA and RNA). Cell cycle: Mitosis, Meiosis.

UNIT-IV **15 Hours**

Continuity of life: Genes and chromosomes, DNA structure, replication; Central dogma of molecular biology: Transcription and translation; Mendelian Genetics; Genetic engineering, Cloning and its applications.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Khalid Rehman Hakeem, Noor Ahmad Shaik, Babajan Banaganapalli, Ramu Elango*

- *Fundamentals of Systems Biology*

SEMESTER-I

Course Title: Applied Mathematics –I

Course Code: BCB104

L	T	P	Cr
3	1	0	4

Course Content **Total Hours: 60**

Unit I: Calculus **15 hours**

Continuity and Differentiability, derivative of composite functions, chain rule, derivative of inverse trigonometric functions, derivative of implicit function. Concepts of exponential and logarithmic functions. Derivatives of logarithmic and exponential functions. Logarithmic differentiation, a derivative of functions expressed in parametric forms. Second-order derivatives. Applications of derivatives: rate of change, increasing/decreasing functions, maxima and minima.

Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts, Evaluation of simple integrals of the following types and problems. Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals. Applications in finding the area under simple curves, especially lines, circles/parabolas/ellipses.

Unit II: Relations and Functions **15 hours**

Relations and Functions: Types of relations: Reflexive, symmetric, transitive and equivalence relations. Types of functions: One to one and onto functions, composition of functions and invertible functions.

Inverse Trigonometric Functions: Definition, Range, Domain, Principal value branches. Graphs of inverse trigonometric functions. Properties of inverse trigonometric functions.

Unit III: Statistics and Probability **15 hours**

Statistics: Measure of central tendency, Measure of Dispersion: Range, mean deviation, variance and standard deviation of ungrouped/grouped data.

Probability: Events: Occurrence of events, exhaustive events, mutually exclusive events. probability, connections with others theories of earlier classes. Probability of an event.

Unit IV: Vectors **15 hours**

Vectors and scalars, magnitude and direction of a vector. Direction cosines and direction ratios of vectors. Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Definition, Geometrical interpretation, properties and application of scalar (dot) product of vectors, vector (cross) product of vectors.

Transaction Mode- Lecture, Demonstration, Video Based Teaching, Collaborative teaching, Project based learning, E-team teaching, Group discussion, ted talks, E team Teaching, Flipped Teaching, Quiz, Open talk, Case analysis.

SUGGESTED READINGS:-

- *Thomes, G.B. and Finney, R.L. (2010) Calculus and Analytic Geometry; Ninth Edition; Pearson Education*
- *Kreyszig, E. (1998) Advanced Engineering Mathematics; Eighth Edition, Johnwiley and sons.*
- *Grewal, B.S. (1965) Higher Engineering Mathematics; Khanna Publishers, New Delhi.*
- *Richard Courant and Fritz John (2012) Introduction to Calculus and Analysis, Volume II, V Springer Publication*
- *Harold M. Edwards (2013) Advanced Calculus: A Differential Forms Approach, Birkhauser.*
- *Ramana, B.V. (2010). Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint.*

SEMESTER-I

Course Title: ENGINEERING GRAPHICS & DRAWING

L	T	P	Credits

Course Code: BCB105

1	0	4	3

Total Hours: 45

Learning Outcomes: On successful completion of this course, students will be able to:

1. Understand about engineering drawing applications and its importance in society.
2. Learn about the visual aspects of engineering design.
3. Understand the engineering graphics standards.
4. Understand the concept of solid modeling techniques.

Course Content

UNIT I **9 Hours**

Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involutes; Scales – Plain, Diagonal and Vernier Scales;

Orthographic Projections covering, Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

UNIT II **12 Hours**

Projections of Regular Solids covering, those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Sections and Sectional Views of Right Angular Solids covering, 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)

UNIT III **14 Hours**

Isometric Projections covering, 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;

Overview of Computer Graphics covering, 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, shares, 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];

Customization& CAD Drawing consisting of 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 tolerance; 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;

UNIT IV **10 Hours**

Annotations, layering & other functions covering applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to Credits ate drawings, Credits ate, 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, multi view, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerance techniques; dimensioning and scale multi views of dwelling;

Demonstration of a simple team design project that illustrates 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 tolerance; Use of solid-modeling software for Credits eating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying color coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modeling (BIM).

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Gill, P.S. (2001). Engineering Drawing. S.K; Kataria and Sons, Ludhiana.*
- *Bhatt, N.D. (2012). Engineering Drawing. Charotar Book Stall, Tulsi Sadan, Anand.*
- *French, T.E. and Vierck. C.J. (1993). Graphic Science. McGraw-Hill, New York.*
- *Zozzora, F. (1958). Engineering Drawing.McGraw Hill, NewYork.*
  (Corresponding set of) CAD Software Theory and User Manuals

SEMESTER-I

Total hours 30

Course Title: ENGINEERING PHYSICS LAB
Course Code: BPE23106

L	T	P	Credits
0	0	4	2

Course Title: Basic Electrical Engineering Lab

Course Code: BCB107

L	T	P	Credits
0	0	4	2

Learning Outcomes On successful completion of this course, the students would be able to:

1. Illustrate the working p-n junction diode.
2. Analyse and solve various engineering problems.
3. Understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.
4. Design new instruments with practical knowledge.

Course Content

List of experiments **30 Hours**

1. To study the V-I characteristics of P-N junction.
2. To verify the logic gates.
3. To calculate the acceleration due to gravity “g” using simple pendulum.
4. To find the moment of inertia of flywheel.
5. To measure the diameter of a small spherical/cylindrical body using Vernier calipers/screw gauge.
6. To draw V-I characteristics of Zener diode and determine reverse breakdown voltage.
7. To study the controls and obtain a wave using Cathode Ray Oscilloscope.
8. To find the resolving power of the prism.
9. To determine the angle of the given prism.
10. To determine the refractive index of the material of a prism.
11. To understand the phenomenon Photoelectric effect as a whole.
12. To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
13. To determine the Planck's constant from kinetic energy versus frequency graph.
14. To plot a graph connecting photocurrent and applied potential.
15. To determine the stopping potential from the photocurrent versus applied potential graph.

Note: Students will perform any 7-8 experiments from the syllabus.

SEMESTER-I

Total Hours: 30

Learning Outcomes: On successful completion of this course, students will be able to:

1. Analysis of Resistive Circuits and Solution of resistive circuits with independent sources.
2. Two Terminal Element Relationships for inductors and capacitors and analysis of magnetic circuits.

3. Analysis of Single-Phase AC Circuits, the representation of alternating quantities and determining the power in these circuits.
4. Categorize and compare different types of Electrical machines. Classify different electrical measuring equipment's and understanding their principles

Course Content

List of Experiments:

1. To study basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. real-life resistors, capacitors and inductors.
2. To verify Ohm's law.
3. To verify Kirchhoff's voltage and current laws.
4. To verify Superposition Theorem.
5. To verify Thevenin Theorem.
6. To obtain the sinusoidal steady state response of R-L circuit – impedance calculation and verification. Observation of phase differences between current and voltage.
7. To obtain the sinusoidal steady state response of R-C circuit – impedance calculation and verification. Observation of phase differences between current and voltage.
8. To study resonance phenomenon in R-L-C series circuits.
9. To perform open circuit and short circuit test on a single-phase transformer and calculate the efficiency.
10. Demonstration of cut-out sections of machines: Induction machine (squirrel cage rotor and slip ring arrangement) and single-phase induction machines.
11. To connect, start and reverse the direction of rotation by change of phase-sequence of connections of three phase induction motor.
12. To connect, start and reverse the direction of rotation of single-phase induction motor.
13. To demonstrate working of DOL starter for three-phase induction motor.

SEMESTER-I

Course Title: FUNDAMENTAL OF COMPUTER AND INFORMATION TECHNOLOGY

Course Code: BCB108

L	T	P	Credits
2	0	0	2

Total Hours: 30

Learning Outcomes: On successful completion of this course, students will be able to:

1. Understanding the concept of input and output devices of Computers
2. Study to use the Internet safely, legally, and responsibly.
3. Understand an operating system and its working, and solve common problems related to operating systems
4. Learn basic word processing, Spreadsheet and Presentation Graphics Software skills

Course Content

UNIT I **8 Hours**

Computer Hardware / Software: Definition, History, Generation, Characteristics, Types & Applications, Overview of a computer system:

Hardware/Software: Definition of Hardware**,** Input Unit: Keyboard, Mouse, Scanner etc.**,** CPU: Arithmetic Logic Unit (ALU), Control Unit (CU), Memory Unit (MU)**,** Output Unit: Monitor, Printer etc.**,** Storage Devices: Primary &Auxiliary Memory (Floppy Disk, Hard Disk, Compact Disk, DVD, Flash Disk etc.)**,** Others: Network Card, Modem, Sound Card etc.

Software: Definition & types of Software, Programming Language, Live ware, Firmware and Cache Memory

UNIT II **7 Hours**

Setting & Protection: of Computer Room and Computer- Concept of Computer related threats (virus, worms, Trojan, phishing etc.) remedies and protection

File Management Basics: Physical structure of disk

UNIT III **7 Hours**

Concept of E-mail / Internet / Extranet, World Wide Web (WWW): Familiarity with internet browsers (e.g., Internet Explorer, Firefox, Opera, Safari, Google Chrome etc.), Introduction of IP address, subnet mask and default gateway, Introduction to Network Media, topology and protocol, Setting up Microsoft Network, Dial-Up Networking

UNIT IV **8 Hours**

Number System: Introduction to binary, octal, decimal and hexadecimal number system

Introduction to ASCII and Unicode standards

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Rajaraman, V., & Adabala, N. (2014). Fundamentals of computers. PHI Learning Pvt. Ltd.*
- *Doja, M. N. (2005). Technology. Deep and Deep Publications.*
- *Bangia, R. (2008). Computer Fundamentals and Information Technology. Firewall Media.*

SEMESTER-I

Course Title: CONSTITUTION OF INDIA

Course Code: BCB109

L	T	P	Credits
2	0	0	NC

Learning Outcomes: On successful completion of this course, students will be able to:

1. Have general knowledge and legal literacy and thereby to take up competitive examinations
2. Understand state and central policies, fundamental duties, Electoral Process, and special provisions
3. Analyze powers and functions of Municipalities, Panchayats and Co-operative Societies, and
4. Understand Engineering ethics and responsibilities of Engineer and an awareness about basic human rights in India

Course Content

Unit I **5 Hours**

Introduction to the Constitution of India, The Making of the Constitution and Salient features of the Constitution.

Preamble to the Indian Constitution Fundamental Rights & its limitations.

Unit II **10 Hours**

Directive Principles of State Policy & Relevance of Directive Principles State Policy Fundamental Duties.

Union Executives – President, Prime Minister Parliament Supreme Court of India.

State Executives – Governor Chief Minister, State Legislature High Court of State.

Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th &91st Amendments.

Unit III **10 Hours**

Special Provision for SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions. Human Rights –Meaning and Definitions, Legislation Specific Themes in Human Rights- Working of National Human Rights Commission in India

Powers and functions of Municipalities, Panchayats and Co – Operative Societies.

Unit IV **5 Hours**

Scope & Aims of Engineering Ethics, Responsibility of Engineers Impediments to Responsibility.

Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.

Suggested Readings:

- *Singh Mahendra, P. (2000). VN Shukla's Constitution of India. Eastern Book Company, Lucknow.*
- *Agrawal, P. K., & Gupta, V. (2023). The Constitution of India Bare Act with Short Notes-Useful for Competitive Examinations: Bestseller Book by Dr. PK Agrawal; Virag Gupta: The Constitution of India Bare Act with Short Notes-Useful for Competitive Examinations. Prabhat Prakashan.*
- *Ghosh, P. K. (1966). Constitution of India (Prabhat Prakashan): How it Has Been Framed. Prabhat Prakashan.*

SEMESTER-II

Course Title: ENGINEERING CHEMISTRY

Course Code: BCB201

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: On successful completion of this course, students will be able to:

1. Demonstrate Schrodinger equation, Particle in a box solution and their applications for conjugated molecules and Nano particles,
2. Evaluate band structure of solids and the role of doping on band structures.
3. Distinguish the ranges of Vibrational and rotational spectroscopy of diatomic molecules, Applications, Nuclear magnetic resonance and magnetic resonance imaging
4. Rationalize periodic properties such as ionization potential, electro-negativity, Oxidation states and electro-negativity.

Course Content

UNIT1 **15 Hours**

Atomic and molecular structure: Schrodinger equation, Particle in a box solution and their applications for conjugated molecules and Nanoparticles, Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations, Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. 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.

UNIT II **10 Hours**

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 characterization techniques, Diffraction and scattering.

Ionic, Dipolar and Vander Waals interactions, Equations of state of real gases and Critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

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 equilibriums, Water chemistry, Corrosion, Use of free energy considerations in metallurgy through Ellingham diagrams.

UNIT III **10 Hours**

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 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.

UNIT IV **10 Hours**

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.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Mahan, B. H. (1987). University chemistry.*
- *Sienko, M. J. & Plane, R. A. Chemistry. (1979): Principles and Applications. New York: McGraw-Hill.*
- *Banwell, C. N. (1966). Fundamentals of Molecular Spectroscop. New York, McGraw-Hill.*
- *Tembe, B. L., Kamaluddin& Krishnan, (2008). M. S. Engineering Chemistry (NPTEL Web-book).*

SEMESTER-II

Course Title: APPLIED MATHEMATICS –II

Course Code: BCB202

L	T	P	Credits
3	1	0	4

Total Hours: 60

Learning Outcomes: On successful completion of this course, students will be able to:

1. Demonstrate the methods of forming and solving Ordinary differential equations and solve linear differential equations with constant and variable coefficients
2. Explain the concept of differential equation and classifies the differential equations with respect to their order and linearity.
3. Solve first-order ordinary and exact differential equations and converts separable and homogeneous equations to exact differential equations by integrating factors.
4. Apply the method of undetermined coefficients to solve the non-homogeneous linear differential equations with constant coefficients.

Course Content

UNIT I **14 Hours**

First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders: Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

UNIT II **15 Hours**

Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

UNIT III **15 Hours**

Complex Variable – Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

UNIT IV **16 Hours**

Transform Calculus: Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions.

Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of Integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method, Fourier transforms.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Thomes, G.B.and Finney, R.L. (2010) Calculus and Analytic Geometry; Ninth Edition; Pearson Education*
- *Kreyszig, E. (1998) Advanced Engineering Mathematics; Eighth Edition, John Wiley and sons.*
- *Grewal, B.S. (1965) Higher Engineering Mathematics; Khanna Publishers, New Delhi.*
- *Babu Ram (2009) Advance Engineering Mathematics; First Edition; Pearson Education.*
- *Richard Courant and Fritz John (2012) Introduction to Calculus and Analysis, Volume II, V Springer Publica*

SEMESTER-II

Course Title: ADVANCED BIOLOGY

L	T	P	Credits
3	1	0	4

Course Code: BCB203

Learning Outcomes: On successful completion of this course, students would be able to:

1. List the defining characteristics of biological life.
2. Discuss the history of the study of life and the diversity of life on Earth.
3. Identify the main branches of biology.
4. Describe biology as a science and identify the key components of scientific inquiry.

COURSE CONTENT

UNIT-1 **15 Hours**

Carbohydrates – Mono, Oligo, Polysaccharides. Proteins – Primary, Secondary (Including types of secondary structures such as helices, strands, loops etc.), Super Secondary Structures, Tertiary and Quaternary Structure. Lipids – Fatty Acids, Structural and Storage Lipids and their Biological Importance. Nucleic Acids – Basic Structure of DNA & RNA. Overview of metabolic pathways such as glycolysis, citric acid cycle, oxidative phosphorylation, pentose phosphate pathway and gluconeogenesis and their regulation.

UNIT – II **15 Hours**

Enzyme nomenclature and classification, substrate specificity, active site, factors affecting enzyme activity: proximity and orientation, covalent catalysis, and acid-base catalysis. Kinetics of single substrate enzyme reaction: Michaelis-Menten equation, effect of temperature and pH on enzyme activity, types of enzyme inhibition (reversible and irreversible). Enzyme regulation: Allosteric and covalent modifications of enzymes. Practical demonstration of enzyme reaction.

UNIT–III **15 Hours**

Immunology: Innate and adaptive immunity, cells and organs of immune system, structure and functions of immunoglobulins, Genetics of antibody diversity, antigens characteristics, antigen- antibody interactions, MHC I & II polymorphism, MHC-Peptide interactions, antigen processing and presentation.

UNIT–IV **15 Hours**

T-cell and B-cell maturation, activation, and differentiation. humoral and cell mediated immunity, Principles of diagnostic kits, precipitation and agglutination techniques, ELISA, immune electrophoresis and immunofluorescence. Practical demonstration of lymphocytes isolation and ELISA.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Khalid Rehman Hakeem, Noor Ahmad Shaik, Babajan Banaganapalli, Ramu Elango*
- *Fundamentals of Systems Biology*

SEMESTER-II

Course Title: PROGRAMMING FOR PROBLEM SOLVING

Course Code: BCB204

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: On successful completion of this course, students will be able to:

1. Design the algorithms to write programs.
2. Apply arrays, pointers and structures to formulate algorithms and programs
3. Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration
4. To implement conditional branching, iteration and recursion.

Course Content

UNIT I **15 Hours**

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/Pseudo code 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-

UNIT II **15 Hours**

Arithmetic expressions and precedence: Conditional Branching and Loops Writing and evaluation of conditionals and consequent branching

Iteration and loops

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

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 requirement.

UNIT III **8 Hours**

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

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.

UNIT IV **7 Hours**

Structure: Structures, Defining structures and Array of Structures

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

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

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Byron Gottfried, Schaum's (1995), Outline of Programming with C, McGraw-Hill.*
- *E. Balaguruswamy (2005) Programming in ANSI C, Tata McGraw-Hill.*

SEMESTER-II

Course Title: COMMUNICATION SKILLS

Course Code: BCB205

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: On successful completion of this course, students will be able to:

1. Develop vocabulary and improve the accuracy in Grammar.
2. Apply the concepts of accurate English while writing and become equally ease at using good vocabulary and language skills.
3. Develop and Expand writing skills through Controlled and guided activities.
4. Compose articles and compositions in English.

Course Content

UNIT I **16 Hours**

Vocabulary Building: The concept of Word Formation, 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.

UNIT II **14 Hours**

Basic Writing Skills: Sentence Structures, use of phrases and clauses in sentences, Importance of proper punctuation, creating coherence, organizing principles of paragraphs in documents, Techniques for writing precisely.

UNIT III **8 Hours**

Identifying Common Errors in Writing: Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Cliché

UNIT IV **7 Hours**

Nature and Style of sensible Writing: Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion

Writing Practices: Comprehension, Précis Writing, Essay Writing.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Swan, Michael. (1995). Practical English. OUP.*
- *Wood, F.T. (2007). Remedial English Grammar. Macmillan.*
- *Zinsser, W. (2001). On Writing Well. Harper Resource Book.*
- *Lyons, L. H. &Heasly, B. (2006). Study Writing. Cambridge University Press.*

- *Kumar, S &Lata, P. (2011). Communication Skills. Oxford University Press.*
- *CIEFL, Hyderabad. Exercises in Spoken English. Parts. I-III. Oxford University Press.*

SEMESTER-II

Course Title: MANUFACTURING PRACTICES

Course Code: BCB206

L	T	P	Credits
1	0	4	3

Total Hours: 45

Learning Outcomes: On successful completion of this course, students will be able to:

1. Apply the various manufacturing methods in different fields of engineering.
2. Learn about the different fabrication techniques
3. Learn about the practices in manufacturing of simple components using different materials.
4. Understand the advanced and latest manufacturing techniques being used in engineering industry

Course Content

UNIT I **8 Hours**

Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods.

UNIT II **6 Hours**

CNC machining, Additive manufacturing, Fitting operations & power tools

UNIT III **6 Hours**

Electrical & Electronics Carpentry, Plastic moulding, glass cutting

UNIT IV **10 Hours**

Metal casting, welding (arc welding & gas welding), brazing [More hours can be given to Welding for Civil Engineering students as they may have to deal with Steel structures fabrication and erection; 3D Printing is an evolving manufacturing technology and merits some lectures and hands-on training.]

Workshop Practice:

1. Machine shop - 10 hours
2. Fitting shop - 8 hours
3. Carpentry - 6 hours
4. Electrical & Electronics - 8 hours
5. Welding shop - 8 hours (Arc welding 4 hrs. + gas welding 4 hrs.)

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- Raghuwanshi, B.S. (2009*). A Course in Workshop Technology, Vol 1 &II*. Dhanpat Rai & Sons.
- Jain, R.K. (2010*). Production Technology. Khanna* Publishers.
- Singh, S. (2003). *Manufacturing Practice*. S.K. Kataria & Sons.

Course Title: ENGINEERING CHEMISTRY LAB

Course Code: BCB207

L	T	P	Credits
0	0	2	1

SEMESTER-II

Total Hours: 15

Learning Outcomes: On successful completion of this course, students will be able to:

1. Estimate rate constants of reactions from concentration of reactants/products as a function of time.
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
3. Apply the theoretical concepts for result analysis and interpret data obtained from experimentation.
4. Identify the compound using a combination of qualitative test and analytical methods.

Course Content

List of Experiments

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Synthesis of a polymer/drug
10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces
14. Chemical oscillations- Iodine clock reaction
15. Determination of the partition coefficient of a substance between two immiscible liquids.
16. Adsorption of acetic acid by charcoal
17. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

SEMESTER-II

Course Title: PROGRAMMING FOR PROBLEM SOLVING LAB

L	T	P	Credits

Course Code: BCB208

0	**0**	**2**	**1**

Total Hours: 15

Learning Outcomes: On successful completion of this course, students will be able to:

1. Create read and write to and from simple text files.
2. Identify and correct logical errors encountered at run time
3. Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.
4. Represent data in arrays, strings and structures and manipulate them through a program

Course Content

1. Problem solving using computers
2. Familiarization with programming Environment
3. Variable types and type conversions
4. Simple computational problems using arithmetic expressions
5. Branching and logical expressions
6. Problems involving if-then-else structures
7. Loops, while and for loops
8. Iterative problems e.g., sum of series
9. 1D Arrays: searching, sorting
10. 1DArray manipulation
11. 2D arrays and Strings, memory structure
12. Matrix problems, String operations
13. Functions, call by value
14. Simple functions
15. Numerical methods (Root finding, numerical differentiation, numerical integration)
16. Numerical methods problems
17. Recursion, structure of recursive calls
18. Recursive functions
19. Pointers, structures and dynamic memory allocation
20. Pointers and structures
21. File handling
22. File operations

Suggested Readings

- *Byron Gottfried, Schaum's (1995), Outline of Programming with C, McGraw-Hill*
- *E. Balaguruswamy (2005) Programming in ANSI C, Tata McGraw-Hill.*

SEMESTER-II

Course Title: COMMUNICATION SKILLS LAB

Course Code: BCB209

L	T	P	Credits
0	0	2	1

Total Hours: 15

Learning Outcomes: On successful completion of this course, students will be able to:

1. Illustrate the importance of pronunciation and apply the same day to day conversation.
2. Apply verbal and non-verbal communication techniques in the Professional Environment.
3. Develop coherence, cohesion and competence in Oral discourse.
4. Handle the interview process confidently.

Course Content

Oral Communication

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

SEMESTER-II

Course Title: ENTREPRENEURSHIP DEVELOPMENT

Course Code: BCB210

L	T	P	Credits
1	0	0	1

Total Hours: 15

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Assess the commercial viability of new technologies, business opportunities and existing companies
2. Plan, organize, and execute a project or new venture with the goal of bringing new products and service to the market
3. Carry out scientific research in the field of entrepreneurship
4. Improved your interpersonal and collaborative skills

Course Content

UNIT I **10 Hours**

Introduction to Generic Skills: Importance of Generic Skill Development (GSD), Global and Local Scenario of GSD, Life Long Learning (LLL) and associated importance of GSD.

Managing Self: Knowing Self for Self-Development- Self-concept, personality, traits, multiple intelligence such as language intelligence, numerical intelligence, psychological intelligence etc., Managing Self – Physical- Personal grooming, Health, Hygiene, Time Management, Managing Self – Intellectual development -Information Search: Sources of information, Reading: Purpose of reading, different styles of reading, techniques of systematic reading, Note Taking: Importance of note taking, techniques of note taking, Writing: Writing a rough draft, review and final draft. Managing Self – Psychological, Stress, Emotions, Anxiety-concepts and significance, Techniques to manage the above.

UNIT II **5 Hours**

Managing in Team: Team - definition, hierarchy, team dynamics, Team related skills-sympathy, empathy, co-operation, concern, lead and negotiate, work well with people from culturally diverse background, Communication in group - conversation and listening skills.

UNIT III **5 Hours**

Task Management: Task Initiation, Task Planning, Task execution, Task close out, Exercises/case studies on task planning towards development of skills for task management

Problem Solving: Prerequisites of problem solving- meaningful learning, ability to apply knowledge in problem solving, Different approaches for problem solving. Steps followed in problem solving. Exercises/case studies on problem solving.

UNIT IV **10 Hours**

Entrepreneurship: Introduction, Concept/Meaning and its need, Competencies/qualities of an entrepreneur, Entrepreneurial Support System e.g., District Industry Centres (DICs), Commercial Banks, State Financial Corporations, Small Industries Service Institute (SISIs), Small Industries Development Bank of India (SIDBI), National Bank of Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC) and other relevant institutions/organizations at State/National level. Market Survey and Opportunity Identification (Business Planning)- How to start a small-scale industry, Procedures for registration of small-scale industry, List of items reserved for exclusive manufacture in small-scale industry, Assessment of demand and supply in potential areas of growth, understanding business opportunity, Considerations in product selection, Data collection for setting up small ventures. **Project Report Preparation-** Preliminary Project Report, Techno-Economic Feasibility Report, Exercises regarding "Project Report Writing" for small projects.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Khanka, S. S. (2006). Entrepreneurial development. S. Chand Publishing.*
- *Desai, V. (2009). Dynamics of entrepreneurial development and management (pp. 119-134). Himalaya Publishing House.*
- *Kennedy, A. (2015). Business development for dummies. John Wiley & Sons*

SEMESTER-II

Course Title: NUMERICAL APTITUDE AND REASONING ABILITY

Course Code: BCB211

L	T	P	Credits
1	0	0	1

Total Hours: 15

Learning Outcomes: On successful completion of this course, students will be able to:

On successful completion of this course, students would be able to:

1. Understand the basic concepts of quantitative ability and logical reasoning Skills
2. Learn the basic concepts of Acquire satisfactory competency in use of reasoning
3. Solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning
4. Create the ability to appear in exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc.

Course Content

UNIT I **4 Hours**

Numerical problem: Percentages *(like profit & loss %, marks, shares etc.,)*, Time & Work, Speed & Distance problems, Fraction, Ratios, Average & Volume, Factoring *(LCM, HCF)*, Mensuration formulas, Simple interest & Compound interest.

UNIT II **4 Hours**

Logical Reasoning: Statements & Assumption, Syllogism, Puzzles, Constraint-Based Reasoning, Proposition Testing, Course of Action, Assertion and Reason, Input Output Relations, Conclusion Estimation from Passages, Cause and Effect Reasoning, Theme Detection etc.

UNIT III **4 Hours**

Verbal Reasoning: Analogy, Series Completion, Blood Relations, Venn Diagrams, Sequential Output Tracing, Ranking & Time Sequence Test, Alphabet Test, Logical Sequence of Words, Inserting the Missing Character, Data Sufficiency, Arithmetical Reasoning Questions, Coding-Decoding, Puzzle Test, Eligibility Test, Situation Reaction Test, Assertion & Reason, etc.

UNIT IV **3 Hours**

Non-Verbal Reasoning: Mirror Images, Reverse Images, Spotting Embedded Figures, Figure Matrix, Paper Folding, Cubes & Dice, Construction of Squares & Triangles, Grouping of Identical Figures, Paper Cutting, Rule Detection, Dot Situation, Figure Formation & Analysis, Series, Classification, Analogy etc.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Aggarwal, R. S. (2012). Quantitative Aptitude for Competitive Examinations. S. Chand & Company Pvt Limited (Unit II, III).*
- *Experts, D. (2021). (Free Sample) NTA UGC NET Paper 1 Topic-wise 52 Solved Papers (2020 to 2004). Disha Publications*.

SEMESTER: II

Course Title: STRESS MANAGEMENT

L	T	P	Credits
1	0	0	1

Course Code: BCB212

Total Hours: 15

Learning Outcomes: On successful completion of this course, students would be able to:

1. Identify the nature and causes of stress in organizations
2. Knowledge of stress prevention mechanism
3. Demonstrate the strategies that help cope with stress
4. Apply stress management principles in order to achieve high levels of performance and adopt effective strategies, plans and techniques to deal with stress

Course Content

UNIT I **3 Hours**

Understanding Stress, Stress – concept, features, types of stress, Relation between Stressors and Stress, Potential Sources of Stress – Environmental, Organizational and Individual, Consequences of Stress – Physiological, Psychological and Behavioral Symptoms, Stress at work place – Meaning, Reasons

Impact of Stress on Performance, Work Stress Model, Burnout – Concept, Stress v/s Burnout

UNIT II **4 Hours**

Managing Stress – I, Pre-requisites of Stress-free Life, Anxiety - Meaning, Mechanisms to cope up with anxiety, Relaxation - Concept and Techniques Meditation-Concept, types, benefits, elements and ways to building skills

Benefits of meditation, Time Management - Meaning, Importance of Time Management, Approaches to Time Management, Stress Management - Concept, Benefits, Managing Stress at Individual level, Role of Organization in Managing Stress/ Stress Management Techniques

2.10 Approaches to Manage Stress - Action oriented, Emotion oriented, Acceptance oriented.

UNIT III **4Hours**

Models of Stress Management – Transactional Model, Health Realization/ Innate Health Model, General Adaption Syndrome (GAS) - Concept, Stages, Measurement of

Stress Reaction - The Physiological Response, The Cognitive Response, The Behavioral Response, Stress prevention mechanism - Stress management through mind control and purification theory and practice of yoga education, Stress management interventions: primary, secondary, tertiary.
Meditation – Meaning, Importance

UNIT IV **4 Hours**

Stress Management Leading to Success, Eustress – Concept, Factors affecting Eustress, Stress Management Therapy - Concept, Benefits, Stress Counseling – Concept, Value education for stress management, Stress and New Technology, Stress Audit Process, Assessment of Stress - Tools and Methods, Future of Stress Management.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Heena T. Bhagtani. (2018). Stress Management. Himalaya Publishing House.*
- *Dutta, P. K, (2010). Stress Management. Himalaya Publishing House.*
- *Roy,S (2012). Managing Stress. Sterling Publication.*

SEMESTER-III

Course Title: OBJECT ORIENTED PROGRAMMING USING C++

Course Code: BCB301

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Describe the procedural and object-oriented paradigm with concepts of streams, classes, functions, data and objects.
2. Illustrate dynamic memory management techniques using pointers, constructors, destructors, etc.
3. Construct the concept of function overloading, operator overloading, virtual functions and polymorphism
4. Classify inheritance with the understanding of early and late binding, usage of exception handling and generic programming.

Course Content

UNIT I **10 Hours**

Object-Oriented Programming Concepts: Introduction, comparison between procedural programming paradigm and object-oriented programming paradigm, basic concepts of object-oriented programming — concepts of an object and a class, interface and implementation of a class, operations on objects, relationship among objects, abstraction, encapsulation, data hiding, inheritance, overloading, polymorphism, messaging.

UNIT II **15 Hours**

Standard Input/output: Concept of streams, hierarchy of console stream classes, input/output using overloaded operators >> and << and member functions of i/o stream classes, formatting output, formatting using ions class functions and flags, formatting using manipulators.

Classes and Objects: Specifying a class, creating class objects, accessing class members, access specifies, and static members, use of const keyword, friends of a class, empty classes, nested classes, local classes, abstract classes, container classes, bit fields and classes.

UNIT III **11 Hours**

Pointers and Dynamic Memory Management: Declaring and initializing pointers, accessing data through pointers, pointer arithmetic, memory allocation (static and dynamic), dynamic memory management using new and delete operators, pointer to an object, this pointer, pointer related problems - dangling/wild pointers, null pointer assignment, memory leak and allocation failures. Constructors/Destructors and Operator Overloading and Type Conversion: Need for constructors and destructors, copy constructor, dynamic constructors, explicit constructors, destructors, constructors and destructors with static members, initialize lists. Overloading operators, rules for overloading operators, overloading of various operators, type conversion - basic type to class type, class type to basic type, class type to another class type

UNIT IV **9Hours**

Inheritance and Virtual functions & Polymorphism: Introduction, defining derived classes, forms of inheritance, ambiguity in multiple and multipath inheritance, virtual base class, object slicing, overriding member functions, object composition and delegation, order of execution of constructors and destructors. Concept of binding - early binding and late binding, virtual functions, pure virtual functions, abstract classes, virtual destructors

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Lafore R. (1992). Object Oriented Programming in C++. WaiteGroup.*
- *BjarneStroustrup. (1985). The C++ Programming Language. AddisonWesley.*
- *Herbert Schildt. (1994). The Complete Reference to C++ Language. McGrawHill-Osborne.*
- *Lippman F. B. (1997). C++ Primer. AddisonWesle*

SEMESTER-III

Course Title: DATA STRUCTURE & ALGORITHMS

L	T	P	Credits
3	0	0	3

Course Code: BCB302

Total Hours: 45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Describe how arrays, records, linked structures, stacks, queues, trees and graphs are represented in memory and used by algorithms
2. Write programs that use arrays, records, linked structures, stacks, queues and trees.
3. Develop knowledge of applications of data structures including the ability to implement algorithms for the creation, insertion, deletion, searching and sorting of each data structure.
4. Describe the concept of recursion, give examples of its use, describe how it can be implemented using a stack

Course Content

UNIT I **8 Hours**

Introduction: Basic Terminologies, Elementary Data Organizations, Data Structure Operations insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.

UNIT II **12 Hours**

Stacks and ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queues: Simple Queue, Circular Queue, Priority Queue; Operations on each Types of Queues: Algorithms and their analysis.

Linked Lists: Singly linked lists, Representation in memory, Algorithms of several operations, Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, doubly linked list, operations on it and algorithmic analysis; Circular Linked Lists, all operations their algorithms and the complexity analysis.

UNIT III **10 Hours**

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree, definitions, algorithms and analysis.

UNIT IV **15 Hours**

Sorting and Hashing: Objective and properties of different sorting algorithms, Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Mark Allen Weiss. (1995). Algorithms, Data Structures, and Problem Solving with C++ Algorithms. Addison-Wesley.*
- *R. G Dromey(2006). How to Solve it by Computer. Pearson Education.*

SEMESTER-III

Course Title: BASIC BIOINFORMATIC.

Course code: BCB303

L	T	P	Credits
4	0	0	4

Total Hours: 60

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Examine the fundamentals concepts and techniques used in digital electronics
2. Examine the structure of various number systems and its application in digital design.
3. Analyze and design various combinational and sequential circuits.
4. Categorize a digital logic and apply it to solve real life problems.

Course Content

UNIT I **15 Hours**

Introduction to bioinformatics and data generation What is bioinformatics and its relation with molecular biology. Examples of related tools(FASTA, BLAST, BLAT, RASMOL), databases(GENBANK, Pubmed, PDB) and software(RASMOL,Ligand Explorer). Data generation; Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray). Applications of Bioinformatics.

UNIT II **15 Hours**

Biological Database and its Types Introduction to data types and Source. Population and sample, Classification and Presentation of Data. Quality of data, private and public data sources. General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum)

UNIT III **15 Hours**

Flat files, relational, object oriented databases and controlled vocabularies. File Format (Genbank, DDBJ, FASTA, PDB, SwissProt). Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search. The challenges of data exchange and integration. Ontologies, interchange languages and standardization efforts. General Introduction to XML, UMLS, CORBA, PYTHON and OMG/LIFESCIENCE.

UNIT IV **15 Hours**

Sequence Alignments and Visualization Introduction to Sequences, alignments and Dynamic Programming; Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm). Methods for presenting large quantities of biological data: sequence viewers (Artemis, SeqVISTA), 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol), Anatomical visualization.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *R. P. Jain. (2009). Modern Digital Electronics. McGraw Hill Education.*
- *M. M. Mano. (2016). Digital logic and Computer design. Pearson Education India.*
- *A. Kumar. (2016). Fundamentals of Digital Circuits. Prentice HallIndia.*

SEMESTER-III

Course Title: ENGINEERING MATHEMATICS

Course Code: BCB304

L	T	P	Credits
3	0	0	3

Total Hours-45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any numerical algorithms.
2. Learn how to obtain numerical solution of nonlinear equations using bisection, secant, newton, and fixed-point iteration methods.
3. Solve system of linear equations numerically using direct and iterative methods and definite integrals and initial value problems numerically
4. Understand how to approximate the functions using interpolating polynomials.

Course Content

UNIT I **10 Hours**

Floating-Point Numbers: Floating-point representation, rounding, chopping, error analysis, conditioning and stability.

Non-Linear Equations: Bisection, secant, fixed-point iteration, Newton method for simple and multiple roots, their convergence analysis and order of convergence.

UNIT II **10 Hours**

Linear Systems and Eigen-Values: Gauss elimination method using pivoting strategies, LU decomposition, Gauss-Seidel and successive-over-relaxation (SOR) iteration methods and their convergence, ill and well-conditioned systems, Rayleigh's power method for eigen-values and eigen-vectors.

UNIT III **10 Hours**

Interpolation and Approximations: Finite differences, Newton's forward and backward interpolation, Lagrange and Newton's divided difference interpolation formulas with error analysis, least square approximations.

UNIT–IV **15 Hours**

Numerical Integration: Newton-Cotes quadrature formulae (Trapezoidal and Simpson's rules) and their error analysis, Gauss-Legendre quadrature formulae.

Differential Equations: Solution of initial value problems using Picard, Taylor series, Euler's and Runge-Kutta methods (up to fourth-order), system of first-order differential equations.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Gerald, C. F. (2004). Applied numerical analysis. Pearson Education India.*
- *Jain, M. K. (2003). Numerical methods for scientific and engineering computation. New Age International.*
- *Mathews, J. H. (1992). Numerical methods for mathematics, science and engineering (Vol. 10). Prentice-Hall International.*
- *Burden, R. L., Faires, J. D., & Burden, A. M. (2015). Numerical analysis. Cengage learning.*

SEMESTER-III

Course Title: DIGITAL ELECTRONICS

Course code: BCB305

L	T	P	Credits
2	0	0	2

Total Hours: 30

Learning Outcomes: On successful completion of this course, the students will be able to:

5. Examine the fundamentals concepts and techniques used in digital electronics
6. Examine the structure of various number systems and its application in digital design.
7. Analyze and design various combinational and sequential circuits.
8. Categorize a digital logic and apply it to solve real life problems.

Course Content

UNIT I **10 Hours**

Fundamentals of Digital Systems and logic families: Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples officiate, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lcs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

UNIT II **10 Hours**

Standard representation for logic functions: K-map representation and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De- Multiplexer/Decoders, Adders, Sub-tractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

UNIT III **5 Hours**

Sequential circuits and systems :A 1-bit memory, the circuit properties of Bus table latch, the clocked SR flip flop, J- K-T and D- Types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops,

special counter IC's, asynchronous sequential counters, application counters, A/D and D/Converters

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A

converter, Specifications for D/A converters, examples of D/A converter lcs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converters

UNIT IV **5 Hours**

Semiconductor memories and Programmable logic devices: Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *R. P. Jain. (2009). Modern Digital Electronics. McGraw Hill Education.*
- *M. M. Mano. (2016). Digital logic and Computer design. Pearson Education India.*
- *A. Kumar. (2016). Fundamentals of Digital Circuits. Prentice HallIndia.*

SEMESTER-III

Course Title: OBJECT ORIENTED PROGRAMMING USING C++ LAB

Course Code: BCB306

L	T	P	Credits
0	0	4	2

Total Hours-30

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Develop solutions for a range of problems using objects and classes.
2. implement the concept of constructors, destructors and operator overloading
3. Apply algorithmic problems including type casting,
4. Inheritance and polymorphism.

Course Content

1. Program to show the of use cin, cout practical
2. Program to implement the operators
3. Program based on decision making statement (if else)
4. Program based on the loops(while,do while)
5. Program based on loops(for),switch statement
6. Program based on structures and enumerated data types
7. Program based functions, overloaded functions
8. Program to show usage of storage classes.
9. Program to show usage of function overloading, default arguments
10. Program to show usage of classes, objects
11. Program to show usage of constructors, destructors
12. Program to manipulate arrays and array of objects
13. Program to manipulate strings.
14. Program to show usage of inheritance of various type (multiple, multilevel etc.)
15. Program to show usage of unary operator overloading
16. Program to show usage of binary operator overloading
17. Program for conversion from basic to user defined data type
18. Program for conversion from user defined to basic
19. Program to show usage of basics of pointers
20. Program to show usage of pointers and arrays.
21. Program to show usage of pointers, function arguments
22. Program to show usage of new, delete, memory management

23. Program to show usage of virtual function
24. Program to show usage of friend, static function
25. Program to show usage of overloaded assignment operator, this pointer
26. Program to read & write contents of a text file
27. Program to show usage of file pointers.
28. Program to show usage of command line arguments
29. Program to show usage of overloading of right & left shift operators.
30. Program to show usage of exception handling mechanism
31. Program to show usage of uncaught exception(), the exception and bad exception classes
32. Program to show usage of templates
33. Program to show usage of generic classes
34. Implementation of File handling
35. Implementation of Wrapper classes
36. Implementation of container classes

SEMESTER-III

Course Title: DATA STRUCTURE & ALGORITHM LAB

Course Code: BCB307

L	T	P	Credits
0	0	4	2

Total Hours-30

Learning Outcomes: On successful completion of this course, the students will be able to**:**

1. Develop C program for Linear data structure operations and its applications
2. Design and implement basic operations such as insertion, deletion, search on stacks, queues, linked list, Circular Queue etc.
3. Implement Breadth First Search Techniques and Depth First Search Techniques
4. Implement the binary search tree.

Course Content

1. Write a program to insert an element into an array.
2. Write a program to delete an element from an array.
3. Write a program to implement linear search algorithm.
4. Write a program to implement binary search algorithm.
5. Write a program to implement bubble sort algorithm.
6. Write a program to implement selection sort algorithm.
7. Write a program to implement PUSH operation in stacks.
8. Write a program to implement POP operation in stacks.
9. Write a program to implement Queues.
10. Write a program to insert an element in the beginning of the link list.
11. Write a program to insert an element in the middle of the link list.
12. Write a program to insert an element in the end of the link list.
13. Write a program to delete an element from the beginning of the link list.
14. Write a program to delete an element from the end of the link list.
15. Write a program for implementation of a graph.
16. Write a program for implementation of binary search tree

SEMESTER-III

Course Title: HUMAN VALUES AND ETHICS

L	T	P	Credits
2	0	0	2

Course Code: BCB308

Total Hours-30

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Develop the ability to distinguish between Value and ethics.
2. Develop the ability to face difficult situations in life boldly and resolve them confidently.
3. Implement the code of ethics in professional life.
4. Create Ethical reason and achieve harmony in life
5. Develop moral responsibility and mould themselves as good professionals

Course Content

UNIT I **5Hours**

Human Values: Morals, Values and Ethics - Integrity - Work Ethic - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - caring - Sharing - Honesty - Courage - Valuing Time - Co-operation - Commitment - Empathy - Self-Confidence - Character – Spirituality.

UNIT II **10Hours**

Engineering Ethics: Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry- moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy - Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.

UNIT III **10Hours**

Engineering as Social Experimentation: Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.

UNIT IV **5Hours**

Safety, Responsibilities and Rights: Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three-mile island and chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

1. ***"Ethics in Engineering",*** *Mike Martin and Roland Schinzinger, McGraw-Hill, New York, 1996.*
2. ***"Engineering Ethics",*** *Govinda rajan M, Natarajan S, Senthil Kumar V. S, Prentice Hall of India, New Delhi, 2004.*

SEMESTER-IV

Course Title: CELL BIOLOGY

Course Code: BCB401

L	T	P	Credits
3	1	0	4

Total Hours-60

Learning Outcomes: On completion of this course, the successful students will be able to:

1. Characterize the features of prokaryotic and eukaryotic cells, their composition, spatial and molecular organization of cellular organelles
2. Summarize the types of transport mechanisms and throw light on process of cell division
3. Describe the mechanisms of signal transduction
4. Relate the principles of Mendelian genetics and non-Mendelian variations

Course Content

UNIT I **15 Hours**

Cell Types, their Structure and Function: Cell - Unit of life, Cell morphology, Difference between bacterial, Plant and Animal cells, Structure and function of membranes, Membrane organization and composition, Structure and functions of cell organelles - Nucleus, Mitochondria, Ribosome, Golgi bodies, Lysosomes, Endoplasmic reticulum, Peroxisomes, Chloroplast and vacuoles.

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UNIT II **15 Hours**

Cytoskeleton and Cell Division: Cytoskeletal elements and architecture - Intermediate filaments, Microtubules, and Microfilaments, Microtrabecular system (lattice) of cytoplasm, Shaping of the cells and mechanical support - Cell to cell integration, Extracellular matrix, Cell locomotion (amoeboid, flagella, ciliary movement), Types of cell division, Mitosis and Meiosis, Cell cycle and Molecules that control cell cycle.

UNIT III **15 Hours**

Cellular Transport Systems: Transport types - Passive and Active transport, Permeases, Na+/K+, Ca2+ - ATPase pumps, ATP dependent proton pumps Cotransport, Symport, Antiport, Role of lysosomal and vacuolar membrane in cellular transport, Transport into prokaryotic cells, Endocytosis and Exocytosis, Entry of viruses and toxins into the cells.

UNIT IV **15 Hours**

Types - Autocrine, Paracrine, and Endocrine signaling molecules, Secondary signaling molecules - G-protein coupled signal transduction pathways involving cAMP, cGMP, IP3, DAG and Ca2+ as second messengers. Basic principles of heredity, Mendel's expewriments, Genetic terminology, Mendel's law of genetics, Monohybrid cross, Dihybrid cross; Deviations of Mendel's ratios – Genetic, interactions, Epistasis, Pleiotropy, Penetrance and Expressivity, Multiple alleles.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *A Molecular Approach, by Geoffrey M Cooper, 8th Edition. 2019, Oxford*
- Genetics, by Monroe W. Strickberger, 3rd Edition, 2015, Pearson Education, Delhi, India.

SEMESTER-IV

Course Title: OPERATING SYSTEM

Course Code: BCB402

L	T	P	Credits
3	0	0	3

Total Hours-45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Design the algorithms to write programs.
2. Apply arrays, pointers and structures to formulate algorithms and programs
3. Apply programming to solve simple numerical method problems, namely rot finding
4. Function, differentiation of function and simple integration

Course Content

UNIT I **10 Hours**

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**.**

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,

UNIT II **15 Hours**

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, 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.

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.

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, and Deadlock Avoidance: Banker's algorithm, Deadlock Recovery

UNIT III **10 Hours**

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).

UNIT IV **10 Hours**

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.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Charles Crowley. (1996). Operating System; A Design-oriented Approach. 1st Edition, Irwin Publishing.*
- *Gary J.Nutt, Addison. (2002). Operating Systems: A Modern Perspective. 2nd Edition Wesley.*
- *Maurice Bach, Prentice-Hall of India (1986). Design of the Unix Operation Systems. 8th Edition.*
- *Daniel P. Bovet, Marco Cesati, O'Reilly and Associates. (2005). Understanding the Linux Kernel. 3rd Edition*

SEMESTER-IV

Course Title: DESIGN & ANALYSIS OF ALGORITHMS

Course Code: BCB403

L	T	P	Credits
3	1	0	4

Total Hours: 60

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Describe the greedy paradigm and develop the greedy algorithms.
2. Implement and examine the divide-and-conquer paradigm.
3. Develop the dynamic programming algorithms and evaluate their computational complexity.
4. Implement the graphs to find shortest path.

Course Content

UNIT I **15 Hours**

Introduction: Algorithm and its importance, Mathematical foundations- Growth functions, Complexity analysis of algorithms.

Divide and Conquer: Basic technique and its application on Binary Search, Finding Maximum and Minimum and on sorting techniques such as Merge Sort, Quick Sort.

UNIT II **15 Hours**

Greedy Algorithms: General method, using greedy algorithm to solve Knapsack problem, Minimum-Cost spanning trees problem, Single source shortest path problem and Travelling salesperson problem.

Dynamic Programming: Introduction to dynamic programming and application of the algorithm to solve multistage graphs, all pair's shortest path problem and Knapsack problem.

UNIT III **14 Hours**

Backtracking: General backtracking algorithm, Application of backtracking to 8 Queens' problem, Sum of subsets, Graph coloring, Hamiltonian cycles and Knapsack problem.

String Matching Algorithms: Introduction, Brute Force algorithm, Rabin-Karp algorithm, KMP algorithm, and Boyer-Moore algorithm.

UNIT IV **16 Hours**

NP-completeness and Approximation Algorithms: Introduction to P, NP, NP-hard and Complete problems, Examples of NP-complete problems, Introduction to approximation algorithms, Absolute approximations, E-approximations

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms" Galgotia Publications.*
- *Thomas H. Cormen, Charles E. Leiserson, Ronald Rivest, and Clifford Stein, "Introduction to Algorithms", MIT Press.*
- *Sanjoy Dasgupta, Christos Papadimitriou, and Umesh Vazirani, "Algorithms", McGraw-Hill Education.*
- *Michael T. Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis, and Internet Examples", Wiley.*
- *Alfred V. Aho, John E. Hopcroft, and Jeffrey. D. Ullman, "The Design and Analysis of Computer Algorithms", Pearson Education. 6. John Kleinberg and Eva Tardos, "Algorithm Design", Pearson Education*

SEMESTER-IV

Course Title: Computer Organization & Architecture

Course Code: BCB404

L	T	P	Credits
3	0	0	3

Total Hours-45

Learning Outcomes: On successful completion of this course, the students will be able to

1. Summarize the basic concept of computer fundamentals, Number system, Boolean algebra, Karnaugh map and Perform problems
2. Explain the concept of stored program, role of operating system, Instruction sets and Addressing modes and Demonstrate problems on Addressing modes.
3. Develop control unit and explain the concept of various I/O operations
4. Explain the concept of Instruction pipeline, RISC, CISC

Course Content

UNIT I **15 Hours**

Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU – registers, instruction execution cycle, RTL0interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common cpus.

Data representation: signed number representation, fixed and floating-point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. Multiplication – shift-and add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic.

UNIT II **10 Hour**

Introduction to x86 architecture: CPU control unit design: hardwired and micro-program design approaches, Case study – design of a simple hypothetical CPU.

Memory system design: semiconductor memory technologies, memory organization.

Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers-program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes–role of interrupts in process state transitions, I/O device interfaces – SCII, US

UNIT III **10 Hours**

Pipelining: Basic concepts of pipelining, through put and speedup, pipeline hazards.

Parallel Processors: Introduction to parallel-processors, Concurrent access to Memory and cache coherency.

UNIT IV **10 Hours**

Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. Block size, mapping functions, replacement algorithms, write policies.

Transaction Modes Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *John P. Hayes. (1988). Computer Architecture and Organization. 3rd Edition, WCB/McGraw- Hill.*
- *William Stallings. (2016). Computer Organization and Architecture. Designing for Performance. 10th Edition, Pearson Education.*
- *Vincent P. Heuring and Harry F. Jordan. (2004). Computer System Design and Architecture, 2nd Edition by Pearson Education.*

SEMESTER-IV

Course Title: OPERATING SYSTEM LAB

L	T	P	Credits
0	0	4	2

Course Code: BCB405

Total Hours-30

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Install Linux operating system.
2. Develop and debug the various Linux commands.
3. Perform various shell commands.
4. Develop shell programming & its concepts.

Course Content

Installation Process of various operating systems

1. **Commands for files & directories:** cd, ls, cp, md, rm, mkdir, rmdir. Creating and viewing files using cat. File comparisons. Disk related commands: checking disk free spaces. Processes in Linux, connecting processes with pipes, background processing, managing multiple processes. Manual help. Background process: changing process priority, scheduling of processes at command, batch commands, kill, ps, who, sleep. Printing commands, grep, fgrep, find, sort, Cal, banner, touch, file. File related commands ws, sat, cut, grep.
2. **Administrative commands:** ACCEPT DATE, LIBVOLUME, EXPORT commands, IMPORT commands, LOCK commands, MOVE commands, QUERY commands, REGISTER commands, ACTIVATE POLICYSET (Activate a new policy set), ASSIGN DEFMGMTCLASS)AUDIT commands, LDAPDIRECTORY, BACKUP commands , BEGIN EVENTLOGGING (Begin logging events), CANCEL commands, CHECKIN LIBVOLUME (Check a storage volume into a library), CHECKOUT LIBVOLUME (Check a storage volume out of a library), CLEAN DRIVE (Clean a drive), COMMIT (Control committing of commands in a macro), COPY commands, DEFINE commands, DELETE commands, DISABLE commands, DISMOUNT command, DISPLAY OBJNAME (Display a full object name), ENABLE commands, EXPORT commands, IMPORT commands, LOCK commands, MOVE commands, QUERY commands, REGISTER commands, PERFORM LIBACTION, PING SERVER, QUERY ,QUIT, RECLAIM STGPOOL, RECONCILE VOLUMES, REGISTER, REMOVE commands, RENAME commands, REPLICATE NODE, REPLY, RESET PASSEXP, PASSEXP, RESET , RESTART EXPORT, RESTORE commands, MACRO, MIGRATE STGPOOL,

REVOKE commands, ROLLBACK, RUN, SET commands, SELECT, SETOPT, SHRED DATA (Shred data), SETOPT, SUSPEND EXPORT UNLOCK commands, UPDATE commands, VALIDATE commands, VARY, AUDIT commands, BACKUP commands, CANCEL commands, COPY commands.

3. **Shell Programming:** Basic of shell programming, various types of shell, Shell Programming in bash, conditional & looping statement, case Statement, parameter passing and arguments, shell variables, shell keywords, creating shell programs for automate system tasks, report printing.

SEMESTER-IV

Course Title: DESIGN & ANALYSIS OF ALGORITHMS LAB

Course Code: BCB406

L	T	P	Credits
0	0	4	2

Total Hours-30

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Examine randomized algorithms.
2. Analyze the performance of algorithms.
3. Describe and implement the dynamic-programming paradigm.
4. Describe and implement the greedy paradigm.

Course Content

1. Write a program to implement bubble sort algorithm by comparing its complexity.
2. Write a program to implement linear search algorithm by comparing it complexity.
3. Write a program to implement binary search algorithm by comparing its complexity.
4. Write a program to implement PUSH operation in stacks.
5. Write a program to implement POP operation in stacks.
6. Write a program to implement Queues.
7. Write a program to insert an element in the beginning of the link list.
8. Write a program to delete an element from the middle of the link list.
9. Write a program to implement the concept of queen's problem.

SEMESTER-IV

Course Title: ENVIRONMENTAL SCIENCES

Course Code: BCB407

L	T	P	Credits
2	0	0	NC

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Examine all aspects of environmental issues and apply understanding from disciplines such as history, economics, psychology, law, literature, politics, sociology, philosophy, and religion to create informed opinions about how to interact with the environment on both a personal and a social level.
2. Recognize the physical, chemical, and biological components of the earth's systems and show how they function.
3. Learn lessons from various field experiences and case studies
4. Implement the independent research on human interactions with the environment.

Course Content

UNIT I **8 Hours**

Introduction: Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness.

Natural Resources: Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources.

Ecosystems: Concept of Ecosystem, Structure, interrelationship, producers, consumers and decomposers, ecological pyramids-biodiversity and importance. Hot spots of biodiversity.

UNIT II **7 Hours**

Environmental Pollution: Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards. Solid waste Management: Causes, effects and control measure of urban and industrial wastes. Role of an individual in prevention of pollution, Pollution case studies.

Disaster Management: Floods, earthquake, cyclone and landslides.

UNIT III **10 Hours**

Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of pollution) Act. Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation public awareness.

UNIT IV **5 Hours**

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Program. Environment and human health, Human Rights, Value Education, HIV/AIDS. Women and child Welfare. Role of Information Technology in Environment and human health. Case studies.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Agarwal, K.C. (2001). Environmental Biology. Nidi Publ. Ltd. Bikaner.*
- *Jadhav, H &Bhosale. (1995). V.M. Environment Protection and Laws. Himalaya Pub House, Delhi.*
- *Rao M. N. &Datta A.K. (2017). Waste Water Treatment. Oxford & IBH Publ. Co. Pvt.Ltd*

SEMESTER-IV

Course Title: BIOSTATICS

Course Code: BCB408

L	T	P	Credits
4	0	0	4

Total Hours-60

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Define the principal concepts about biostatistics.
2. Identify data relating to variable/variables.
3. Interpret data via normal distribution.
4. Recognize the definition of statistics, its subject and its relation with the other sciences.

COURSE CONTENTS:

UNIT I **15Hours**

Random variables (discrete and continuous), Distribution function and its properties, Relation of distribution function with uniform variate. Review of univariate discrete and continuous distributions with special reference to biostatistics; Bernoulli, Binomial, Poisson, Hyper-geometric, Geometric, Negative binomial, Discrete uniform, Power series, Continuous uniform, Normal, Exponential, Gamma, Beta, Cauchy, Weibull, Pareto, Laplace and Lognormal (elementary properties and applications only), Truncated distributions, Compound distributions.

UNIT II **15 Hours**

Functions of random variables, their distributions in case of univariate random variables and its applications. Exponential family of distributions. Location and scale families, non-regular families. Symmetric distributions, properties of symmetric distributions, non-regular families, location and scale families and examples. Order statistics-their distributions and properties. Joint and marginal distributions of order statistics.

UNIT III **15Hours**

Expectation and moments, probability generating function, moment generating function, convolution and examples. Moment inequalities: Markov, Chebychev, Holder, Minkowski and Jensen inequalities with their applications. Basic inequality of Liapunov's.

UNIT IV **15 Hours**

Bivariate discrete and continuous distributions, marginal and conditional distributions. Distribution function of bivariate random variable using Jacobian of transformation. Multinomial distribution, Bivariate Poisson, Bivariate exponential (Marshall and Olkin), Bivariate Normal distributions and their properties.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Rohtagi V.K. and. Saleh A. K. M. E (2015): An Introduction to Probability Theory and Mathematical Statistics, 3rd Edition, Wiley.*
- *Ross S. M. (2014): Introduction to Probability Models, 11th Edition, Academic Press.*

SEMESTER-V

Course Title: MOLECULAR BIOLOGY

L	T	P	Credits
4	0	0	4

Course Code: BCB501

Total Hours-60

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Formulate the basic concepts of molecular biology.
2. Describe the design principles of molecular biology.
3. Examine the fundamental molecular processes involved in central dogma.
4. Identify the problems in nucleic acids and protein metabolism.

Course Content

UNIT I **15 Hours**

Genome Organization: Structure of DNA - Nucleotides, Nucleosides, Sugar, Bases, Bonds involved in double stranded DNA; Chargaff's rule; Genome organization in prokaryotes and eukaryotes; Chromosome structure – Different types of histones and chromosome packing; Central dogma of life; DNA and RNA as genetic material; Differences between DNA and RNA.

UNIT II **15 Hours**

DNA Replication: Classical experiments to understand mechanism of DNA replication; Proteins involved in replication, Replication in prokaryotes; End replication problem; Different models of DNA replication; Differences between prokaryotic and eukaryotic replication; Inhibitors of DNA replication

UNIT III **15 Hours**

DNA Damage and Repair Mechanisms: Endogenous - Replication errors, DNA base mismatches and topoisomerase-DNA complexes, Spontaneous base deamination, Abasic sites, Oxidative DNA damage, DNA methylation; Exogenous- Environmental, Physical and Chemical agents; Ionizing radiation, Ultraviolet radiation, Alkylating agents, Aromatic amines, Toxins; DNA repair pathways - Base excision repair, Nucleotide excision repair, Mismatch repair, Homologous recombination and Non-homologous end joining.

UNIT IV **15Hours**

Transcription: Events occurring in promoter region, Mechanism of RNA synthesis - Initiation, Elongation, Termination and Transcription cycle; Differences between prokaryotic and eukaryotic transcription; Post-transcriptional modifications of mRNA, tRNA and rRNA; RNA splicing,

Alternative splicing; Inhibitors of transcription.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Molecular Biology, by David Freifelder, 2nd Edition, Reprint 2020, Narosa Publishers,New Delhi, India.*
- *Lininger Principles of Biochemistry, by David L Nelson and Michael M Cox, 8th Edition, 2021, W H Freeman publisher, USA.*

SEMESTER-V

Course Title: ADVANCED JAVA PROGRAMMING FOR BIOTECHNOLOGY

Course Code: BCB502

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Discuss the basic concepts of java like if-else, control structures, array and strings.
2. Outline the structure and model of the Java programming language.
3. Synthesize Java programming language for various programming technologies
4. Develop software in the Java programming language on different platforms.

Course Content

UNIT I **15 Hours**

An overview of Java: Object oriented programming, Two paradigms, abstraction, the OOP principles, Java class libraries

Date types, variables and arrays: Integers, floating-point types, characters, Boolean, Iterates, Variable, Data types and casting, array operators.

Operators: Arithmetic operators, bit wise operators, relational operators, Boolean logical operators, assignment operators, operator precedence

Control Statement: Java's selection Statement, iteration Statement, jumps Statement.

Introduction to classes: Class fundamentals, declaring object reference variable, introducing methods, constructors, the keywords, garbage collection, the finalize () method.

Methods and Classes: Overloading methods, using objects as parameters, recursion.

UNIT II **10Hours**

Inheritance: Inheritance basics, using super, method overriding, dynamic method dispatch, using abstract Classes, using final with inheritance, Package and Interfaces, Package protection, importing packages

Exception handling: Exception handling fundamentals, Exception types, Uncaught Exceptions, using try and catch, multiple catch clauses, nested try Statement throw, and finally Java built in exception creating your own exception, sub classes, using exceptions

UNIT III **10 Hours**

Multithreaded Programming: The Java thread model, the main thread, creating thread, creating multiple thread, using is alive () and join (). Thread priorities, synchronization, inter thread communications, suspending resuming and stopping thread using multithreading.

String handling: The string constructor, string length, special string operator character extraction, string comparison, searching string, modifying string, data conversion, changing the case of characters, string buffer.

UNIT IV **10Hours**

Networking: Networking basics, Java and the Internet Address, TCP/IP client Sockets URL, URL connection, TCP/IP server Sockets, the Applet Class.

The Applet Class: Architecture displays method, The HTML APPLET, Passing parameters to Applet. The get Documentation Base () and get Code Base () methods Applet Context and Show Document ().

Micro servicing: Standards and Syntax, Advantages of Micro services, Java Micro Services Framework, Spring Cloud and Spring Boot, Different strategies used in Micro service deployment, Domain-Driven Design containers in Microservices, Contract Testing, Monolithic, SOA, and Micro Services Architecture, Docker, DC, Bounded Context

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *McGraw-Hill. (1999). Java 2 Computer Reference. Tata McGraw Hill.*
- *Horstmann. (2018). Core Java-I. Addison Wesley.*
- *E Balagurusami. (2006). Programming with JAVA. Tata McGraw-Hill Education.*

SEMESTER-V

Course Title: RELATIONAL DATABASE MANAGEMENT SYSTEM

Course Code: BCB503

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Formulate query, using SQL, solutions to a broad range of query and data update problems.
2. Describe various database concepts and database management system software.
3. Have high-level understanding of major DBMS components and their function.
4. Design a model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model.

Course Content

UNIT I **15 Hours**

Database Management: Introduction, Types of DBMS and their advantages and disadvantages, Characteristics of Database Approach, Data Models, Data Abstraction and Knowledge Representation, Database Language.

DBMS Architecture and Data Independence: Attributes and Keys, Relationships, Relationship Types, Roles, ER Diagrams, Relational Model concepts, functional dependence.

UNIT II **10 Hours**

SQL, PL SQL, SQL *PLUS, Managing Database and Queries: Creating, Defining and Modifying Table structure, Update Operations and Dealing with Constraint Violations, Basic Relational Algebra Operations, Example of Queries in Relational Algebra, The Tuple Relational Calculus, The Domain Relational Calculus, granting and revoking privileges.

UNIT III **10 Hours**

Normalization: Overview of Recovery and Backup, Normalization & its forms.

Transaction: Processing Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp-based schedulers, multi-version and optimistic Concurrency Control schemes. Database recovery.

UNIT IV **10 Hours**

Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, Integrity in Data Base. Types of Integrity, SQL injection.

SQL Server: Introduction to SQL Server and Oracle Server, Indexes, Views, Cursors, Packages, Triggers, Stored Procedures.

No SQL: Introduction to NoSQL, **Key Features, Advantages and Disadvantages of NoSQL, Types of NoSQL database.**

Non-relational data and NoSQL: Document data stores, columnar data stores, Key/value data stores, Graph data stores, Object data stores, External index data stores, typical requirements.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *J. D. Ullman,Computer Science Press. (2016). Principles of Database and Knowledge–Base Systems. Vol1*
- *R. Elmasri and S. Navathe,Pearson Education.(1905). Fundamentals of Database System.5th Edition*
- *Serge Abiteboul, Richard Hull, Victor Vianu,Addison-Wesley. (1995). Foundations of Databases Reprint.*

SEMESTER-V

Course Title: WEB DESIGNING & DEVELOPMENT

Course Code: BCB504

L	T	P	Credits
3	0	0	3

Total Hours-60

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Design web pages by JavaScript in HTML.
2. Get fundamental skills to maintain web server services required to host a website.
3. Restate scripting languages and web services to transfer data and add interactive components to web pages.
4. Manipulate web media objects using editing software

Course Content

UNIT I **15 Hours**

Introduction to HTML: HTML Common tags- List, Tables, images, forms, Frames; Cascading Style sheets; Introduction to JavaScript: Scripts, Objects in Java Script, Dynamic HTML with Java Script XML: Document type definition, XML Schemas, Document Object model, Presenting XML, Using XML Processors: DOM and SAX

UNIT II **15 Hours**

Java Beans: Introduction to Java Beans, Advantages of Java Beans, BDK Introspection, Using Bound properties, Bean Info Interface, Constrained properties Persistence, Customizes, Java Beans API, Introduction to EJB's Web Servers and Servlets: Tomcat web server, Introduction to Servlets: Lifecycle of a Servlet, JSDK, The Servlet API, Thejavax.servlet Package, Reading Servlet parameters, and Reading Initialization parameters. The javax. servlet HTTP package, Handling Http Request & Responses, Using Cookies-Session Tracking, Security Issues

UNIT III **15 Hours**

JavaScript & Document Object Model: Introduction to JavaScript, Variables and Objects, Decision Making Statement, Loops, Arrays, Functions & Prototypes, Core JavaScript Objects, DOM Introduction, Event Model, Function

Flutter: Introduction , Container class in Flutter, Flutter – Tabs, Flutter Horizontal List, Flutter – Expansion Tile Card, Icon Classes, Expand Class, Dialogs, Circular & Linear Progress Indicators, Staggered Grid View

Hybrid Course Design: Models of hybrid Courses, Benefits and challenges, Challenges of hybrid

Responsive Web designing: HTML Responsive Web Design, Responsive Images, Responsive Text Size, Responsive Web Design

UNIT IV **15 Hours**

Frameworks Angular JS : Intro, Expressions, Modules, Directives, Model, Data Binding, Controllers, Scopes , Filters, Services, Http, Tables, Select, SQL , AngularJS DOM, Events , Validation, API, W3.CSS, Includes, Animations, Routing, Application.

Database Access: Database Programming using JDBC, Studying Javax. sql. * Package, accessing a Database from a JSP Page, Application – Specific Database Actions, Deploying JAVA Beans in a JSP Page, Introduction to struts framework. One android application development.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *WILEY Dreamtech. (2010). Web Programming, building internet applications. Chris Bates 2nd edition.*
- *Hans Bergsten. (2000). Java Server Pages. SPDO' Reilly.*
- *Dietel and Nieto. (2001). Internet and World Wide Web. PHI/Pearson Education Asia.*
- *Joglekar. (2009). Web Warrier guide to web design technologies. Cengage Learning, New Delhi.*

SEMESTER-V

Course Title: RELATIONAL DATABASE MANAGEMENT SYSTEM LAB

Course Code: BCB505

L	T	P	Credits
0	0	2	1

Total Hours: 15

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Explain the features of database management systems and Relational database.
2. Design conceptual models of a database using ER modeling or real-life Applications and also construct queries In Relational Algebra.
3. Create and populate a RDBMS for a real-life application, with constraints and keys, using SQL.
4. Retrieve any type of information from a data base by formulating complex queries in SQL.

Course Content

List of Experiments:

1. Introduction to SQL and installation of SQL Server / Oracle.
2. Data Types, Creating Tables and Retrieval of Rows using Select Statement, Conditional Retrieval of Rows, Alter and Drop Statement.
3. Working with Null Values, matching a Pattern from a Table, Ordering the Result of a Query, Aggregate Functions, Grouping the Result of a Query, Update and Delete Statement.
4. Set Operators, Nested Queries, Joins, Sequences.
5. Views, Indexes, Database Security and Privileges: Grant and Revoke Commands, Commit and Rollback Commands.
6. PL/SQL Architecture, Assignments and Expressions, Writing PL/SQL Code, Referencing, Non-SQL parameters.
7. Stored Procedures and Exception Handling.
8. Triggers and Cursor Management in PL/SQL.
9. Suggested Tools – My SQL, DB2, Oracle, SQL Server 2012

SEMESTER-V

Course Title: WEB DESIGNING& DEVELOPMENT LAB

Course Code: BCB506

L	T	P	Credits
0	0	2	1

Total Hours-15

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Develop a dynamic webpage by the use of java script.
2. Connect a java program to a DBMS.
3. Design a well-formed and valid and XML and DHTML document.
4. Examine a server-side java application called Servlet to update and delete operations on DBMS table.

Course Content

1. Create a basic web page to show use of head, title, and body tag.
2. Create a web page to show use heading and text formatting tags.
3. Create a web page to show use img, ul, ol and anchors.
4. Create a web page to show use tables and div tags.
5. Create a web page using class, id and inline styles.
6. Create a web page to create a form.
7. Create a web page to show an alert using java script.
8. Show the use of get Element by Id in java script.
9. Create a web page using variables, loop and Conditions in java script.
10. Create a web page using Switch in java script.
11. Create a web page to show use of j query.
12. Create a web page to implement get & post in Ajax.
13. Create a web page to print your name using PHP.
14. Create a web page to show use of all data types in PHP
15. Create a web page to show use loops &Conditional Statement.
16. Create a web page to show use arrays in PHP.

SEMESTER-V

Course Title: ADVANCED JAVA PROGRAMMING FOR BIOTECHNOLOGY LAB

Course Code: BCB507

L	T	P	Credits
0	0	2	1

Total Hours: 15

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Solve the computational problems using basic statements like if-else, control structures, array, and strings.
2. Learn about the user requirements for software functionality and Run software applications in Java programming language.
3. Know about basic principles of creating Java applications with Applet programming.
4. Develop a given program using the basic elements like Control and Conditional statements

Course Content

List of Programs:

1. Introduction to JAVA, its features & basic program
2. Write a program for Operators in JAVA
3. Write a program to show use of IF-Else Statements in JAVA
4. Write a program use switch case in JAVA
5. Write a program to use looping in JAVA
6. Write a program to use methods in JAVA
7. Write a program to create class and objects
8. Write a program to use Method Overloading a method overriding
9. Write a program to use Final Keyword.
10. Write a program to show Implementation of Array.
11. Write a program to show Implementation of Inheritance
12. Write a program to show creation and use of package
13. Write a program to show use of Interface
14. Write a program to apply replace, concate methods on String.
15. Write a program to sort strings of array
16. Write a program to Show Implementation of Threads
17. Write a program to create applet
18. Write a program to create applet with passing parameters

19. Write a program to show use of Exception Handling
20. Write a program to make usage of JAVA lang.awt package and design GUI. Usage of event handling in Java GUI (Graphical user interface) programs.

SEMESTER-V

Course Title: MOLECULAR BIOLOGY LAB

Course Code: BCB508

L	T	P	Credits
0	0	6	3

Total Hours: 45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Demonstrate the process of isolating bio macromolecules.
2. Evaluate the quality and quantity of bio macromolecules.
3. Develop analytical skills.
4. Analyze bio macromolecules.

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Course Contents

1. Micropipette usage and calibration
2. Preparation of buffers and reagents for molecular biology
3. Spectrophotometric analysis of DNA, RNA and Protein
4. Quality check and quantitation of DNA by spectrophotometry
5. Bacterial Genomic DNA isolation
6. Separation of DNA by agarose gel electrophoresis
7. Plant Genomic DNA isolation
8. Human Genomic DNA isolation
9. Total cellular RNA isolation by Trizol method.
10. Isolation of protein from different sources
11. Separation of proteins by SDS-PAGE

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *A Classroom Laboratory Manual, by Sue Carson, Heather Miller, Melissa Srougi, Scott Witherow D, 4th Edition, 2019, Elsevier,London, UK*

SEMESTER-VI

Course Title: FORMAL LANGUAGE & AUTOMATA THEORY

L	T	P	Credits
3	1	0	4

Course Code: BCB601

Total Hours: 60

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Write a formal notation for strings, languages and machines.
2. Design finite automata to accept a set of strings of a language.
3. Design context free grammars to generate strings of context free language.
4. Determine equivalence of languages accepted by Push Down Automata and languages

Course Content

UNIT I **15 Hours**

Theory of Computation: Deterministic Finite Automata, Acceptance by Finite Automata, Transition systems, Non-Deterministic Finite Automata, Equivalence of DFA and NDFA, Moore and Mealy machines, Equivalence of Moore and Mealy machine, Minimization of Finite Automata, Applications and limitations of Finite Automata.

Formal Languages: Basics of strings, alphabets, grammar, formal language, Chomsky classification of languages, languages and their relation, operations on languages, Closure properties of language classes.

UNIT II **12 Hours**

Regular grammar: Regular grammars, Regular expressions, Algebraic method using Arden's theorem, Equivalence of Finite Automata and Regular expressions, Properties of regular languages, pumping lemma.

UNIT III **18 Hours**

Context Free Language: Derivation, ambiguity, simplification of context free grammar, normal forms- Chomsky Normal Form, Greibach Normal Form, pumping lemma. Context Sensitive Language, The model of Linear Bounded Automata, Relation between Linear Bounded Automata and Context Sensitive Language

UNIT IV **15 Hours**

Push down Automata: Description and Definition, acceptance by Push down Automata, Equivalence of Push down Automata and context free grammars and languages.

Turing Machine: Definition and Model, Representation of Turing Machine, Design of Turing Machine, Variants of Turing Machine, Decidability and Recursively Enumerable Languages, Halting Problem, Post Correspondence Problem.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Harry R. Lewis and Christos H. Papadimitriou. (1998). Elements of the Theory of Computation.*
- *Pearson Education Asia.*
- *Dexter C. Kozen. (1997). Automata and Computability. Undergraduate Texts in Computer*
- *Science, Springer.*
- *Michael Sipser. (1997). Introduction to the Theory of Computation.PWS Publishing.*
- *John Martin. (2007). Introduction to Languages and The Theory of Computation. Tata McGrawHill.*

SEMESTER-VI

Course Title: COMPUTER NETWORKS

Course Code: BCB602

L	T	P	Credits
3	0	0	3

Total Hours-45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Understand the fundamentals of computer networking.
2. Learn the basic taxonomy and terminology of the computer networking area.
3. Get acquainted with various congestion control algorithms.
4. Describe the functions of the different layer of the OSI Protocol.

Course Content

UNIT I **15 Hours**

Data Communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN.

Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

UNIT II **10 Hours**

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CDCDMA/CA

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

UNIT III **10 Hours**

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

UNIT IV **10 Hours**

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, and Basic concepts of Cryptography.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Andrew S. Tanenbaum, Pearson New International Edition. (2013). Computer Networks. 8th Edition.*
- *Prentice Hall of India. (2015). Internetworking with TCP/IP Volume 1. 6th Edition Douglas Comer.*
- *W. Richard Stevens, Addison-Wesley, United States of America. (2005). TCP/I Illustrated. Volume1.*

SEMESTER-VI

Course Title: MACHINE LEARNING

L	T	P	Credits
3	0	0	3

Course Code: BCB603

Total Hours: 45

Learning Outcomes: On successful completion of this course, students will be able to:

1. Be exposed to technology and business trends impacting mobile applications
2. Be competent with the characterization and architecture of mobile applications.
3. Be competent with understanding enterprise scale requirements of mobile applications.
4. Be competent with designing and developing mobile applications using one application development framework.

Course Content

UNIT I **15 Hours**

Supervised Learning (Regression/Classification) Basic methods: Distance-based methods, Nearest-

Neighbors', 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

UNIT II **10 Hours**

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)

UNIT III **10 Hours**

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, and Random Forests).

Python libraries for machine learning

UNIT IV **10 Hours**

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature

Representation Learning.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012*
- *Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)*
- *Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.*

SEMESTER-VI

Course Title: COMPUTER NETWORK LAB

Course Code: BCB604

L	T	P	Credits
0	0	2	1

Total Hours: 15

Learning Outcomes: On successful completion of this course, students will be able to:

1. Know about the various networking devices, tools and also understand the
   Implementation of network topologies;
2. Create various networking cables and know how to test these cables;
3. Create and configure networks in packet tracer tool using various network devices and
   topologies;
4. Understand IP addressing and configure networks using the subnet in;

Course Content

1.To study the different types of Network cables and network topologies.
2.Practically implement and test the cross-wired cable and straight through cable using clamping tool and network lab cable tester.
3.Study and familiarization with various network devices.
4.Familiarization with Packet Tracer Simulation tool/any other related tool.
5.Study and Implementation of IP Addressing Schemes
6.Creation of Simple Networking topologies using hubs and switches
7.Simulation of web traffic in Packet Tracer
8.Study and implementation of various router configuration commands
9.Creation of Networks using routers.
10.Configuring networks using the concept of subnetting
11.Practical implementation of basic network command and Network configuration
commands like ping, ipconfig, netstat, tracert etc. for troubleshooting network related problems.
12.Configuration of networks using static and default routes.

SEMESTER-VII

Course Title: PROJECT -I

L	T	P	Credits
0	0	6	3

Course Code: BCB605

Total Hours: 45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Use latest multimedia devices and programming software.
2. Design and construct a hardware and software system, component or process to meet desired needs.
3. Do work on multidisciplinary Problems.
4. Work as professionals, with portfolio ranging from data management, network configuration, designing hardware, database and software design to management and administration of entire systems.

Course Content

1. Project should include following phases: System Analysis and Design
2. Coding - Implementation Testing
3. It should be a working project Must have a future perspective
4. The Domain of project can be from: Databases
5. Application software
6. System software
7. Multimedia
8. Web Applications, etc.

A complete project report must be submitted along with softcopy of project. Project report may include Requirements of Project, Flow Chart, DFD's, Coding and Test Results

SEMESTER-VI

Course Title: Molecular Modelling and Drug Design

Course Code: BCB606

L	T	P	Credits
3	0	0	3

Total Hours-45

Learning Outcome: On successful completion of this course, students will be able to:

1. Derive the various force fields and quantum mechanical equations.
2. Explore the concept of geometry optimization and molecular dynamics.
3. Interpret the physicochemical properties and the techniques involved in QSAR.
4. Validate the diversity of drug targets

Course Content

UNIT1 **10 Hours**

Quantum Mechanics: Experimental basis of quantum physics, Computing of physical principles, Bohr's model, Schrodinger wave equation, Born-Oppenheimer approximation, Quantum mechanical methods, Molecular orbital theory, Single point energy calculation, Bio-organic reaction mechanism, Applications of quantum mechanics.

UNIT II **10 Hours**

Molecular Mechanics: Overview of Molecular mechanics, Principles of stereoisomerism, Concept of hydrophobic and hydrophilic interactions, Energy contribution and distance of non-covalent interactions, Allosteric mechanism, Force fields and types.

UNIT III **15 Hours**

Molecular Simulation: Geometry optimization, Steepest descent and conjugate gradient method, Molecular dynamics, Integration of equation of motion - Verlet algorithm, Monte-carlo simulation and applications, Geometric similarity of structures.

UNIT IV **10 Hours**

Drug Discovery: Drug design process, Drug targets, Properties of drugs, Overview of clinical trials, Pharmacogenomics. Virtual screening, Pharmacophore mapping Analogbased drug design, Types of descriptors, QSAR modelling, ADMET prediction, Peptidomimetics.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *In Silico Drug Discovery and Design: Theory, Methods, Challenges, and Applications, by Claudio N. Cavasotto, 1st Edition, 2015, CRC Press Florida, USA,*
- *Concepts and Experimental Protocols of Modelling and Informatics in Drug Design, by Om Silakari, 1st Edition, 2020, Academic Press Inc, USA.*

SEMESTER-VI

Course Title: Data Analytics in Bioinformatics

L	T	P	Credits
3	0	0	3

Course Code: BCB607

Total Hours-45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Develop an appreciation for what is involved in Learning models from data
2. Understand how to evaluate models generated from data
3. Access public-domain biological datasets.
4. Analyze genomics using decision trees, and random forests

Course Content

UNIT– I **10 Hours**

Machine Learning: Supervised learning - Learning process and its methodologies, Classification and its types, Regression, Unsupervised learning - Clustering in unsupervised learning, Clustering in Bioinformatics - Genetic data

.

UNIT– II **10 Hours**

Feature Selection and Genomic Technology: Dimensionality reduction techniques - Principles, Benefits and Limitations of dimension reduction methods, Components of dimension reduction, Methods of dimensionality reduction

UNIT– III **15 Hours**

Approaches for Gene selection - Multi-level omics data intergration, Machine learning approaches for multi-level data integration, Random forest algorithm in imbalance genomics classification - Proposed model

.

UNIT– IV **10 Hours**

Microarray data, Grey Wolf Optimization (GWO) Algorithm, Studies on GWO variants,

Application of GWO in medical domain, Application of GWO in Microarray data, Future work. Various image segmentation techniques, Deal with image dataset, Class imbalance problem, Optimization of hyper parameter, Case study, Using AI to detect Coronavirus

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems, by Aurélien Géron, 2019, O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472.*

SEMESTER-VI

Course Title: BIOCHEMISTRY

Course Code: BCB608

L	T	P	Credits
3	0	0	3

Total Hours-45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Interpret cell behavior based on physical and chemical composition.
2. Relate water interaction with macromolecules in biological system.
3. Analyze structure and function of carbohydrates and proteins.
4. Infer metabolic reactions and its role in the cell.

Course Content

UNIT I **10 Hours**

Foundations of Biochemistry:

Properties of living system- review on cellular, chemical, physical, genetic and evolutionary backgrounds to biochemistry.

UNIT II **15 Hours**

Water and Buffers: Structure of water, Solvent and ionization property of water and water as a reactant, pH and buffers and their importance

UNIT III **10 Hours**

Carbohydrates: Classification, Structure and function, Glycoconjugates: Proteoglycans, Glycoproteins and glycolipids.

UNIT IV **10 Hours**

Metabolism of Carbohydrates: Glycolysis, TCA cycle, Oxidative phosphorylation, Gluconeogenesis and pentose phosphate pathway and their regulation. Classification, Structure and biological importance of amino acids, Acid base properties and stereochemistry of amino acids, Amino acid synthesis precursors and routes of non- essentialamino acids.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Biochemistry, by U. Satyanarayan and U. Chakrapani, 6th Edition, 2021, Elsevier, India.*
- *Biochemistry, by Jeremy M. Berg, Lubert Stryer, John Tymoczko and Gregory Gatto, 9th Edition, 2019, Macmillan International Higher Education, New York, USA.*

SEMESTER-VI

Course Title: DATA WARE HOUSING & DATA MINING

Course Code: BCB609

L	T	P	Credits
3	0	0	3

Total Hours-45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Design and deploy appropriate classification techniques
2. Cluster the high dimensional data for better organization of the data
3. Discover the knowledge imbibed in the high dimensional system
4. Evolve Multidimensional Intelligent model from typical system

Course Content

UNIT1 **10 Hours**

Need for strategic information, difference between operational and Informational data stores Data warehouse definition, characteristics, Data warehouse role and structure, OLAP Operations, Data mart, Different between data mart and data warehouse, Approaches to build a data warehouse, Building a data warehouse, Metadata & its types.

UNIT II **10 Hours**

Data Pre-processing: Need, Data Summarization, Methods. De-normalization, Multidimensional data model, Schemas for multidimensional data (Star schema, Snowflake Schema, Fact Constellation Schema, Difference between different schemas. Data warehouse architecture, OLAP servers, Indexing OLAP Data, OLAP query processing, Data cube computation.

UNIT III **10 Hours**

Data Mining: Definition, Data Mining process, Data mining methodology, Data mining tasks, Mining various Data types & issues. Attribute-Oriented

Induction, Association rule mining, Frequent itemset mining, The Apriori Algorithm, Mining multilevel association rules.

UNIT IV **15 Hours**

Overview of classification, Classification process, Decision tree, Decision Tree Induction, Attribute Selection Measures. Overview of classifier's accuracy, evaluating classifier's accuracy, Techniques for accuracy estimation, increasing the accuracy of classifier. Introduction to Clustering, Types of clusters, Clustering methods, Data visualization & various data visualization tools.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Data Warehousing, Data Mining &Olap by Berson, Tata Mcgraw- Hill.*
- *Han J., Kamber M. and Pei J., Data mining concepts and techniques, Morgan Kaufmann Publishers (2011) 3rd ed.*
- *Pudi V., Krishana P.R., Data Mining, Oxford University press, (2009) 1st ed.*
- *Adriaans P., Zantinge D., Data mining, Pearson education press (1996), 1st ed.*
- *Pooniah P., Data Warehousing Fundamentals, Willey interscience Publication, (2001)*

SEMESTER-VI

Course Title: CLOUD COMPUTING

Course Code: BCB610

L	T	P	Credits
3	0	0	3

Total Hours-45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Design Vision, Reference Model, Benefits, Limitations, Open Challenges, Grid and Utility Computing.
2. Demonstrate Service Models, Deployment Models, Cloud Entities, Cloud Clients, and Cloud Programming Models.
3. Describe Cloud Security: Infrastructure Security, Data Security, Identity and Access Management, Privacy Management, Security as a Service on Cloud
4. Resource Provisioning, Bill Management, Multitenancy and Isolation, Service Level Agreement (SLA) and Quality of Service (QoS)

Course Content

UNIT I **10 Hours**

Cloud Computing: Overview, Applications, Intranet and the Cloud, First Movers on the cloud, the need for Cloud Computing, Benefits of cloud Computing, Limitations of the

Cloud Computing, security concerns and regulatory issues, over view of different cloud computing applications which are implemented, Business case for implementing a Cloud.

UNIT II **15 Hours**

Cloud computing and Service Models: Public, Private, and Hybrid Clouds, Cloud Ecosystem and Enabling Technologies

Service models: Infrastructure-as- a- Service (IaaS), Platform-as-a- service (Paas) and Software-as-a-Service (SaaS)

Architectural Design of Compute and Storage Clouds: A Generic Cloud Architecture Design, Layered Cloud Architectural development, Architectural Design Challenges. Cloud Standards: Applications, Client, Infrastructure, Services.

UNIT III **10 Hours**

Cloud Computing Mechanisms: Software as a service: Overview, Driving Forces, Company offerings, Industries, Software services, Overview Mobile Device Integration, Providers, Microsoft Online Application development, Google, Microsoft, Intuit Quick base, Cast Iron Cloud, Bungee Connect, Development Platforms: Google, Sales Force, Azure, Trouble shooting, Application management

UNIT IV **10 Hours**

Local Clouds: Virtualization, server solutions, Thin Clients

Migrating to the clouds: Cloud services for individuals, Mid-market, and Enterprise wide, Migration, best practices, analysing the service.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Mastering Cloud Computing, RajkumarBuyya, Christian Vecchiola, and ThamaraiSelvi, Tata McGraw Hill, ISBN-13: 978-1-25-902995-0, New Delhi, India,Feb 2013.*
- *Cloud Computing Bible, Barrie Sosinsky, Wiley India Pvt. Ltd, ISBN-13: 978-81-265-2980-3, New Delhi, India, 2011.*
- *Cloud Computing: Principles and paradigms, Raj Kumar Buyya, James Broberg, AndrezeiM.Goscinski, Wiley India Pvt. Ltd, ISBN-13: 978-81-265-4125-6, New Delhi, India, 2011.*
- *Dr. Saurabh Kumar, Cloud Computing: Insights into New-Era Infrastructure, Wiley India Pvt. Ltd, ISBN-13: 978-8-12-6528837, New Delhi, India, 2011.*

SEMESTER-VI

Course Title: MOBILE APPLICATION DEVELOPMENT

Course Code: BCB611

L	T	P	Credits
3	0	0	3

Total Hours-45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Design and develop user Interfaces for the Android platform.
2. Demonstrate knowledge of mobile ecosystem technologies
3. Interpret and critically evaluate existing mobile ecosystem solutions for real-world business problems.
4. Apply an understanding of security, privacy and ethical issues associated with mobile ecosystems.

Course Content

UNIT I **10 Hours**

Introduction: Mobile operating system, Operating system structure, Constraints and Restrictions, Hardware configuration with mobile operating system, Features: Multitasking Scheduling, Memory Allocation, File System Interface, Keypad Interface, I/O Interface, Protection and Security, Multimedia features.

UNIT II **10 Hours**

Introduction to Mobile development IDE's: Introduction to Work light basics, Optimization, pages and fragments, writing a basic program- in Work light Studio, Client technologies, Client-side debugging, creating adapters, invoking adapters from Work light Client application, Common Controls, Using Java in adapters, Programming exercise with Skins, Understanding Apache Cordova, Offline access, Encrypted cache deprecated, Using JSON Store

UNIT III **10 Hours**

Understanding Apple iOS development: Android development, Shell Development, Creating Java ME application, Exploring the Work light Server, Working with UI frameworks, Authentication, Push notification, SMS

Notifications, Globalization, Web View overlay, Creating Authentication application: development for Apple iOS by using a login module, Device Analytics, Work light Server Administration

UNIT IV **15 Hours**

Android: Introduction to Android, Architecture, memory management, communication protocols, application development methods, deployment. Case Study: Design and development of Application using mobile application development platforms e.g., Work Light, Kendo, Appcon, Xcode, Xpages Unit VI: iOS: Introduction to iOS, Architecture, memory management, communication protocols, application development methods, deployment. Case Study: Design and development of Application using mobile application development platforms e.g., Work Light, Kendo, Appcon, Xcode, Xpages

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *AnubhavPradhan, Anil V Deshpande. (2014). Mobile Apps Development. Edition: I*
- *Jeff McWherter, Scott Gowell. (2012). Professional Mobile Application Development.John Wiley & Sons.*
- *Barry Burd. (2015). Android Application Development All in one for Dummies. Edition: I*
- *SAMS. (2010). Teach Yourself Android Application Development In 24 Hour. Edition: I, Publication.*
- *Neal Goldstein, Tony Bove. (2011). iPhone Application Development All-In-One for Dummies. John Wiley & Sons.*
- *Henry Lee, Eugene Chuvyrov. (2012). Beginning Windows Phone App Development.Apress.*
- *ochenSchiller. (2004). Mobile Communications. Addison-Wesley, 2nd edition,*

SEMESTER-VII

Course Title: PYTHON USING R-PROGRAMMING FOR BIOLOGIST.

Course Code: BCB701

L	T	P	Credits
3	0	0	3

Total Hours-60

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Understand and use R – Data types and R – Data Structures.
2. Develop programming logic using R – Packages and analyze data sets using R – programming capabilities
3. Acquire programming skills in core Python and Implement Object Oriented concepts to develop live projects.
4. Design Graphical user Interfaces in Python and create database connectivity to create, search and sort the information.

Course Content

UNIT I **15 Hours**

R-Programming: R Basics Basic operations in R, Math operations in R, Vector, working with null values, Import & Export files in R, Data-frame, Joins, One-way and Two-way tables, Vectors, Matrices, R Basics

Installing R and RStudio. Getting started with RMarkdown. Getting started with R: installing libraries, variables and data types, logical and arithmetic operations, functions and methods, loops, the %> % operator.

Introduction: Python Installation and Working with Python, Understanding Python variables, Python basic Operators, Understanding python blocks.

Python Data Types Declaring and using Numeric data types: int, float, complex, using string data type and string operations, defining list and list slicing, Use of Tuple data type.

Python Program Flow Control Conditional: if, else and else if, simple for loops in python, for loop using ranges, string, list and dictionaries Use of while loops in python, Loop manipulation using pass, continue, break and else Programming using Python conditional and loops block.

UNIT II **15 Hours**

Python Functions: Modules and Packages Organizing python codes using functions, organizing python projects into modules, importing own module as

well as external modules, Understanding Packages, Powerful Lambda function in python Programming using functions, modules and external packages.

Python String: List and Dictionary Manipulations Building blocks of python programs, understanding string in build methods, List manipulation using in build methods, Dictionary manipulation, Programming using string, list and dictionary in build functions.

Libraries and APIs: Standard Libraries of Python, API Using Python, Python Web Framework, Computer Vision using Python

UNIT III **15 Hours**

Python File Operation: Reading config files in python, Writing log files in python, Understanding read functions, read (), readline() and readlines(),Understanding write functions, write() and writelines(),Manipulating file pointer using seek, Programming using file operations.

Python Object Oriented Programming: Oops Concept of class, object and instances Constructor, class attributes and destructors, Real time use of class in live projects, Inheritance, overlapping and overloading operators, Adding and retrieving dynamic attributes of classes, Programming using Oops support.

Python Regular Expression: Powerful pattern matching and searching Power of pattern searching using regex in python, Real time parsing of networking or system data using regex, Password, email, URL validation using regular expression, Pattern finding programs using regular expression

UNIT IV **15 Hours**

Python Exception Handling: Avoiding code break using exception handling, safe guarding file operation using exception handling, Handling and helping developer with error code, Programming using Exception handling

Python Database Interaction SQL: Database connection using python, creating and searching tables, Reading and storing configure information on database, Programming using database connections

Python Multithreading: Understanding threads, forking threads, synchronizing the threads.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- John V Guttag. (2013). *Introduction to Computation and Programming Using Python Revised and expanded Edition.* MITPress

- Robert Sedgewick, Kevin Wayne, Robert Dondero. (2016). *Introduction to Programming in Python: An Inter-disciplinary Approach.* Pearson India Education Services Pvt.Ltd.
- Timothy A. Budd. (2015). *Exploring Python.,* Mc-Graw Hill Education (India)PrivateLtd.
- Kenneth A. Lambert. (2012). *Fundamentals of Python First Programs.*", CENGAGE Learning.
- Charles Dvierbach. (2013). *Introduction to Computer Science using Python. A ComputationalProblem-Solving Focus*. Wiley IndiaEdition.
- Paul Gries, Jennifer Campbell and Jason Montojo. (2013). *Practical Programming: An Introduction to Computer Science using Python 3.* Second edition, Pragmatic Programs, LLC.

SEMESTER-VII

Course Title: Analytical Bioinformatics

Course Code: BCB702

L	T	P	Credits
4	0	0	4

Total Hours: 60

Learning Outcomes: On successful completion of this course, the students will be able to

1. Apply knowledge of bioinformatics in a practical project
2. Develop the ability for critical assessment of scientific research publications in bioinformatics
3. Build an understanding of the research process in general, such as research methods, scientificwriting, and research ethics
4. Evaluate the main databases at the NCBI and EBI resources

Course Contents

UNIT I **15 Hours**

Overview on Bioinformatics:

Scope and applications of bioinformatics, Alignment of pairs of sequences**;** Introduction, Definition of sequence alignment, Methods Dot matrix sequence comparison.

UNIT II **15Hours**

Pairwise Sequence Alignment and Database Similarity Search: Dynamic programming algorithm, Needleman-Wunsch, Smith-Waterman, Gap penalty, Assessing the significance of an Alignment-Database searching for similar sequences, FASTA, BLAST, Other methods of comparing database of sequences and patterns.

UNIT III **15 Hours**

Scoring Matrices: Similarity searches, PAM and BlOSUM matrix, Dayhoff mutation matrix, construction of PAM and BLOSUM matrix; Differences between PAM & BLOSUM.

UNIT IV **15Hours**

Multiple Sequence Alignment: Dynamic programming, Progressive methods, Iterative methods, MSA using CLUSTALW, PILEUP and CLUSTALX, Purpose and applications of multiple sequence alignment.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Bioinformatics, by Andreas D Baxevanis, Gary D Bader, David S Wishart, 4th Edition, 2020, Wiley, USA.*
- *Bioinformatics: Methods and Applications, by Dev Bukhsh Singh, Rajesh Kumar Pathak, 1st Edition , 2021, Oxford, UK.*

SEMESTER-VII

Course Title: ARTIFICIAL INTELLIGENCE

Course Code: BCB703

L	T	P	Credits
3	0	0	3

Total Hours-45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Design expert system by using AI tools.
2. Compare and develop expert system with the help of Neural Networks
3. Justify expert system using Machine Learning.
4. Restate expert system using Fuzzy Logic.

Course Content

UNIT I **10Hours**

Introduction: What is AI, Importance of AI, Early work in AI, Applications of AI, Knowledge and its definition. Knowledge Representation: Prepositional logic, FOPL, Properties of Well-formed formulas, Conversion to Clausal form, Inference rules, Resolution principle.

Structured Knowledge: Introduction, Associate frame structures, Conceptual dependencies and scripts.

UNIT II **15Hours**

Knowledge Organization and Manipulation: Concepts, Uninformed or Blind search, informed search, Searching- And-OR graphs, Pattern Recognition, Recognition Classification process, Classification patterns, Recognizing and understanding speech.

Generative AI: How does generative AI work? Generative AI models, what are Dall-E, ChatGPT and Bard, use cases, benefits and its limitations, Ethics and bias, Generative AI vs. AI, Generative AI history.

UNIT III **10 Hours**

Planning: planning as search, partial order planning, construction and use of planning graphs. Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory and sample applications.

UNIT IV **10 Hours**

Expert System: Definition, Rule based architecture, dealing with uncertainty, Knowledge acquisition and validation, knowledge system building tools.

Knowledge Acquisition: Types of learning, General Learning model, Performance measures. Learning nearest neighbor, naive Bayes, and decision tree classifiers.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Dan W. Patterson. (1990). Introduction to Artificial Intelligence and Expert Systems.PHI Publication.*
- *Peter Jackson. (1998). Introduction to Expert System. AddisonWesley.*

SEMESTER-VII

Course Title: PYTHON USING R-PROGRAMMING FOR BIOLOGIST LAB

Course Code: BCB704

L	T	P	Credits
0	0	4	2

Total Hours-30

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Apply the basic principles of python programming. And extend the functionality of R by using add-on packages.
2. Extract data from files and other sources and perform various data manipulation tasks on them.
3. Code statistical functions in R and create applications using python programming
4. Use R Graphics and Tables to visualize results of various statistical operations on data and looping functions; use Web Services using python programming and apply the knowledge of R gained to data Analytics for real life applications and manipulate python programs by utilizing the data structures like lists.

Course Content

List of Programs:

Introduction: Installing R on personal machines. Installing R and RStudio.

1. The basic functionality of R will be demonstrated, Variable types in R. Numeric variables, strings and factors.
2. Accessing the help system. Retrieving R packages.
   a) Basic data types and operations: numbers, characters and composites.
   b) Data entry and exporting data 02 LO 1, LO 2, LO 3
3. R as a programming language:
   a) Grouping, loops and conditional execution, Functions Exploratory data analysis
   b) Range, summary, mean, variance, median, standard deviation, histogram, box plot, scatterplot 04 LO 1, LO 4
4. Graphics in R
   a) Graphics and tables
   b) Working with larger datasets
   c) Building tables with aggregate
   d) Introduction to ggplot2 graphics 06 LO 3
5. Regression and correlation

a) Simple regression and correlation, Multiple regression
b) Tabular data and analysis of Categorical data 02 LO 4

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton ‘s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

SOFTWARE requirements:

- The R statistical software program. Available from: https://www.r-project.org/
- RStudio an Integrated Development Environment (IDE) for R. Available from: https://www.rstudio.com/

SEMESTER-VII

Course Title: Analytical Bioinformatics Lab

L	T	P	Credits
0	0	6	3

Course Code: BCB705

Total Hours: 45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Characterise and manage the different types of biological data.
2. Perform and assess different sequence alignment method.
3. Predict and analyse biological macromolecular structures

Course Content

1. Retrieval of Data from Biological Database
2. Protein Sequence Retrieval from Uniprot
3. Global and Local Alignment
4. Dot Plot Sequence alignment
5. BLAST
6. Multiple Sequence Alignment and Phylogeny- Clustal O
7. Motif/Domain database search
8. PDB database
9. Protein secondary structure prediction
10. Protein 3D structure visualization

SEMESTER-VII

Course Title: BLOCK CHAIN ARCHITECTURE DESIGN

Course Code: BCB706

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: On successful completion of this course, students will be able to:

1. Describe the basic concepts and technology used for block chain
2. Describe the primitives of the distributed computing and cryptography related to block chain.
3. Apply security features in block chain technologies.
4. Use smart contract in real world applications.

Course Content

UNIT1 **10 Hours**

Introduction to Block chain: Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, And Privacy. Block chain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hash chain to Block chain, Basic consensus mechanisms

UNIT II **10 Hours**

Consensus: Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Block chain consensus protocols Permissioned Block Chain Design goals, Consensus protocols for Permissioned Block chain.

UNIT III **10 Hours**

Hyper ledger Fabric (A): Decomposing the consensus process, Hyper ledger fabric components, Chain code Design and Implementation

Hyper ledger Fabric (B): Beyond Chain code: fabric SDK and Front End (b) Hyper ledger composer tool

UNIT IV **15 Hours**

Use case 1: Block chain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance

Use case 2: Block chain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc 08 V

Use case 3: Block chain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public

distribution system social welfare systems Block Chain Cryptography, Privacy and Security on Block chain.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Narayanan, Bonneau, Felten, Miller and Goldfeder, "Bitcoin and Cryptocurrency Technologies – A Comprehensive Introduction", Princeton University Press.*
- *Josh Thompson, 'Block chain: The Block chain for Beginnings, Guild to Block Chain Technology and Block Chain Programming', Create Space Independent Publishing Platform, 2017.*
- *Imran Bashir, "Mastering Block chain: Distributed ledger technology, decentralization, and smart contracts explained", Packt Publishing.*
- *Merunas Grincalaitis, "Mastering Ethereum: Implement Advanced Block Chain Applications Using Ethereum-supported Tools, Services, and Protocols", Packet Publishing.*

SEMESTER-VII

Course Title: DIGITAL FORENSICS

Course Code: BCB707

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: On successful completion of this course, students will be able to:

1. Determine the hardware and operating system requirements for digital forensics
2. Represent digital forensics by organization of data and metadata in computer systems.
3. Analyze file recovery and hidden file extraction techniques and Integrate security of computer systems with digital forensics and evaluate its performance.
4. Identify various types of forensics in the arena of information technology and Critic the computer crimes by studying the security Laws and legal Landscape around the world.

Course Content

UNIT I **10 Hours**

Introduction to Digital Forensics: digital crimes, digital investigation, evidence, extraction, preservation etc.; overview of hardware and operating systems: structure of storage media/devices, Windows/Macintosh/Linux registry, boot process; disk and file system analysis, data acquisition of physical storage devices

UNIT II **10 Hours**

Data recovery: identifying hidden data, recovering deleted files; digital evidence controls: uncovering attacks that evade detection by event viewer, task manager and other windows GUI tools; disk imaging, recovering swap files, temporary and cache files; automating analysis and extending capabilities.

UNIT III **15 Hours**

Network Forensics: collecting and analyzing network-based evidence, reconstructing web browsing, email activity, intrusion detection, tracking offenders, windows registry changes, etc.; Mobile Network forensics:

introduction, investigations, collecting evidences, where to seek digital data for further investigations; Email and database forensics; memory acquisition

UNIT IV

10 Hours

Computer crime and legal issues: intellectual property, privacy issues, criminal justice system for forensic, audit/investigative situations and digital crime scene, investigative procedure/standards for extraction, preservation and deposition of legal evidence in a court of law.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Thomas J Holt, Adam M Bossler, Kathryn C Seigfried-Spellar, Cybercrime and Digital Forensics: An Introduction, Routledge, 2015.*
- *Cory Altheide and Harlan Carvey, Digital Forensics with Open-Source Tools, Elsevier publication, April 2011.*
- *B. Nelson, A. Phillips, F. Enfinger, C. Steuart, Guide to Computer Forensics and Investigations 4 th edition, Thomson, 2009.*

SEMESTER-VII

Course Title: DESIGN & DEVELOPMENT OF APPLICATIONS

Course Code: BCB708

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: On successful completion of this course, students will be able to:

1. Learn the basics of learning problems with hypothesis and version spaces
2. Understand the features of machine learning to apply on real world problems
3. Characterize the machine learning algorithms as supervised learning and unsupervised learning and apply and analyze the various algorithms of supervised and unsupervised learning
4. Analyze the concept of neural networks for learning linear and non-linear activation functions

Course Content

UNIT1 **10 Hours**

Introduction: Introduction to mobile applications – Embedded system s - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications

UNIT II **10 Hours**

Basic Design: Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability

UNIT III **15 Hours**

Advanced Design: Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

Technology Android: Introduction – Establishing the development environment Android architecture – Activities and views – Interacting with UI –

Persisting data using SQLite – Packaging and deployment – Interaction with server-side applications – Using Google Maps, GPS and Wi-Fi – Integration with social media applications.

UNIT IV **10 Hours**

IOS: Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wi-Fi - iPhone marketplace. Swift: Introduction to Swift, features of swift**.**

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", DreamTech, 2012*
- *AnubhavPradhan, Anil V Despande Composing Mobile Apps,Learn ,explore, apply*
- *James Dovey and Ash Furrow, "Beginning Objective C", Apress, 2012*
- *Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012*
- *David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6. Development: Exploring the iOS SDK", Apress, 2013.*

SEMESTER-VII

Course Title: INTRODUCTION TO BIG DATA

L	T	P	Credits
3	0	0	3

Course Code: BCB709

Total Hours-45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Develop a dynamic webpage by using java script.
2. Connect a java program to a DBMS.
3. Design a well-formed and valid XML and DHTML document.
4. Write a server-side java application called Servlet to update and delete operations on DBMS table.

Course Content

UNIT I **10 Hours**

Introduction to Big Data: Overview of Big Data, Stages of analytical evolution, Challenges of Conventional Systems, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs. Reporting, Modern Data Analytic Tools, Statistical Concepts: Sampling Distributions - Re-Sampling, Statistical Inference - Prediction Error

UNIT II **10 Hours**

Mining Data Streams: 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

UNIT III **15 Hours**

Hadoop: History of Hadoop, The 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

UNIT IV **10 Hours**

Frameworks: Applications on Big Data Using Pig and Hive, Data processing operators in Pig Hive services, HiveQL, Querying Data in Hive, Fundamentals of HBase and Zookeeper, Visualizations: Visual data analysis techniques, interaction techniques. Systems and applications.

Apache: What is Apache Web Server? Apache Web Application Architecture, Features of Apache Web Server

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Michael Berthold, David J. Hand. (2007). Intelligent Data Analysis. Springer.*
- *Chris Eaton, Dirk De Roos, Tom Deutsch, George Lapis, Paul Zikopoulos.(2012). Understanding Big Data: Analytics for Enterprise Class Hadoop and Tom White, Hadoop. (2012). The Definitive Guide Third Edition. O'reilly Media.*
- *Anand Rajaraman and Jeffrey David Ullman. (2012). Mining of Massive Datasets. Cambridge University Press.*
- *Bill Franks. (2012). Taming the Big Data Tidal Wave: Finding Opport UNIT Ies in Huge Data Streams with Advanced B Analytics. John Wiley & sons.*

SEMESTER-VIII

Course Title: PROJECT -II

Course Code: BCB705

L	T	P	Credits
0	0	10	5

Total Hours: 75

Learning Outcomes: On successful completion of this course, the students will be able to:

1.Use latest multimedia devices and programming software.

2.Design and construct a hardware and software system, component or process to meet desired needs.

3.Do work on multidisciplinary Problems.

4.Work as professionals, with portfolio ranging from data management, network configuration, designing hardware, database and software design to management and administration of entire systems.

Course Content

Project should include following phases: System Analysis and Design
Coding - Implementation Testing
It should be a working project Must have a future perspective
The Domain of project can be from:
Databases
Application software
System software
Multimedia
Web Applications, etc.
A complete project report must be submitted along with softcopy of project. Project report may include Requirements of Project, Flow Chart, DFD's, Coding and Test Results

SEMESTER-VIII

Course Title: Biological Databases

Course Code: BCB802

L	T	P	Credits
3	0	0	3

Total Hours-45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Discuss concepts of biological data and database creations
2. Infer the process of biological data integration and mining
3. Distinguish among biomolecular sequence databases and structural databases
4. Identify various databases employed to determine protein functions, interactions and pathways

Course Content

UNIT – I **15 Hours**

Sequence Submission Tools: Introduction, relational database, motivation of biological database; Central dogma of life -Submission of sequences to the database, sequence formats, Interconversion of molecular sequences.

UNIT – II **10 Hours**

Biological Data Integration and Mining: General data integration; Major areas in biological data integration; **Biological data mining-**
General and biological data mining; Case study of biological pattern discovery, Case study in biological data mining. **10 Hours**

UNIT – III

Nucleotide and Protein Sequence Databases: European molecular biology laboratory (EMBL), NCBI GenBank DNA Data Bank of Japan(DDBJ), Genes and genetic disorders: COSMIC, Clinvar - SNP database (DbSNP), UniProt Knowledgebase - SwissProt and TrEMBL - Protein Information Resource (PIR).

UNIT – IV **10 Hours**

Protein data bank (PDB), SCOP - Structural classification of proteins, CATH – Protein structure classification database.
Pfam-protein family database - GO-gene ontology, PROSITE-protein function pattern and profile, ENZYME- Enzyme commission, KEGG Pathway database, BioGRID- Database of

Protein, Chemical, and Genetic Interactions; STRING- functional protein association networks, DIP - Database of Interacting Proteins.

Transactional Modes

Video based Teaching, Collaborative Teaching, Cooperative Teaching; Case based Teaching, Case Analysis, and Group Discussion.

Suggested Readings

- *Biological Database Modeling 1st Edition, by Jake Chen, Amandeep S., Amandeep S,Sidhu, 2012, Artech House Publishers, UK.*
- *Bioinformatics: Methods and Applications, by Dev Bukhsh Singh, Rajesh Kumar Pathak,1st Edition, 2021, Oxford, UK.*

Course Title: BIG DATA

L	T	P	Credits
3	0	0	3

Course Code: BCB803

SEMESTER-VIII

Total Hours-45

Learning Outcomes: On successful completion of this course, the students will be able to:

5. Develop a dynamic webpage by using java script.
6. Connect a java program to a DBMS.
7. Design a well-formed and valid XML and DHTML document.
8. Write a server-side java application called Servlet to update and delete operations on DBMS table.

Course Content

UNIT I **10 Hours**

Introduction to Big Data: Overview of Big Data, Stages of analytical evolution, Challenges of Conventional Systems, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs. Reporting, Modern Data Analytic Tools, Statistical Concepts: Sampling Distributions - Re-Sampling, Statistical Inference - Prediction Error

UNIT II **10 Hours**

Mining Data Streams: 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

UNIT III **15 Hours**

Hadoop: History of Hadoop, The 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

UNIT IV **10 Hours**

Frameworks: Applications on Big Data Using Pig and Hive, Data processing operators in Pig Hive services, HiveQL, Querying Data in Hive, Fundamentals of HBase and Zookeeper, Visualizations: Visual data analysis techniques, interaction techniques. Systems and applications.

Apache: What is Apache Web Server? Apache Web Application Architecture, Features of Apache Web Server

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Michael Berthold, David J. Hand. (2007). Intelligent Data Analysis. Springer.*
- *Chris Eaton, Dirk De Roos, Tom Deutsch, George Lapis, Paul Zikopoulos.(2012). Understanding Big Data: Analytics for Enterprise Class Hadoop and Tom White, Hadoop. (2012). The Definitive Guide Third Edition. O'reilly Media.*
- *Anand Rajaraman and Jeffrey David Ullman. (2012). Mining of Massive Datasets. Cambridge University Press.*
- *Bill Franks. (2012). Taming the Big Data Tidal Wave: Finding Opport UNIT Ies in Huge Data Streams with Advanced B Analytics. John Wiley & sons.*

SEMESTER-VIII

Course Title: NATURAL LANGUAGE PROCESSING

Course Code: BCB804

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Apply the computational knowledge for Natural Language Processing to understand the properties of natural languages, its algorithms for processing linguistic information in various tasks such as Machine translation, Information extraction and retrieval, and Speech Technology.
2. Understand the concepts of linguistic foundations that underlie natural language processing, which would provide the knowledge for building components of NLP systems.
3. Discover the capabilities, analyze them and explore the limitations of current natural language technologies, and some of the algorithms and techniques that underline these technologies to take up various research challenges in the field.
4. Recognize the significance of research in natural language processing for common NLP tasks such as text classification, spam filtering, spell checking, machine learning, etc. to engage in lifelong learning.

Course Content

UNIT1 **10 Hours**

Introduction: Basic concepts of Natural language Processing, evolution of NLP, issues and challenges in NLP, basic concepts of phases of natural language processing mor-phological analysis, syntactic analysis, semantic analysis, pragmatic analysis, tools and techniques used for performing these analysis, ambiguities, Types of ambiguities

UNIT II **9 Hours**

Syntactic analysis: Concept of Grammars, Chomsky hierarchy of grammars, concept of parsing, top-down parsing, bottom-up parsing, bidirectional parsing, generating parse tree, data structures and algorithms used for parsing, tokenize Case study of parsers of NLP systems like ELIZA, LUNAR

UNIT III **15 Hours**

Semantic Analysis: understanding meaning, CASE grammars, transformational gram-mars used for performing semantic analysis. Resolving ambiguities to generate correct meaning, Word Sense Disambiguation Case study of Toolkit of word sense disambiguation used in WORDNET

Dialog flow: Basics of Dialogflow,Features , Use Cases, Components, Advantages of Dialogflow, Dialog flow Agent, , Parameters, Entities, Custom Intent, fallback intent, Knowledge Base in Dialogflow, Training in Dialogflow, Intent Matching with Follow-up Intent, Integration with an Integration, How to Build Resume Chatbot for Google Assistant, How to Build an Appointment Scheduler with Dialogflow

UNIT IV **11 Hours**

Software tools for Performing NLP: English WORDNET, components of WorldNet understanding NLTK tool for using wordnet, HINDI wordnet, Indian Govt initiative for language analysis and machine translation.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Allen,James, "Natural Language Understanding", Second Edition, Benjamin/ Cum-ming, 1995.*
- *Jurafsky, Danand Martin, James," Speech and Language Processing", Second Edition, Prentice Hall,2008*
- *Ela Kumar, "Natural Language Processing", IK international Publication, second edition 2014*

SEMESTER-VIII

Course Title: INTRODUCTION TO ARTIFICIAL INTELLIGENCE & EXPERT SYSTEM

Course Code: BCB805

L	T	P	Credits
3	0	0	3

Total Hours-45

Learning Outcomes: On successful completion of this course, the students will be able to:

5. Design expert system by using AI tools.
6. Compare and develop expert system with the help of Neural Networks
7. Justify expert system using Machine Learning.
8. Restate expert system using Fuzzy Logic.

Course Content

UNIT I **10 Hours**

Introduction: What is AI, Importance of AI, Early work in AI, Applications of AI, Knowledge and its definition. Knowledge Representation: Prepositional logic, FOPL, Properties of Well-formed formulas, Conversion to Clausal form, Inference rules, Resolution principle.

Structured Knowledge: Introduction, Associate frame structures, Conceptual dependencies and scripts.

UNIT II **15 Hours**

Knowledge Organization and Manipulation: Concepts, Uninformed or Blind search, informed search, Searching- And-OR graphs, Pattern Recognition, Recognition Classification process, Classification patterns, Recognizing and understanding speech.

Generative AI: How does generative AI work? Generative AI models, what are Dall-E, ChatGPT and Bard, use cases, benefits and its limitations, Ethics and bias, Generative AI vs. AI, Generative AI history.

UNIT III **10 Hours**

Planning: planning as search, partial order planning, construction and use of planning graphs. Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory and sample applications.

UNIT IV **10 Hours**

Expert System: Definition, Rule based architecture, dealing with uncertainty, Knowledge acquisition and validation, knowledge system building tools.

Knowledge Acquisition: Types of learning, General Learning model, Performance measures. Learning nearest neighbor, naive Bayes, and decision tree classifiers.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Dan W. Patterson. (1990). Introduction to Artificial Intelligence and Expert Systems.PHI Publication.*
- *Peter Jackson. (1998). Introduction to Expert System. AddisonWesley.*