SEMESTER – I
PCBCA20 BIOMOLECULES

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks 100
I / I	PCBCA20	Biomolecules	Theory	Core	6	5	40+60=100

Objective:
To understand the salient features of biomolecules in the organization of life.

Course Outcome (CO)
On completion of the course, the students will be able to;
1. Outline the structural features, properties and biological importance of carbohydrates
2. Attain idea on the structural and biological aspects of proteins
3. Examine the structure of nucleic acids, its isolation and sequencing techniques
4. Gain knowledge on the structure, different forms and significance of lipids in the system
5. List out the significance of vitamins, its deficiency diseases and about the porphyrin ring containing molecules in living system

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	M	M	M	H	M
CO 2	H	M	M	H	H	M
CO 3	H	H	M	H	H	M
CO 4	H	H	M	H	H	M
CO 5	H	H	L	L	H	L
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	M	M	M	M	H
CO 2	H	M	H	M	H	H
CO 3	H	H	H	H	M	H
CO 4	H	M	M	M	M	M
CO 5	H	H	M	M	H	H
H- High (3), M-Medium (2), L-Low (1)						

Unit I: **(18 Hours)**

1.1 Carbohydrates: Monosaccharides (Glucose, Fructose, Galactose, Mannose)- Structure, Functions. (K1, K2, K3)

1.2 Polysaccharides - Occurrence, structure, isolation, properties and functions of homoglycans - starch, glycogen, cellulose, dextrin, inulin, chitins, xylan, arabinans, galactans (K1, K2, K3, K4, K5)

1.3 Occurrence, structure, properties, and functions of heteroglycans - bacterial cell wall

polysaccharides, glycosamino glycans (K1, K2, K3)

1.4 Occurrence, structure, properties, and functions of agar, alginic acid, pectin, amino sugars and deoxy sugars, blood group substances and sialic acids. (K1, K2, K3)

1.5 Glycoprotein and their biological applications. (K1, K2, K3)

1.6 Lectins structure and functions. (K1, K2, K3)

Unit II: (18 Hours)

2.1 Proteins: Classification of proteins on the basis of solubility and shape, structure, and biological functions. (K1, K2, K3)

2.2 Isolation, fractionation and purification of proteins. (K1, K2, K3)

2.3 Denaturation and renaturation of proteins. Primary structure - determination of amino acid sequence of proteins (K1, K2, K3)

2.4 Peptide bond: Ramachandran plot. (K1, K2, K3)

2.5 Secondary structure - weak interactions involved- alpha helix and beta sheet and beta turns structure. Pauling and Corey model for fibrous proteins. Collagen triple helix. Super secondary structures - helix-loop-helix. (K1, K2, K3)

2.6 Tertiary structure - alpha and beta domains. Quaternary structure - structure of hemoglobin. Solid state synthesis of peptides. (K1, K2, K3)

Unit III: (18 Hours)

3.1 Nucleic acids: Watson - Crick model of DNA structure. (K1, K2, K3)

3.2 A, B and Z - DNA Cruciform structure in DNA, formation and stability of cruciforms, miscellaneous alternative conformation of DNA, slipped mispaired DNA, parallel stranded, anisomorphic DNA (K1, K2, K3)

3.3 Palindrome, secondary and tertiary structure of DNA (K1, K2, K3)

3.4 Methods for nucleic acid sequence determination, denaturation, strand separation, fractionation, isolation and purification of DNA (K1, K2, K3, K4, K5, K6)

3.5 Cot curve, hypochromic effect, DNA-protein interactions. Molecular hybridization. (K1, K2, K3, K4)

3.6 Structure and functions of mRNA, rRNA and tRNA, Heterogenous nuclear RNA (HnRNA) (K1, K2, K3)

Unit IV: (18 Hours)

4.1 Lipids: Lipids – classification-simple, compound, derived. (K1, K2, K3)

4.2 Fatty acids: saturated and unsaturated fatty acids. (K1, K2, K3, K4)

4.3 Phospholipids - classification, structure and functions. (K1, K2, K3)

4.4 Amphipathic lipids -membranes, micelles, emulsions and liposomes. (K1, K2)

4.5 Steroids - structure and biological role of cholesterol, bile acids and bile salts. (K1, K2, K3)

4.6 Eicosanoids – Structure and Functions of Prostaglandins, thromboxanes, leukotriens. Types and functions of plasma lipoproteins. (K1, K2, K3)

Unit V: (18 Hours)

5.1 Vitamins - Sources, structure, daily requirements, biochemical functions and deficiency diseases of water-soluble vitamins (K1, K2, K3, K4)

5.2 Vitamins - Sources, structure, daily requirements, biochemical functions and deficiency diseases of fat -soluble vitamins. (K1, K2, K3)

5.3 Porphyrins – Biosynthesis (K1, K2, K3)

5.4 Porphyrins- the porphyrin ring system of chlorophyll (K1, K2, K3)

5.5 Porphyrins- the porphyrin ring system of hemoglobin and myoglobin (K1, K2, K3)

5.6 Porphyrin ring system of Cytochrome (K1, K2, K3)

[Knowledge Level: K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create]

Text Books:

1. David L. Lehninger's Principle of Biochemistry. Nelson and Michael M. Cox. W. H. Freeman; 4th edition, 2004.

2. Voet and Voet. Fundamentals of Biochemistry. John Wiley and sons NY, 2nd edition, 2002.

Reference Books:

1. Martin David W, Harper, Harold A - Harper's review of Biochemistry- 31stedition, 2018.
2. Stryer L. Biochemistry. W.H. Freeman and Co. 5th edition, 2002.
3. Thomas. M. Devlin. Text Book of Biochemistry with clinical correlation. John Wiley-Liss, Hobokhen NJ publishers, 2006.
4. West, Todd, Mason, Vanbruggen - Textbook of Biochemistry, Oxford Publishers, - 4thedition,2000.
5. Eric E Conn, P.K Stumpf, G. Brueins and Ray H Doi, John. Outlines of Biochemistry. Wiley and Sons. 5th edition, 2005.

Open Educational Resources (OER):

1. https://youtu.be/N64RAIG49rY
2. https://youtu.be/Nh0Km4bv18
3. https://youtu.be/eb5PPWFZzxl
4. https://youtu.be/Sh3eolzdrdl
5. https://youtu.be/Qv-KExGKAYw

SEMESTER – I

PCBCB20 - HUMAN PHYSIOLOGY AND NUTRITION

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I / I	PCBCB20	Human Physiology and Nutrition	Theory	Core	6	5	40+60= 100

Objective:

To study about the Physiological system of human body and Nutrients with their deficiencies.

Course Outcomes (CO)

On completion of the course, the students will be able to:

1. Outline the physiological system of the human body
2. Describe the general function of each organ system
3. Assess the activities of organs for maximum efficiency
4. Explain the physiology of muscle and neurotransmitters
5. Utilize knowledge on nutrients with their deficiencies

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	H	H	H	H	M
CO 2	H	H	H	H	M	M
CO 3	H	H	L	H	M	M
CO 4	H	H	H	H	M	M
CO 5	H	L	H	H	H	H
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	H	H	H	H	M
CO 2	H	H	H	L	M	M
CO 3	H	H	H	H	M	M
CO 4	H	H	H	H	M	M
CO 5	H	H	L	H	H	H
H- High (3), M-Medium (2), L-Low (1)						

Unit I: (18 Hours)

1.1 Composition and functions of blood and plasma. Blood groups (K1, K2, K3, K4)

1.2 Blood coagulation - mechanism, fibrinolysis, anticoagulants (K2, K3, K4)

1.3 Hemoglobin - structure, abnormal types of Hemoglobin (K2, K3, K4)

1.4 Structure of heart, cardiac cycle, heart sounds, E.C.G (elementary knowledge) (K2, K3)

1.5 Vasomotor circulation, coronary circulation, blood pressure (K2, K3)
1.6 Spleen, Lymph-composition and function of lymph -lymph Organs. (K2, K3)

Unit II: (18 Hours)

2.1 Composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions (K1, K2, K3, K4)

2.2 Digestion and absorption of carbohydrates and lipids (K2, K3, K4)

2.3 Digestion and absorption of proteins (K2, K3, K4)

2.4 Excretory system - structure of Kidney and nephron (K2, K3)

2.5 Formation of urine - glomerular filtration (K2, K3, K4)

2.6 Tubular reabsorption of glucose, water and electrolytes, tubular secretion. (K2, K3, K4)

Unit III: (18 Hours)

3.1 Structure and functions of organs of respiration**.** (K2, K3, K4)

3.2 Mechanism and regulation of respiration Transport of gases - O_2 and CO_2. (K2, K3)

3.3 Acid-base balance: Acidosis and alkalosis - Fluid electrolyte balance - regulation of water balance and sodium balance, Role of renin-angiotensin and ADH. (K2, K3, K4)

3.4 Structure and Function of Male and Female reproductive organs (K2, K3, K4)

3.5 Menstruation (K3, K4)

3.6 Physiology of pregnancy, parturition and lactation (K2, K3, K4)

Unit IV: (18 Hours)

4.1 Chemical composition and metabolic adaptation, neurotransmitters and cAMP, biochemical aspects of learning and memory, enkephalins and endorphins**.** (K2, K3)

4.2 Structure and function of nerves, neurons, resting and action potential. (K2, K3, K4)

4.3 Transmission of nerve impulses, synaptic transmission, compounds affecting synaptic transmission and neuromuscular junction. (K2, K3)

4.4 Composition and functions of cerebrospinal fluid. (K2, K3, K4)

4.5 Structure of muscle cells, muscle contraction and molecular organization of muscle (K2, K3, K4)

4.6 Proteins of contractile element - their organization and role in contraction (K2, K3)

Unit V: (18 Hours)

5.1 Basal metabolism- basal metabolic rate, factors affecting BMR, determination of BMR - direct and indirect method**.** (K1, K2, K3, K4)

5.2 Respiratory quotient - biological oxygen demand, their importance in nutrition (K2, K3)

5.3Nutrition at different stages of life - during infancy, adolescence, pregnancy and Geriatrics. (K2, K3)

5.4 Role of fiber in diet and role of essential amino acids (K2, K3, K4)

5.5 Protein Malnutrition: Marasmus and Kwashiorkor. (K2, K3)

5.6 Minerals- macro and micro elements, [Fe, Cu, Zn, I, Ca, Na, Cl, K, P, Mg] daily requirements, functions and deficiency manifestations. (K2, K3)

Text Books:

1. Ross & Wilson- Anatomy and Physiology in Health and illness- Elsevier-13th Edition,2018

2. C.C. Chatterjee- Human Physiology- CBS publishers-12th Edition,2018

Reference Books:

1.Ganong's Review of Medical physiology- McGraw Hill Education-25th Edition,2016

2.Guyton and Hall -Textbook of Medical Physiology- Elsevier- 13th Edition,2016

3. Davidson -Human Nutrition and Dietetics- Churchill Livingstone- 8th Edition,2008

4. M.E. Skilis and V.R. Young-Modern Nutrition and Health Diseases,2008

5. M.S. Swami Nathan- Principles of Nutrition- New Age Publications-5th Edition ,2011

Open Educational Resources (OER): 1.https://www.youtube.com/watch?v=BxV06Zn0Kck 2.https://www.youtube.com/watch?v=tXXEn6IdLPY 3.https://www.youtube.com/watch?v=HI-R8uAh2fI 4.https://www.youtube.com/watch?v=YKULwuxgUE05.https://www.youtube.com/watch?v=LKZZrJjI_NI

SEMESTER – I
PCBCC20 - CELL BIOLOGY

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks 100
I / I	PCBCC20	Cell Biology	Theory	Core	5	4	40+60=100

Objectives:
To understand the Cell, Cell organelles structure, function and metabolism.

Course Outcome (CO):
On completion of the course, the students will be able to:
1. Relate cell as basic unit of life, its structure, organization and importance of molecular motors
2. Discuss about the various sub-cellular components of cells and its functions in the biological system
3. Assess the knowledge on techniques adopted for the identification of cellular components and cancerous cell
4. Identify the different types of cell-cell communication and its significance
5. Describe clearly about the mechanism of cell signalling and cell death

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	H	M	M	H	L
CO 2	H	H	H	H	L	M
CO 3	H	H	H	L	H	H
CO 4	H	H	L	H	H	M
CO 5	H	H	H	M	H	M
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	H	M	M	H	L
CO 2	H	M	H	H	H	M
CO 3	H	H	H	H	L	H
CO 4	H	L	M	H	H	M
CO 5	H	H	H	M	H	M
H- High (3), M-Medium (2), L-Low (1)						

Unit I: **(15 Hours)**

1.1 Scope of cell Biology- History of cell Biology - Cell Theory – Cell Diversity: Size,

Shape, Internal organization - Cell types: Prokaryotic and Eukaryotic (K1, K2, K3)

1.2 Functions of Cell – Prokaryotic cell: Structural Organization with the examples: Mycoplasma, *E. Coli*, Cyanobacteria (K1, K2, K3)

1.3 Eukaryotic cell: Structural Organization - Plant cell and Animal Cell (K1, K2, K3)

1.4 Plasma membrane – Structure – Molecular Model of Plasma membrane – Functions (K1, K2, K3)

1.5 Specializations of cell membrane – microvilli, Desmosomes, Gap junction, Tight junctions, Plasmodesmata - Cell wall – Structure – pits – functions (K1, K2, K3)

1.6 Structure, Composition and function of Cilia – Flagella – Filaments - Microtubules – Centrioles - Basal bodies (K1, K2, K3)

Unit II: (15 Hours)

2.1 Cellular organelles: Morphology and functions of Cytoplasm, Nucleus and nucleolus (K1, K2, K3)

2.2 Morphology and functions of Endoplasmic reticulum (K1, K2, K3)

2.3 Morphology and functions of Golgi apparatus (K1, K2, K3)

2.4 Morphology and functions of Mitochondria (K1, K2, K3)

2.5 Morphology and functions of Plastids (K1, K2, K3)

2.6 Morphology and functions of Lysosomes and Microbodies (K1, K2, K3)

Unit III: (15 Hours)

3.1 Cell-cell interaction - Cell adhesion proteins - Cell surface of plant, animal and cancer cells (K1, K2, K3)

3.2 Overview of membrane protein - peripheral and integral, molecular model of cell membrane: fluid mosaic model and membrane fluidity (K1, K2, K3)

3.3 Transport systems: passive and active transport by ATP powered pumps. (K1, K2, K3)

3.4 Chromosome – Structure and Functions (K1, K2, K3)

3.5 Cell cycle - phases of cell cycle - Cell division - Mitosis, (K1, K2, K3)

3.6 Cell division: Meiosis - Regulation of cell growth (K1, K2, K3)

Unit IV: (15 Hours)

4.1 Cell aging and death - necrosis and apoptosis (K1, K2, K3)

4.2 Mitochondrial and death receptor pathway (K1, K2, K3)

4.3 Cell signaling –Types of cell signaling-Ion channel linked; G-protein coupled receptors (K1-K5)

4.4 Receptor tyrosine kinases and Ras, MAP kinase pathways (K1, K2, K3)

4.5 Insulin receptor pathway (K1, K2, K3)

4.6 Functions of cell surface receptors, pathways of intracellular signal transduction (K1, K2, K3)

Unit V: (15 Hours)

5.1 Methods in cell biology: Microscopy – fluorescence, electron microscopy and phase contrast microscope. (K1, K2, K3)

5.2 Methods for disrupting tissues and cells, organ and tissue slice techniques

5.3 Isolation of clones, tissue culture techniques (Animal and Plant) (K1, K2, K3)

5.4 Cell fixation -fluid fixatives, freezing and section drying, fixation for electron microscopy - buffered osmium solutions, fixation of organic and inorganic substances (K1, K2, K3)

5.5 Staining techniques acid and basic, fluorescent and radioactive dyes, staining of lipids, steroids, nucleic acids, proteins and enzymatic reaction products. (K1, K2, K3)

5.6 Histopathological studies - organ specific morpho histological examination, identification of morphological changes related to pathology. (K1, K2, K3)

Textbooks:

1. A.K Berry. A text book of Cell Biology. Emkey Publication,2014.

2. The Cell: A Molecular Approach by Cooper G.M and Hausman, 6th edition, Sinauer Associates, Inc, 2013.

Reference Books:

1. Becker, Klein smith and Harden. The World of the Cell. Academic Internet Publishers; 5th edition, 2015.
2. Geoffrey M. Cooper and Robert E Hausma. The Cell: A Molecular Approach. Oxford University Press,7th edition, 2015.
3. Gerald Karp. Cell and Molecular Biology by concepts and experiments John Wiley sons &Inc, 2016.
4. Harvey Lodish. Molecular cell Biology. W. H. Freeman; Sol edition, 2007.
5. J. Brachet and A. E. Mirsky. The Cell - Biochemistry, physiology and morphology, Academic Press, 2014.

Open Educational Resources (OER):

1. https://m.ypotube.com/watch?v=bRcjB11hDCU
2. https://m.youtube.com/watch?v=ZyWYID2cTK0
3. https://youtu.be/qAoa94WBaIc
4. https://m.youtube.com/watch?v=J5pWH1r3pgU
5. https://m.youtube.com/watch?v=jRZHDhHf3tA

SEMESTER – I

PEBCA20 ELECTIVE I A: BIOPHYSICAL CHEMISTRY

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I / I	PEBCA20	Biophysical Chemistry	Theory	Elective I A	3	3	40+60=100

Objective:

To make the students to understand the concepts of bioenergetics and techniques.

Course Outcome (CO):

On completion of the course, the students will be able to,

1. Demonstrate the concept of bioenergetics and its importance
2. Describe the spectroscopic techniques – NMR, UV and MS
3. Define and recognize covalent bonding between atoms in molecules.
4. Classify organic molecules by their functional groups
5. Compare the isomeric relationship

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	H	H	H	H	M
CO 2	H	H	H	H	M	M
CO 3	H	H	L	H	M	M
CO 4	H	H	H	H	M	M
CO 5	H	L	H	H	H	H
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	H	H	H	H	M
CO 2	H	H	H	L	M	M
CO 3	H	H	H	H	M	M
CO 4	H	H	H	H	M	M
CO 5	H	H	L	H	H	H
H- High (3), M-Medium (2), L-Low (1)						

Unit I: (9 hours)

1.1 Bioenergetics: Thermodynamics - basic concepts (K1, K2)

1.2 First, second and third laws of thermodynamics (K2, K3)

1.3 Enthalpy and entropy, exothermic and endothermic reactions - Free energy (K1, K3)

1.4 Measurement of free energy in chemical reactions (K1, K2, K3)

1.5 Equilibrium for biochemical reactions (K1, K2)

1.6 High energy phosphates, Redox reactions and free energy changes in biological reactions (K2, K3)

Unit II: **(9 hours)**

2.1 Spectroscopy and structural elucidation (K1, K2)

2.2 Regions of the spectrum (K2, K3)

2.3 Basic principles of UV, NMR and mass spectrometry and their biological applications (K3, K4)

2.4 FT-NMR Nuclear overhauzer effect (K3)

2.5 Use of X-ray crystallography in the study of proteins and nucleic acids (K1, K3)

2.6 Use of CD in the study of proteins and nucleic acids (K1, K2)

Unit III: **(9 hours)**

3.1 Atomic structure and chemical bonds (K1, K2)

3.2 Atomic orbitals, quantum numbers. Shapes of s, p and d orbitals (K3)

3.3 Aufbau principle, Pauli exclusion principle and Hund's rule (K2, K3)

3.4 Electronic configuration of atoms (K2)

3.5 Formation of chemical bonds, octet rule (K1, K3)

3.6 Ionic bond, covalent bond and co-ordinate bonds with examples (K1, K2)

Unit IV: **(9 hours)**

4.1 Functional groups and reactions - Classification of organic compounds based on functional groups and their nomenclature (K1, K2, K3)

4.2 Biologically important organic compounds (names and structures) (K3)

4.3 Homolytic and heterolytic cleavage of covalent bonds (K1, K3)

4.4 Reactive species: electrophiles, nucleophiles and radicals (K1, K2)

4.5 Types of organic reactions with examples (K2, K3)

4.6 Inductive effect and resonance (K3)

Unit V: **(9 hours)**

5.1 Isomerism - Isomerism in organic compounds. Types of isomerism (K2, K3)

5.2 Tautomerism with special reference to lactic acid (K1, K2)

5.3 Stereoisomerism-Geometric isomerism with special reference to maleic acid and unsaturated fatty acids (K2, K3)

5.4 Partial double bond character of C-N bonds in amides. Geometrical isomerism in such compounds (K2, K3)

5.5 Optical isomerism, optical activity, enantiomers, diastereomers. Meso and dl forms. R-S and D-L notations in amino acids and sugars (K2, K4)

5.6 Conformational analysis, conformations of ethane and cyclohexane (K3)

Text Books:

1. K. Wilson and I. Walke - Practical Biochemistry - Cambridge University press - 5 th edition, 2000
2. David L. Nelson and Michael M- Lehninger's Principle of Biochemistry - Cox. W. H. Freeman - 7 th edition, 2017

Reference Books:

1. Victor Rodwell and David Bender- Harper's Illustrated Biochemistry - 31 st edition, 2018
2. E. S. West,W. R. Todd, H.S. Mason and J. T. V. Bruggen - Text book of Biochemistry - Oxford and IBH publishing - 4 th edition, 2017
3. Kensal E. Van Holde - Physical Biochemistry- 2 nd edition, 2006
4. Principle of Instrumental Analysis – Dougals A- 6 th edition, 2017.
5. Robert D. Braun - Introduction to Instrumental Analysis - Pharma Book Syndicate - 1 st edition, 2006

Open Educational Resources (OER):

1. https://youtu.be/CiXDXpw9HyM?list=PLWPirh4EWFpHTPJZ7ATErCFsKxN0C7St7
2. https://youtu.be/AwKqO4Lg8_U
3. https://youtu.be/5bhQXC6Uklo
4. https://youtu.be/JO8w_BnX-w4
5. https://youtu.be/3_H3YU5EbeY

SEMESTER – I

PEBCB20 - ELECTIVE I B: PHARMACEUTICAL BIOCHEMISTRY

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I / I	PEBCB20	Pharmaceutical Biochemistry	Theory	Elective I B	3	3	40+60=100

Objective:

To make the students aware of uses and abuse of drugs.

Course Outcome (CO)

On completion of the course, the students will be able to,

1. Outline the basic scientific concepts related to mechanism of drug action
2. Assess the drug tolerance and the factors that modify the effect of drugs
3. Explain the use of genetically engineered methods on novel drug delivery systems
4. Discuss the mechanism of action of drugs in the therapy of specific diseases
5. Use the medicinal plants in drugs as a curative

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	H	H	H	H	M
CO 2	H	H	H	H	M	M
CO 3	H	H	M	H	M	M
CO 4	H	H	H	L	M	M
CO 5	H	L	H	H	H	H
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	H	H	H	H	M
CO 2	H	H	H	M	M	M
CO 3	H	H	H	H	M	M
CO 4	H	H	H	H	L	M
CO 5	H	H	L	H	H	H
H- High (3), M-Medium (2), L-Low (1)						

Unit-I: **(9 hours)**

1.1 Drug - Structural feature and pharmacology activity (K1, K2, K4)
1.2 Prodrug concept (K1, K3)
1.3 Absorption -first –pass effect & distribution (K2, K4)
1.4 Metabolism- Phase I, II reactions, action of cytochrome p450 (K1, K2, K4)
1.5 Drug receptor- localization, type and subtypes, models and their drug (K2, K3)
1.6 Receptor interaction, agonist & antagonist (K2, K3)

Unit-II: **(9 hours)**

2.1 Adverse response to drugs and drug tolerance (K1, K3)
2.2 Idiosyneracy (pharmacogenesis) and drug allergy - Tachyphylaxis (K2, K3, K4)
2.3 Drug abuse and vaccination against infection (K1, K3, K4)
2.4 Factor that modifies the effect of drug (K2, K3)
2.5 Assay of drug potency- Bioassay and immunoassay (K3, K4)
2.6 Plasma therapy (K1, K2, K3)

Unit-III: **(9 hours)**

3.1 Biotechnology and pharmacy: Genetically engineered protein and peptide agents (K2,K4)
3.2 Novel drug delivery systems (K1, K2, K4)
3.3 Non conventional routes of administration (K3, K4)
3.4 Anti-AIDS drug development (K1, K2, K4)
3.5 Oncogenes ras target for drugs (K1, K2)
3.6 Multi-drug resistance (K2, K3)

Unit-IV: **(9 hours)**

4.1 Mechanism of action of drugs used in therapy of: Respiratory system – cough, bronchial – asthma, pulmonary tuberculosis (K1, K2, K3)
4.2 GIT – Digestants, appetite suppressants, Hypolipidemic agents, vomiting, constipation and peptic ulcer (K2, K3)
4.3 Cardiovascular drugs - Structure and action of cardiac glycosides- Digoxin and Digitoxin (K2, K3)
4.4 Antimicrobial drugs – sulfonamides, trimethoprim, cotrimoxazole, penicillin, Aminoglycosides, Cephalosporin and bacterial resistance and macrolides (K1, K2, K3, K4)
4.5 Insulin and oral diabetic drugs (K2, K3, K4)
4.6 Antifertility and ovulation inducing drugs (K1, K2, K3)

Unit-V: **(9 hours)**

5.1 Drugs of plant origin: Drug dependence and abuse (K1, K3)
5.2 Management of self poisoning cancer (K2, K4)
5.3 Chemotherapy - Cytotoxic drug (K1, K2)
5.4 Immuno suppressive drug therapy (K3, K4)

5.5 New Biological Targets for Drug Development (K1, K3, K4)
5.6 Novel Drug Screening Strategies (K2, K3)

Text Books:

1. R. S. Satoskar. S. D. Bhandhakar and S.S. Anilapure - Pharmacology and pharmacotherapeutics - Popular Prakashar Bombay - 24th edition, 2015.
2. Goodman and Gillman, Mc Graw Hill - The pharmacology Vol I and II - 13th edition, 2017

Reference Books:

1. William O.F - Principles of Medicinal Chemistry- B.I waverks Pvt Ltd, New Delhi- 4th edition, 2016
2. D. G. Burgers- Medicinal Chemistry & Drug Discovery - Oxford textbook of Clinical Pharmacology and Drug therapy - 3rd edition, 2008
3. Michael Pakmer and Alice Chan - Biochemical Pharmacology – Wiley Publications – 1st edition - 2012
4. Katzung and Bertram - Basic & Clinical Pharmacology - McGraw-Hill Publishers – 14th edition - 2018
5. Charles P. Woodbury - Biochemistry for the Pharmaceutical Sciences- 1st edition, 2011.

Open Educational Resources (OER):

1. https://youtu.be/oCPRi5JFMdg
2. https://youtu.be/GPoDNQhP0Mg
3. https://youtu.be/SZ7lgFb-KqM
4. https://youtu.be/j6J9cBGix-s
5. https://youtu.be/k8xat-XzgEA?list=RDQM2AXP_m3A14s
6. https://youtu.be/7O0V3ocMiAQ

SEMESTER II

PCBCD20 - ANALYTICAL BIOCHEMISTRY

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I / II	PCBCD20	Analytical Biochemistry	Theory	Core	5	5	40 + 60 =100

Objectives:

To understand the principles and applications of analytical techniques. .

Course Outcome (CO)

On completion of the course, the students will be able to;

1. Identify the behavior of molecules and prioritize related analytical tools
2. Interpret and use the results from a given chromatographic technique
3. Apply the electrophoretic techniques for the separation of proteins and nucleic acids
4. Pursue knowledge about centrifugation and radioactivity and critically assess advances with in the field
5. Categorize, evaluate and implement a suitable technique for a given analytical problem

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	M	M	M	H	M
CO 2	H	M	M	H	H	M
CO 3	H	L	M	L	H	M
CO 4	H	H	M	H	H	M
CO 5	H	H	M	L	H	M
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	M	M	M	M	H
CO 2	H	M	H	M	H	L
CO 3	H	L	H	H	L	H
CO 4	H	M	M	M	M	M
CO 5	H	H	M	M	L	H
H- High (3), M-Medium (2), L-Low (1)						

Unit-I: **(15 Hours)**

1.1 Principle - electrochemical cells (K1, K2, K3)

1.2 Henderson - Hasselbalch equation - Buffer capacity (K1, K2, K3)

1.3 pH measurement- Glass electrode: Principle and application (K1, K2, K3, K4)

1.4 Ion-selective electrodes: Principle and application (K1, K2, K3, K4)
1.5 Gas sensing electrodes - Oxygen electrode: Principle and application (K1, K2, K3, K4)
1.6 Biosensors. (K1, K2, K3)

Unit-II: (15 Hours)

2.1 Planar and Column chromatography: Principle and application (K1, K2, K3, K4)
2.2 Ion – exchange chromatography: Principle and application (K1, K2, K3, K4)
2.3 Molecular exclusion chromatography: Principle and application (K1, K2, K3, K4)
2.4 Gas – liquid chromatography: Principle and application (K1, K2, K3, K4)
2.5 HPLC (Normal phase & Reverse phase): Principle and application (K1, K2, K3, K4)
2.6 Chromatofocusing - Immunoaffinity and Capillary electrochromatography. (K1, K2, K3, K4)

Unit-III: (15 Hours)

3.1 General principles - Support media for Electrophoresis (K1, K2, K3)
3.2 Electrophoresis of proteins: SDS – PAGE, 2D – PAGE (Native gels & Gradient gels) (K1, K2, K3, K4, K5)
3.3 Isoelectric focusing: Principle and application (K1, K2, K3, K4)
3.4 Cellulose acetate electrophoresis: Principle and application (K1, K2, K3, K4)
3.5 Detection, estimation and recovery of proteins in gels - Protein blotting (K1, K2, K3, K4)
3.6 Electrophoresis of nucleic acids: Agarose gel electrophoresis - DNA sequencing gels - pulsed field gel electrophoresis. (K1, K2, K3, K4)

Unit-IV: (15 Hours)

4.1 Centrifugation - Basic principles (K1, K2, K3)
4.2 Preparative ultracentrifugation: Differential and Density gradient centrifugation. (K1, K2, K3, K4)
4.3 Analytical centrifugation: Applications - Determination of molecular mass and purity of macromolecules. (K1, K2, K3, K4)
4.4 Radioactivity, Nature of radioactivity: Stable and Radioactive isotopes - Units and interaction of radioactivity with matter. (K1, K2, K3)
4.5 Detection and measurement of radioactivity - GM counter - Solid and Liquid

scintillation counter - Autoradiography and Cerenkov counting. (K1, K2, K3, K4, K5)

4.6 Applications of radioisotopes in the Biological sciences. (K1, K2, K3)

Unit-V: **(15 Hours)**

5.1 Laws of Absorption and Absorption spectrum - UV-VIS -IR spectrophotometer: Principle, instrumentation and Applications (K1, K2, K3, K4)

5.2 Luminometry: Principle and applications (K1, K2, K3, K4)

5.3 Flame Emission Spectrophotometer: Principle, instrumentation, operation and applications. (K1, K2, K3, K4)

5.4 Atomic flame and flameless spectrophotometer: Principle and applications (K1, K2, K3, K4)

5.5 NMR, MS, MALDI: Principle, and applications. (K1, K2, K3)

5.6 Use of lasers for spectroscopy. (K1, K2, K3, K4)

Text Books:

1. Keith Wilson and John Walker – Principles and Techniques of Practical Biochemistry Cambridge University - 7th Edition, 2010
2. Upadhyay - Upadhyay and Nath - Biophysical Chemistry – Principles and Techniques - Himalaya Publishing House, 4th Ed, 2022

Reference Books:

1. Chatwal Anand – Instrumental methods of Analysis – Himalaya Publishing House,2011
2. Galen Wood Ewing McGraw - Instrumental methods of Chemical Analysis - Hill College -5th Ed. 2015
3. Robert D. Braun - Introduction to Instrumental Analysis – Pharma Book Syndicate, 2006
4. David Frifelder - Physical Biochemistry - W.H. Freeman 4th Ed, 2017
5. Shawney SK and Randhir Singh - Practical Biochemistry - Alpha Science, 2005

Open Educational Resources (OER):

1. https://youtu.be/P1wRXTl2L3I
2. https://youtu.be/VOSkyj1dtbc
3. https://youtu.be/5obiHqeYEc0
4. https://youtu.be/_-YT44KP3do
5. https://youtu.be/tbUx-RaZS7M

SEMESTER II

PCBCE20 ENZYMOLOGY

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I / II	PCBCE20	Enzymology	Theory	Core	5	5	40 + 60=100

Objectives:

To learn the methodology involved in assessing the enzyme activity and mechanism ofenzyme action.

Course Outcomes (CO)

On completion of the course, the students will be able to,

1. List the enzyme properties, nomenclature and purification of enzymes
2. Apply the biochemical calculation for enzyme kinetics
3. Compare methods for enzyme catalysis and various methods of inhibition
4. Outline the effect of coenzymes and isoenzymes in enzyme catalysis
5. Explain various industrial and clinical applications of enzymes as a catalyst in industries and also as a therapeutic aid

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	M	H	H	M	H
CO 2	H	H	H	H	H	M
CO 3	H	M	H	H	H	H
CO 4	H	M	H	M	M	H
CO 5	H	M	H	H	M	M
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	H	M	M	M	H
CO 2	H	H	H	H	H	H
CO 3	H	H	M	M	M	H
CO 4	H	H	H	M	M	M
CO 5	H	H	H	H	H	H
H- High (3), M-Medium (2), L-Low (1)						

Unit-I: (15 hours)

1.1 Nomenclature, classification, isolation and purification of enzymes (K1, K2)

1.2 Determination of enzymes by different methods, criteria of purity – specific activity (K2, K3)

1.3 Enzyme units - Katal, IU and turnover number (K1, K2)

1.4 Measurement of enzyme activity – Coupled kinetic assay, kinetic assay using radio labelled substrates (K1, K2, K4)

1.5 Active site - determination of active site amino acids- chemical probe, affinity label, and site-directed mutagenesis, intrinsic and extrinsic regulations (K1, K3)

1.6 Investigation of 3-D structure of active site and a brief account of nonprotein enzymes - ribozymes and DNA enzymes (K3, K4)

Unit-II: (15 hours)

2.1 Kinetics of single substrate enzyme - catalyzed reactions - Michaelis - Menten equation, importance of Vmax, Km (K2, K4)

2.2 MM equation; Lineweaver - Burk plot, Eadie - Hofstee plot (K1, K2, K4)

2.3 Hanes - Woolf plot and Eisenthal and Cornish - Bowden plot (K2, K3)

2.4 Pre steady - state kinetics and relaxation kinetics (K1, K2, K4)

2.5 Kinetics of Allosteric enzymes - MWC and KNF models Hill equation coefficient (K2, K3)

2.6 Kinetics of multi - substrate enzyme - catalyzed reactions - Ping-pong bi-bi, random order and compulsory order mechanism (K1, K2, K3, K4)

Unit-III: (15 hours)

3.1 Mechanism of enzymic action - general acid-base catalysis, covalent catalysis (K2, K3)

3.2 Role of metal ion in enzyme catalysis (K1, K3)

3.3 Mechanism of serine proteases - Chymotrypsin, Lysozyme, Carboxy peptidase A and Ribonuclease (K1, K2, K3)

3.4 Reversible inhibition - competitive, uncompetitive, noncompetitive, mixed, (K1, K3)

3.5 Allosteric inhibition (K1, K2)

3.6 Irreversible inhibition – suicide inhibition (K1, K2)

Unit-IV: (15 hours)

4.1 Coenzymes - prosthetic group, classification - vitamin and nonvitamin coenzymes, thiamine pyrophosphate (K1, K2)

4.2 Mechanism of oxidative and nonoxidative decarboxylation, transketolase reaction (K2, K3)

4.3 FMN and FAD - flavoprotein enzymes -mechanism of oxidation and reduction of flavin enzymes, NAD and NADP role in enzyme catalysis (K1, K2, K3)

4.4 PALP and PAMP - role of PALP in transamination and decarboxylation reaction, Coenzyme A involved reactions (K2, K3)

4.5 Biotin - carboxylation reaction, folate coenzymes, coenzyme role of vitamin B_{12} and vitamin C, metabolite and non-vitamin coenzymes, lipoic acid, coenzyme Q, nucleoside triphosphate and S-adenosyl methionine (K1, K2, K4)

4.6 Isoenzymes -Abzymes (K1, K2, K3)

Unit-V: (15 hours)

5.1 Industrial uses of enzymes - sources of industrial enzymes, thermophilic enzymes, amylases, glucose isomerases, cellulose degrading enzymes, lipases, proteolytic enzymes in meat and leather industry, detergents and cheesed production (K2, K3, K4)

5.2 Clinical enzymology – Enzymes as thrombolytic agents, anti-inflammatory agents, digestive aids (K2, K3)

5.3 Therapeutic use of Asparaginases (K1, K2)

5.4 Therapeutic use of Streptokinase (K1, K2)

5.5 Enzymes and isoenzymes in diagnosis - LD, CK, Transaminases, Phosphatases, Amylase and Cholinesterase (K2, K3)

5.6 Immobilization of enzymes and their applications (K1, K2, K4)

Text Books:

1. Trevor Palmer – Enzymes: Biochemistry, Biotechnology and Clinical Chemistry- Albion; Reprint edition - 4th Reprint Edition, 2004
2. Athel Cornels- Bowden, Fundamentals of Enzymes Kinetics - 4th edition, 2012

Reference Books:

1. Bowden A C - Fundamentals of Enzyme Kinetics- Medtech Publishers – 3rd edition - 2017
2. Enzymes by Boyer - Academic Press - 3rd edition, 1983
3. Metzlre – Text of Biochemistry - Academics Press, 2000
4. T.D.H Bugg - Introduction to Enzymes & coenzyme chemistry, 3rd edition, 2012
5. Stewen - Diagnostic Enzymology, 2nd edition, 2014

Open Educational Resources (OER):

1. https://youtu.be/1rfwsCNfLCs
2. https://youtu.be/l4s1TGGnT28
3. https://youtu.be/WfYawcKzyAM
4. https://youtu.be/pzdjg3iG4oM
5. https://youtu.be/Wrz7AISR8xY

SEMESTER II

PCBCF20 INTERMEDIARY METABOLISM

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I / II	PCBCF20	Intermediary Metabolism	Theory	Core	5	4	40 + 60=100

Objective:

To make the students to understand the reactions catalyzed by different enzymes and their metabolic pathways.

Course Outcome (CO)

On completion of the course, the students will be able to;

1. Restate in own words how reduced electron carriers are used to generate ATP via Electron Transport System in Mitochondria
2. Translate the reactions catalyzed by different Enzymes in metabolic pathway
3. Compare the important characteristics of metabolic pathways and assess their regulation
4. Analyze complex chemical reactions and draw logical conclusion by interrelating metabolism
5. Interpret how plants convert energy to nourish themselves

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	H	H	H	H	M
CO 2	H	H	H	H	M	M
CO 3	H	H	L	H	L	M
CO 4	H	H	H	H	M	M
CO 5	H	M	H	H	H	H
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	H	H	H	H	M
CO 2	H	H	H	M	M	M
CO 3	H	H	H	H	L	M
CO 4	H	H	H	H	M	M
CO 5	H	H	L	H	H	H
H- High (3), M-Medium (2), L-Low (1)						

Unit-I: (15 Hours)

1.1 Free energy and entropy - Enzymes involved in redox reactions (K1, K2, K3)

1.2 Electron Transport Chain (K1, K2, K3)

1.3 Oxidative Phosphorylation ATPase: Structure and mechanism of action (K1, K2)

1.4 Chemiosmotic theory – mechanism (K1, K2)

1.5 Inhibitors of respiratory chain and oxidative phosphorylation – Uncouplers (K1, K2, K3, K4)

1.6 Mitochondrial transport systems - ATP/ADP exchange - Malate and Glycerophosphate shuttle. (K1, K2)

Unit-II: (15 Hours)

2.1 Glycolysis - Citric acid cycle: Pathway, Key enzymes and regulations. (K1, K2, K3)

2.2 Metabolism of Glycogen: Pathway, Key enzymes and regulations. (K1, K2, K3)

2.3 Gluconeogenesis (Cori cycle): Pathway, Key enzymes and regulations. (K1, K2, K3)

2.4 Pentose phosphate pathway: Pathway, Key enzymes and regulations. (K1, K2, K3)

2.5 Uronic acid pathway: Pathway, Key enzymes and regulations. (K1, K2, K3)

2.6 Metabolism of galactose and fructose - Glyoxylate cycle: Pathway, Key enzymes and Regulations. (K1, K2, K3)

Unit-III: (15 Hours)

3.1 Oxidation of fatty acids **-** Alpha, Beta and Omega oxidation (K1, K2, K3)

3.2 Biosynthesis of fatty acids (K1, K2, K3)

3.3 Metabolism of ketone bodies - Biosynthesis of triglycerides (K1, K2, K3)

3.4 Metabolism of phospholipids and sphingolipids (K1, K2, K3)

3.5 Cholesterol – Biosynthesis and regulation (K1, K2, K3)

3.6 Cholesterol – Transport and excretion (K1, K2, K3)

Unit-IV: (15 Hours)

4.1 Overview of biosynthesis of nonessential amino acids (K1, K2, K3)

4.2 Catabolism of amino acid - Transamination, Deamination and ammonia formation (K1, K2, K3)

4.3 Urea cycle - Disorders of the urea cycle – Decarboxylation (K1, K2, K3)

4.4 Catabolism of carbon skeletons of amino acids: Phenyl alanine, Tyrosine and Histidine (K1, K2, K3)

4.5 Catabolism of carbon skeletons of amino acids: Methionine and Cysteine (K1, K2, K3)

4.6 Detoxification: Oxidation, Reduction, Hydrolysis and Conjugation (K1, K2, K3)

Unit-V: (15 Hours)

5.1 Interrelationship of carbohydrates, proteins and fat metabolism. (K1, K2, K3, K5)

5.2 Purine anabolism: De novo and salvage pathways for biosynthesis - Purine catabolism (K1, K2, K3)

5.3 Biosynthesis and catabolism of pyrimidines (K1, K2, K3)

5.4 Photosynthesis - Photosynthetic apparatus - light reaction - cyclic and noncyclic photophosphorylation (K1, K2, K3)

5.5 Dark reaction - Calvin cycle - Hatch-Slack pathway (K1, K2, K3)

5.6 Photorespiration - Starch biosynthesis and degradation -Bioluminescence (K1, K2, K3)

Text Books:

1. David L. Nelson Michael M. Cox - Lehninger's Principles of Biochemistry - W H Freeman & co - 7th Edition, 2017
2. Robert K. Murray, et al. - Harper's Illustrated Biochemistry - McGraw Hill - 31st Edition, 2018

Reference Books:

1. Lippincott Williams and Wilkins - Davidson and Sittman Biochemistry NMS - 4th Edition
2. Donald Voet - Judith G. Voet – Biochemistry - Wiley - 4th edition
3. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer – Biochemistry - W H Freeman - 7th edition, 2011
4. Christopher K. Mathews, K.E Van Holde, Kevin G. Ahern – Biochemistry –Pearson Education - 3rd Edition, 2000
5. U. Satyanarayana – Biochemistry - Elsevier - 5th Edition, 2019

Open Educational Resources (OER):

1. https://youtu.be/nCr3iCzX4lc
2. https://youtu.be/ydhr0QAyxYg
3. https://youtu.be/Dc3_LLXsguw
4. https://youtu.be/fJScSmrR1MI
5. https://youtu.be/v-G-d27C1TU

SEMESTER: II

PEBCC20 – ELECTIVE II A: ECOLOGY, EVOLUTION AND DEVELOPMENTAL BIOLOGY

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I /II	PEBCC20	Ecology, Evolution and Developmental Biology	Theory	Elective II A	3	3	40+60=100

Objective:

The course enables the students to understand and analyze the role of ecological and evolutionary modifications in the development of organisms and their survival.

Course Outcome (CO)

On completion of the course, the students will be able to,

1. Outline the concept of ecosystem and its interaction
2. Apply the concept of evolution in population genetics
3. Describe the structures and the development of the embryo at different stages
4. Explain the insight on morphogenesis and organogenesis in plants
5. Schematize pedigree analysis and genetic mapping

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	M	M	M	H	H
CO 2	L	H	H	H	M	M
CO 3	M	H	L	M	H	H
CO 4	L	M	M	L	M	L
CO 5	H	H	L	M	H	L
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	M	H	M	H	H
CO 2	L	H	M	H	M	M
CO 3	H	M	H	L	H	M
CO 4	M	L	M	M	M	H
CO 5	M	H	L	H	L	L
H- High (3), M-Medium (2), L-Low (1)						

Unit I: **(9 hours)**

1.1 Physical environment, biotic environment, biotic and abiotic interaction (K1, K2, K3, K4)

1.2 Concept of habitat and niche, niche width and overlap, fundamental and realized niche (K1, K2, K3, K4, K5, K6)

1.3 Characteristic of a population, population growth curves, population regulation (K1, K2, K3, K4, K5, K6)

1.4 Nature of communities, community structure and attributes, level of species diversity and its measurement. (K1, K2, K3, K4, K5, K6)

1.5 Types and mechanism of succession, concept of climax. (K1, K2, K3, K4)

1.6 Types of interaction, interspecific competition, herbivory, carnivory, pollination, symbiosis. (K1, K2, K3, K4)

Unit II: **(9 hours)**

2.1 Lamarck; Darwin concept of variation, adaptation, natural selection. (K1, K2, K3)

2.2 Origin of basic biomolecule; Abiotic synthesis of organic monomers and polymers (K1, K2, K3)

2.3 Concept of neutral evolution, molecular divergence and molecular clock (K1, K2, K3, K4)

2.4 Population genetics -Populations, gene pool, gene frequency, Hardy-Weinberg Law (K1, K2, K3, K4, K5, K6)

2.5 Adaptive radiation, Isolating mechanisms, Speciation, Allopatricity and Sympatricity (K1, K2, K3, K4, K5, K6)

2.6 Convergent evolution, Sexual selection, Co-evolution (K1, K2, K3, K4)

Unit III: **(9 hours)**

3.1 Production of gametes (K1, K2, K3)

3.2 Cell surface molecules in sperm-egg recognition in animals (K1, K2, K3, K4, K5, K6)

3.3 Embryo sac development (K1, K2, K3, K4)

3.4 Double fertilization in plants (K1, K2, K3, K4)

3.5 Mammalian cleavage, gastrulation (K1, K2, K3, K4)

3.6 Programmed cell death (K1, K2, K3, K4, K5, K6)

Unit IV: **(9 hours)**

4.1 Organization of shoot and root apical meristem (K1, K2, K3, K4)

4.2 Shoot and root development (K1, K2, K3, K4, K5, K6)

4.3 Leaf development and phyllotaxy (K1, K2, K3, K4, K5, K6)

4.4 Transition to flowering, floral meristems (K2, K3)

4.5 Floral development in Arabidopsis (K3, K4)

4.6 Antirrhinum (K1, K2, K3, K4)

Unit V: **(9 hours)**

5.1 Linkage maps, mapping with molecular markers (K1, K2, K3, K4. K5, K6)

5.2 Mapping by using somatic cell hybrids, development of mapping population in plants.

(K1, K2, K3, K4, K5, K6)

5.3 Pedigree analysis (K1, K2, K3)

5.4 LOD score for linkage testing (K1, K2, K3)

5.5 Karyotypes. Polygenic inheritance, heritability and its measurements (K1, K2, K3, K4)

5.6 QTL mapping (K1, K2, K3)

Textbooks:

1. David C- Advanced Molecular Biology, Delve Publishing LLC, 2015.
2. William H. Elliot & Daphne C. Elliott - Biochemistry and Molecular biology, Oxford University Press, 2018.

Reference Books:

1. Gilbert S.F - Developmental Biology-Sinacer Associates Inc, Massachuseets–11th edition, 2016
2. Balinsky B.I - An Introduction to Embryology - W.B. Saunders Publishing Company - 5th edition, 2014.
3. Ridley Mark- Evolution-John Wiley and Sons Ltd, 2007.
4. Charles J.Krebs. Ecology-Pearson Publication, 6th edition, 2016.
5. Hugh Fletcher- Instant notes in genetics - Verlag publishers, 2012.

Open Educational Resources (OER):

1. https://youtu.be/ZeATszO-6e0
2. https://youtu.be/7ww5T7hCdn4
3. https://youtu.be/_fN1H2VnHUs
4. https://youtu.be/5e9RcEGbvm4
5. https://youtu.be/f2dvh0YNDwM

SEMESTER II

PEBCD20 - ELECTIVE II B: TOXICOLOGY

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I / II	PEBCD20	Toxicology	Theory	Elective II B	3	3	40+60=100

Objective:
The course gives a detailed understanding and identification of toxic substances, dose-response, tests conducted and its impact on cellular activities.

Course Outcomes (CO)
On completion of the course, the students will be able to,

1. Outline the scope and factors influencing toxicology
2. Explain the clinical and laboratory findings in the treatment of acute toxic exposures
3. Assess various methods of toxicity testing
4. Discuss the effects of toxic substances on molecular and cellular levels
5. Use the knowledge of air pollutants in the assessment of occupational hazards

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	M	M	H	M	M	H
CO 2	H	H	M	H	H	M
CO 3	H	M	M	M	H	H
CO 4	H	H	H	M	H	H
CO 5	H	H	H	H	H	H
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	M	M	H	M	M	H
CO 2	H	H	H	M	H	M
CO 3	M	M	M	H	M	H
CO 4	H	M	M	M	H	M
CO 5	M	H	H	H	H	H
H- High (3), M-Medium (2), L-Low (1)						

Unit-I: **(9 hours)**

1.1 Eco-toxicology and its environment significance toxic effects (K1, K2, K3, K4)

1.2 Basis for general classification & nature, dose - response relationship (K1, K2, K3)

1.3 Synergism and Antagonism (K1, K2)

1.4 Determination of ED_{50} & LD_{50} (K1, K2, K3, K4, K5 K6)

1.5 Acute and chronic exposures (K1, K2, K3, K4, K5 K6)

1.6 Factors influencing toxicity. Pharmacodynamics & Chemo dynamics (K1, K2, K3, K4)

Unit-II: **(9 hours)**

2.1 Regulators guidelines, mammalian systems affected & the clinical signs of systemic toxicity (K1, K2, K3, K4)

2.2 Factors affecting acute toxicity studies (K1, K2, K3, K4)

2.3 Biochemical basis of toxicity, Mechanism of toxicity: disturbance of excitable membrane function altered calcium homeostasis. (K1, K2, K3, K4, K5, K6)

2.4 Covalent binding to cellular macromolecules (K1, K2, K3)

2.5 Genotoxicity (K1, K2)

2.6 Tissue specific toxicity (K2, K3)

Unit-III: **(9 hours)**

3.1 Test Protocol, Genetic Toxicity Testing & Mutagenesis Assays: Invivo test systems (K1, K2, K3)

3.2 Bacterial Mutation Tests: Reversion Tests, Ames test, Fluctuation Tests & Eukaryote Mutation Tests (K1, K2, K4)

3.3 In Vivo Mammalian Mutation Tests – host mediated assay & dominant lethal test (K2, K3, K4, K5, K6)

3.4 Use of drosophila in toxicity testing (K3, K4, K5, K6)

3.5 DNA repair assays. Chromosome damage test (K3, K4, K5, K6)

3.6 Toxicological Evaluation of Recombinant DNA –Derived Proteins (K2, K3, K4)

Unit-IV: **(9 hours)**

4.1 Toxicology of food additives (K1, K2, K3)

4.2 Metal toxicity: Toxicology of Arsenic, Mercury, Lead and Cadmium (K2, K3)

4.3 Environmental Factors Affecting Metal Toxicity- Effect of Light, Temperature & P^H (K1, K2)

4.4 Diagnosis of toxic changes in liver and kidneys (K3, K4, K5, K6)

4.5 Metabolism of Haloalkanes (K2, K3)

4.6 Haloalkenes & Paracetamol with their toxic effects on tissues (K2, K3, K4, K5, K6)

Unit-V: **(9 hours)**

5.1 Air pollution & ozone (K2, K3, K4)

5.2 Air pollution due to chlorofluorocarbons (CFCS) and asbestos (K1, K2, K3, K4)

5.3 Occupational toxicology and assessment of occupational hazards: industrial effluent toxicology & environmental health (K2, K3, K4, K5, K6)

5.4 An overview of regulatory agencies: responsibilities of regulatory agencies (K3, K4, K5)

5.5 Management of toxicological risks (K3, K4, K5, K6)

5.6 Regulatory approaches. Regulatory systems and organizations (K3, K4, K5, K6)

Text Books:

1. G. Tyler Miller and Scott E. Spoolman - Environmental Science - Cengage learning - 15th edition, 2016
2. George Tyler Miller, Jr. and Scott Spoolman - Living in the Environment – Principles, Connections and Solutions, Brooks/Cole, USA - 17th edition, 2012.

Reference Books:

1. Casarett and Doull's – Toxicology - Mc Graw Hill Education – 9th edition, 2013
2. Raymond D and Marie M - Industrial Toxicology - Wiley Publications – 6th Ed, 2015
3. Hayes A W-Principles and methods of Toxicology- CRC press New York, 6th Ed, 2014
4. Stepham M and Robert C –Principles of Toxicology - Wiley-Interscience – 3rd Ed, 2015
5. Anil Agarwal - Textbook of Forensic Medicine and Toxicology - Avichal Publishing Company - 1st edition, 2017

Open Educational Resources (OER):

1. https://youtu.be/eIZr7M-kt2s
2. https://youtu.be/YnsN1LozlEc
3. https://youtu.be/v4jmPpTcdxQ
4. https://youtu.be/dBcS_-WrTIE
5. https://youtu.be/hYgma4mYM0w

SEMESTER – III

PCBCJ20 - ADVANCED IMMUNOLOGY

Year/Sem	Course Code	Title Of The Course	Course Type	Course Category	H/W	Credits	Marks
II / III	PCBCJ20	Advanced Immunology	Theory	Core	6	5	40+60=100

Objectives:

To help the students to understand the components of immune system and it's functioning.

Course Outcomes (CO)

On completion of the course, the students will be able to;

1. Identify various mechanisms that regulate immune response
2. Compare and contrast innate and adaptive immunity
3. Outline the cell types and organ present in the immune response
4. Discuss the reason for different vaccination
5. Communicate the adverse effect of immunodeficiency disorder

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	M	H	H	M	M
CO 2	H	H	H	M	H	M
CO 3	M	H	M	H	H	M
CO 4	H	M	H	M	H	M
CO 5	H	H	H	H	M	M
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	H	M	M	L	H
CO 2	H	M	H	H	H	M
CO 3	H	H	M	M	L	M
CO 4	H	M	M	M	L	M
CO 5	H	H	M	M	L	M
H- High (3), M-Medium (2), L-Low (1)						

Unit I: **(18 Hours)**

1.1 Lymphoid system-Definition, Central lymphoid organs-Thymus, Bone marrow (K1, K2, K3, K4, K5, K6)

1.2 Peripheral lymphoid organs-Lymph node, Spleen & MALT (K1, K2, K3, K4, K5, K6)

1.3 Cells involved in immune system-Lymphocytes, Mononuclear phagocytes, Granulocytes, Mast cells, NK cells (K1, K2, K3, K4, K5, K6)
1.4 Antigen, Haptens, adjuvants, antigenicity, Epitopes (K1, K2, K3, K4, K5, K6)
1.5 Immunoglobulins - basic structure, classification & functions, allotypes and idiotypes. Theories of antibody formation- side chain (K1, K2, K3, K4, K5, K6)
1.6 Clonal selection theory (K1, K2, K3, K4, K5, K6)

Unit II: (18 Hours)

2.1 Immunity: Types of immunity - innate and acquired immunity (K1, K2, K3, K4, K5, K6)
2.2 Antitoxic, antibacterial and antiviral immunity (K1, K2, K3, K4, K5, K6)
2.3 Humoral and cell mediated immunity (K1, K2, K3, K4, K5, K6)
2.4 Antigen recognition - T cell and B cell receptor complexes, antigen processing and presentation (K1, K2, K3, K4, K5, K6)
2.5 Interaction of T and B cells, cytokines. Immunological memory (K1, K2, K3, K4, K5, K6)
2.6 Cytotoxicity - immunotolerance, immunosuppression (K1, K2, K3, K4, K5, K6)

Unit III: (18 Hours)

3.1 Complement system -Nomenclature, activation of complement –classical & alternative pathway (K1, K2, K3, K4, K5, K6)
3.2 Complement fixation test (K1, K2, K3, K4, K5, K6)
3.3 Immunological techniques- Immunoprecipitation, RIA, ELISA (K1, K2, K3, K4, K5, K6)
3.4 Avidin-biotin mediated assay (K1, K2, K3, K4, K5, K6)
3.5 Immunohistochemistry and immuno electrophoresis (K1, K2, K3, K4, K5, K6)
3.6 Immunoblotting (K1, K2, K3, K4, K5, K6)

Unit IV: (18 Hours)

4.1 Vaccines - killed, attenuated organisms, toxoids, recombinant vector vaccines (K1, K2, K3, K4, K5, K6)
4.2 Subunit vaccines, anti-idiotypic vaccines (K1, K2, K3, K4, K5, K6)
4.3 MHC complex – MHC genes - HLA genes, class I and II antigens-Structure and function (K1, K2, K3, K4, K5, K6)
4.4 Histocompatibility testing -cross matching (K1, K2, K3, K4, K5, K6)
4.5 Transplantation – types (K1, K2, K3, K4, K5, K6)
4.6 Genetics of transplantation - graft versus host reactions (K1, K2, K3, K4, K5, K6)

Unit V: (18 Hours)

5.1 Hypersensitivity - Definition, classification and factors influencing hypersensitivity (K1, K2, K3, K4, K5, K6)
5.2 Type I-hypersensitivity-mechanism (K1, K2, K3, K4, K5, K6)

5.3 Type II, III, IV and V hypersensitivity-mechanism, diagnosis and treatment (K1, K2, K3, K4, K5, K6)
5.4 Immunodeficiency disorders - B cell deficiencies (K1, K2, K3, K4, K5, K6)
5.5 Immunodeficiency disorders - T cell deficiencies (K1, K2, K3, K4, K5, K6)
5.6 AIDS, COVID -pathogenesis, diagnosis & Treatment (K1, K2, K3, K4, K5, K6)

Text Books:

1. Dulsi Fathima & Arumugam-Immunology- Saras Publications- 4th Edition, 2014
2. Ivo Roitt- Essential Immunology -Blackwell Publishing-13th Edition, 2017

Reference Books:

1. Abul K. Abbas, Andrew Lichtman-Cellular and Molecular Immunology-Saunders Publishers -9th Edition, 2017
2. Kuby J. – Immunology-W H Freeman Company, New York- 7th Edition-2013.
3. Tizard L R –Immmunology-Saunders Publishers-13th Edition, 2017
4. Frank C. Hay, Olwyn M. R. Westwood, Paul N. Nelson, and Leslie Hudson-Practical Immunology -Blackwell Publishing, Incorporated- 4th Edition, 2008
5. D. M. Weir- Immunological Techniques -13th Edition, 2002

Open Educational Resources (OER):

1. https://www.youtube.com/watch?v=O-r7FFkiItk
2. https://www.youtube.com/watch?v=sYjtMP67vyk
3. https://www.youtube.com/watch?v=YJ0-qQslqqQ
4. https://www.youtube.com/watch?v=mH8IoSuh64o
5. https://www.youtube.com/watch?v=uW96-mBFGag

SEMESTER – III

PCBCK20 - ADVANCED BIOTECHNOLOGY

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
II / III	PCBCK20	Advanced Biotechnology	Theory	Core	5	4	40+60=100

Objective:

To learn how to apply the knowledge of genetic engineering in problem solving and in practice.

Course Outcome (CO)

On completion of the course, the students will be able to;

1. Illustrate the tools and strategies used in genetic engineering
2. Apply the knowledge of genetic engineering in problem solving and in practice
3. Categorize how plant and animal cells are cultured and genetically manipulated in laboratory
4. Make use of the various steps in the development of a biotechnology derived products
5. Report the applications of genetic engineering technique in basic and applied experimental biology

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	H	H	H	H	M
CO 2	H	H	H	H	M	M
CO 3	H	H	M	L	M	L
CO 4	H	H	H	H	M	M
CO 5	H	M	H	H	H	H
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	H	H	H	H	M
CO 2	H	H	H	H	M	M
CO 3	H	H	H	H	M	M
CO 4	H	H	H	L	M	L
CO 5	H	H	M	H	H	H
H- High (3), M-Medium (2), L-Low (1)						

Unit I: (15 Hours)

1.1 Basic principles – Steps involved - Enzymes used in genetic engineering (K1, K2, K3)

1.2 Restriction enzymes: Types and target sites (K1, K2, K3)
1.3 Cutting and joining of DNA molecules - linkers and adaptors - Homopolymers (K1, K2, K3)
1.4 Cloning vehicles and their properties: Natural and Based plasmids (pBR322) (K1, K2, K3)
1.5 Cosmid vectors (K1, K2, K3, K5)
1.6 Shuttle vectors. (K1, K2, K3, K5)

Unit II: **(15 Hours)**

2.1 DNA library: cDNA and Genomic libraries (K1, K2, K3, K5)
2.2 Recombinant selection and screening methods - Expression of cloned genes - Problems and solutions (K1, K2, K3)
2.3 DNA sequencing strategies - Sanger's and Maxam - Gilbert's methods (K1, K2, K3, K4)
2.4Applications of PCR and DNA hybridization (K1, K2, K3, K5)
2.5 Southern and Northern blotting (K1, K2, K3, K4, K5)
2.6 Western blotting. (K1, K2, K3, K4, K5)

Unit III: **(15 Hours)**

3.1 Culturing explants and haploids - Protoplasts fusion and Embryoids (K1, K2, K3, K4, K5, K6)
3.2 Methods of gene transfer to plants, animals and bacteria- Transfection, Electroporation, shotgun and others (K1, K2, K3, K4)
3.3 Transgenic plants, GM foods and biopesticides, gene knockouts (K1, K2, K3, K4)
3.4 Transgenic animals, animal pharming and xenografting (K1, K2, K3, K4, K5)
3.5 Biodegradation, stimulation and its applications (K1, K2, K3, K4, K5)
3.6 Bioleaching. (K1, K2, K3)

Unit IV: **(15 Hours)**

4.1 Industrial biotechnology – fermentors (K1, K2, K3)
4.2 Ethanol and Citric acid production: Principle, types, product recovery and purification (K1, K2, K3, K4)
4.3 Vitamin B_{12} and Streptomycin production: Principle, types, product recovery and purification (K1, K2, K3, K4)
4.4 Enzyme biotechnology-production and uses of industrially important enzymes such as protease (K1, K2, K3, K4)
4. 5 Immobilization of enzymes and their applications (K1, K2, K3, K4)
4.6 Waste treatment, bioenergy and biogas production. (K1, K2, K3, K4)

Unit V: **(15 Hours)**

5.1 Gene therapy (somatic): Principle and approaches. (K1, K2, K3, K4)
5.2 Potential hazards - Biological weapons - Biosafety of GM foods and GMOs - substantial equivalence and safety testing - Gene drain - Tangled genes (K1, K2, K3)

5.3 Human genome research – the objectives and approaches, genomics and genome prospecting - the controversies (K1, K2, K3, K4)
5.4 Issues of biotechnology-social and scientific – technology protecting systems and the terminator (K1, K2, K3, K4)
5.5 IPR: concepts and conditions (K1, K2, K3)
5.6 Patenting of genes, cells and life forms - evaluation of life patenting. (K1, K2, K3, K5, K6)

Text Books:

1. William J. Thieman, Michael A. Palladino - Introduction to Biotechnology –Pearson New international Edition, 2013
2. Bourgaise Jewell, Buiser– Biotechnology - Pearson Education – 2nd Edition, 2004

Reference Books:

1. R.C. Dubey - A Text book of Biotechnology - S. Chand Publishing - 5th edition
2. Lewin B - Genes – VIII - Pearson - 2004
3. Glick & Pasternak - Molecular Biotechnology - 4th Edition, 2010
4. T.A. Brown-Gene Cloning & DNA Analysis–an introduction-6th Edition Wiley-Blackwell
5. U. Satyanarayana - Biotechnology – 12th Edition, 2019

Open Educational Resources (OER):

1. https://www.youtube.com/watch?v=1lqQn3_PvMs
2. https://youtu.be/Ll_7z4YS2Ak
3. https://youtu.be/aSb5PNwrRx0
4. https://www.slideshare.net/mobile/DineshS50/citric-acid-production-74641179
5. https://youtu.be/-hryHoTIHak

SEMESTER-III & IV

PCBCN20 – MAIN PRACTICAL – III

[Endocrinology, Immunotechniques, Biotechnology]

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
II/ III & IV	PCBCN20	Main Practical - III	Practical	Core	5	4	40+60 =100

Objective:

The course is aimed to enable the student interpret hormonal imbalance and clinical conditions and also to provide in-depth practical knowledge and skill in performing immune-techniques and cell culture techniques.

Course Outcome (CO)

On completion of the course, the students will be able to,

1. Analyse the prevalence and impact of endocrine hormone in regulating health
2. Use the practical skill for diagnosing immunological reaction in relation to disease condition
3. Apply tissue culture technique and fermentation process for various applications

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	H	M	L	M	H
CO 2	L	H	H	H	H	L
CO 3	H	H	L	H	M	L
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**1**	**2**	**3**	**4**	**5**	**6**
CO 2	H	H	M	H	M	M
CO 3	H	L	H	L	H	H
H- High (3), M-Medium (2), L-Low (1)						

Endocrinology

Case Studies (Identification of diseases based on patient history)

Immunotechniques:

1. Blood film preparation and identification of cells.
2. Demonstration of immuno reaction
   - Blood group
   - Widal test
   - Pregnancy test
   - Coombs test
   - ELISA
   - Antigen antibody reaction
   - Ouchterlony double diffusion, Immunoelectrophoretic, Immunoblotting, Immunostaining, Immunofluorescent
3. Antibody sensitivity test
4. Measurement of antibodies - Serial dilution
5. Determination MIC

Biotechnology

1. Preparation of Culture media & Reagents - Media composition, Nutrition, Hormones. Tissue Culture – Callus culture, Cell suspension.
2. Organ Micro-culture - Shoot tip, excised root, Leaf culture Plant micro-propagation – micro-culture of plants.
3. Basic sterilization techniques required for Media preparation & Cytological techniques Preparation of Slides.
4. Staining of Slides.
5. Image analysis & Karyotyping.
6. Preparation of alcohol using fermentation process.

Reference Books:

1. Shirlyn B McKenzie- Clinical Laboratory Haematology- Pearson Publication, 2009
2. Hrudayanath Thatol, Supriya Dash, Swagat Kumar Das- Practical Biotechnology: Principles and Protocols- I K International Publishing House Pvt, 2017.
3. Robert H Smith. Plant tissue Culture- Techniques and Experiments- Academic Press, 3rd Edition, 2012.
4. Ivan Roitt, Jonathan Brostoff, David Male, David Roth- Immunology-Mosby Publication. 7th Edition, 2006
5. Charles GD Brook and Nicholas J Marshall- Essential Endocrinology - New Age International Publishers, 4th Edition, 2006

ONE WEEK HANDS ON TRAINING IN ANY INDUSTRY

SEMESTER-III & IV SEMESTER – III
PEBCE20 - ELECTIVE III A: MICROBIOLOGY

Year/ Sem	**Course Code**	**Title of the Course**	**Course Type**	**Course Category**	**H/W**	**Credits**	**Marks 100**
II / III	PEBCE20	Microbiology	Theory	Elective III A	3	3	40+60=100

Objective:
To understand the importance of applications of microorganisms.

Course Outcome (CO)
On completion of the course, the students will be able to;
1. Recall the taxonomy, morphological features and division process of microbes
2. Outline the microbial growth and its metabolism
3. Apply the microbial culture technique
4. Gain knowledge on the replication processes in microbes
5. Identify the various infectious diseases, its causative agents and antimicrobial drugs

CO / PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	H	H	M	H	H	L
CO 2	H	L	M	H	M	L
CO 3	H	H	H	H	H	M
CO 4	H	H	H	M	L	M
CO 5	H	H	H	L	M	M
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO 1	H	M	M	M	H	M
CO 2	H	M	M	M	M	M
CO 3	H	H	M	H	H	L
CO 4	H	H	M	M	M	M
CO 5	H	H	H	H	H	M
H- High (3), M-Medium (2), L-Low (1)						

Unit I: **(9 Hours)**

1.1 Morphology and Ultrastructure of bacteria, fungi, algae and protozoa. (K1, K2)

1.2 Classification of microbes, molecular taxonomy, cell walls of eubacteria – peptidoglycan and related molecules (K1, K2)

1.3 Structure and synthesis of cell wall and cell membrane of gram – positive and negative bacteria (K1, K3)

1.4 Flagella and motility. Cell inclusion bodies. (K1, K2)

1.5 Blue and green bacteria. Budding and appendaged bacteria, spirilla, spirochaetes, gliding and sheathed bacteria, pseudomonas, lactic and propionic acid bacteria. (K1, K2, K3)

1.6 Endospore forming rods and cocci, myobacteria, rickettsia and mycoplasma. Archaebacteria (K1, K2, K3)

Unit II: **(9 Hours)**

2.1 Microbial growth – Definition. Mathematical expression of growth, growth curve, measurement of growth and factors affecting growth. (K1, K2, K3)

2.2 Microbial metabolism – Overview, photosynthesis in microbes. Role of chlorophylls, carotenoids and phycobilins, Calvin cycle. (K1, K2, K3, K4)

2.3 Chemolithotrophy: hydrogen ion – nitrite oxidizing bacteria: nitrate and sulfate reduction: methanogenesis and acetogenesis (K1, K2, K3)

2.4 Fermentations – diversity, syntrophy – role of anoxic decompositions (K1, K2, K3)

2.5 Nitrogen metabolism, nitrogen fixation (K1, K2)

2.6 Hydrocarbon transformation (K1, K2, K4)

Unit III: **(9 Hours)**

3.1 Methods in microbial identification. Pure culture techniques (K1, K2, K3, K4)

3.2 Theory and practice of sterilization (K2, K2, K3, K4)

3.3 Principles of microbial nutrition (K1, K2)

3.4 Construction of culture media (K1, K2, K3, K4)

3.5 Enrichment culture techniques for isolation of hemoautotrophs (K1, K2, K3, K4)

3.6 Chemoheterotrophs and photosynthetic microbes. (K1, K2, K3, K4)

Unit IV: **(9 Hours)**

4.1 Bacteria, plant, animal and tumour viruses (K1, K2)

4.2 Classification and structure of viruses. Lytic cycle and lysogeny (K1, K2)

4.3 DNA viruses: positive and negative strand (K1, K2)

4.4 Double stranded RNA viruses (K1, K2, K3)

4.5 Replication: example of Herpes, Adenoviruses (K1, K2)

4.6 Replication: example Retrovirus, Viroids and Prions (K1, K2)

Unit V: **(9 Hours)**

5.1 Disease reservoirs; Epidemiological terminologies. Infectious disease transmissions. Respiratory infections caused by bacteria and viruses (K1, K2, K3)

5.2 Tuberculosis, sexually transmitted diseases including AIDS; Vector bone diseases (K1, K2, K3, K4)

5.3 Water borne diseases, Public health and water quality. (K1, K2, K5)

5.4 Pathogenic fungi (K1, K2, K3, K4)

5.5 Antimicrobial agents, Antibiotics. Penicillin and Cephalosporins, Broad spectrum antibiotics. Antibiotics from Prokaryotes (K1, K2, K3, K4)

5.6 Antifungal antibiotics – mode of action, Resistance to antibiotics. (K1, K2, K3, K4)

Text Books:

1. Michael J Pelczar, E.C.S Chan and Noel R Krieg Microbiology- McGraw Hill, 5th Edition, 2001
2. Ananthanarayan and Paniker- Textbook of Microbiology- Universities Press, 10th Edition, 2002.

Reference Books:

1. Jawetz, Melnick and Adelberg- Medical Microbiology-Jaypee Medical- 2015.
2. Patrick R Murray- Basic Medical Microbiology- Elsevier, 2019.
3. Robert W Bauman- Microbiology with diseases by Taxonomy- Pearson Publication, 2012.
4. Prescott. Microbiology- McGraw Hill Education, 9th Edition, 2013.
5. Jacquelyn G Black-Microbiology- International Student Version, 8th Edition, 2012.

Open Educational Resources (OER)

1. https://youtu.be/ei6Z7orCpPk
2. https://youtu.be/NYMTeqpr6JI
3. https://youtu.be/J5Nz4cQJ2u8
4. https://youtu.be/fH1zS7hlW54
5. https://youtu.be/202hkf43HXQ

SEMESTER III

PEBCF20 - ELECTIVE III B: RESEARCH METHODOLOGY

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
II / III	PEBCF20	Research Methodology	Theory	Elective III B	3	3	40+60=100

Objective:

To addresses the issues inherent in selecting a research problem and discuss the techniques and tools to be employed in completing a research project.

Course Outcome (CO):

On completion of the course, the students will be able to;

1. Design the research work
2. Gain an idea on the role of biostatistics in research
3. Understand the significance of internet in research
4. Develop the understanding on database management system
5. Practice the concepts of animal studies and CPCSEA guidelines in research

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	H	H	H	M	L
CO 2	H	H	H	M	M	M
CO 3	H	H	M	H	H	M
CO 4	H	H	H	M	M	L
CO 5	H	H	M	H	M	M
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	H	H	H	M	H
CO 2	H	H	H	M	M	M
CO 3	H	H	M	M	M	M
CO 4	H	H	M	M	M	L
CO 5	H	H	M	H	M	M
H- High (3), M-Medium (2), L-Low (1)						

Unit I: **(9 Hours)**

1.1 Scientific research & writing - Importance and need for research. (K1, K2, K3, K4)

1.2 Ethics and scientific research. Formulation of hypothesis. (K1, K2, K3, K4)

1.3 Types and characteristic designing a research work. (K1, K2, K3, K4, K6)

1.4 Scientific writing - Characteristics - Logical format for writing thesis and papers. (K1, K2, K3, K4, K6)

1.5 Essential features of abstract, introduction, review of literature, materials and methods, and discussion. (K1, K2, K3, K4, K6)

1.6 Effective illustration - tables and figures. Reference styles - Harvard and Vancouver systems. (K1, K2, K3)

Unit II: **(9 Hours)**

2.1 Biostatistics - Collection and classification of data (K1, K2, K3, K4, K6)

2.2 Diagrammatic and graphic representation of data measurement of central tendency (K1, K2, K3, K4, K5, K6)

2.3 Standard deviation - normal distribution (K1, K2, K3)

2.4 Test of significance based on large samples - small samples - Student t test (K1, K2)

2.5 Correlation and regression (K1, K2)

2.6 Chi square test for independence of attributes - ANOVA. (K1, K2, K3)

Unit III: **(9 Hours)**

3.1 Bioinformatics - Introduction to bioinformatics (K1, K2, K3)

3.2 Scope of bioinformatics (K1, K2, K3, K4)

3.3 Role of computers in biology (K1, K2)

3.4 Internet - The World Wide Web. (K1, K2, K3)

3.5 Useful search engines - Boolean searching, search engine algorithms. (K1, K2, K3)

3.6 Finding scientific articles – PubMed, Science direct. (K1, K2, K3)

Unit IV: **(9 Hours)**

4.1 Databases - Data base concepts - database, database system, database management systems - hierarchical, rational and network, database security**.** (K1, K2, K3, K4)

4.2 Biological databases - types, sequence and structure. (K1, K2)

4.3 Data submission (K1, K2)

4.4 Data retrieval. (K1, K2)

4.5 Searching sequence databases - sequence similarity searches, amino acid substitution matrices. (K1, K2, K3, K4, K6)

4.6 Database search - FASTA and BLAST, CLUSTAL. (K1, K2, K3, K6)

Unit V: **(9 Hours)**

5.1 Bioethics. (K1, K2)

5.2 Ethics in animal experimentation. CPCSEA guidelines - Animal care and technical personnel environment, animal husbandry, feed, bedding, water, sanitation and

cleanliness, waste disposal, anesthesia and euthanasia. (K1, K2, K3, K6)

5.3 Composition of (Human) institutional Ethical Committee (IEC) - General ethical issues. (K1, K2, K3)

5.4 Specific principles for chemical evaluation of drugs, herbal remedies and human genetics research (K1, K2, K3)

5.5 Ethics in food and drug safety. (K1, K2, K3)

5.6 Environmental release of microorganisms and genetically engineered organisms. Ethical issues in human gene therapy and human cloning. (K1, K2)

Text Books:

1. C R Kothari -Research Methodology- Methods and Techniques, 4th Edition., 2019.
2. Ranjit Kumar -Research methodology- Pearson education, 2005.

Reference Books:

1. Bryan Bergeron MD- Bioinformatics Computing- Prentice-Hall of India Pvt.Ltd, 2012.
2. Bergeron BP- Bioinformatics Computing- Printice Hall, 1st Edition, 2002.
3. John M Lachin-Biostatistical Methods- Wiley interscience, 1st Edition, 2000.
4. Ethical guidelines for biomedical research on human subjects. ICMR, New Delhi, 2000.
5. Sundar Rao, Jesudian Richard -An Introduction to Biostatistics, 5th Edition, 2012.

Open Educational Resources (OER)

1. https://youtu.be/3FE5ldiIp6A
2. https://youtu.be/Coe0N2xb8kk
3. https://youtu.be/Nx_E4Z4y8uQ
4. https://youtu.be/Ap3rUxB4k9Q
5. https://youtu.be/kAxTbc6nsFs

SEMESTER IV

PCBCL20 MOLECULAR BIOLOGY

Year/ Sem	**Course Code**	**Title of the Course**	**Course Type**	**Course Category**	**H/W**	**Credits**	**Marks**
II / IV	PCBCL20	Molecular Biology	Theory	Core	6	5	40+60=100

Objective:

The course will enable the student to learn the molecular events occurring in gene and its application in field of biomedical and genetic research.

Course Outcome (CO)

On completion of the course, the students will be able to;

1. Demonstrate the nature and role of Gene in life activity
2. Describe the blueprint of life and its functions
3. Outline the mechanism of Replication
4. Outline the role of Transcription
5. Demonstrate the features of Genetic code and mechanism of Translation

CO / PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	M	H	H	M	M	M
CO 2	H	L	M	H	H	H
CO 3	L	M	M	L	H	M
CO 4	M	M	H	H	M	L
CO 5	H	H	H	H	M	L
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO 1	M	H	H	L	M	M
CO 2	H	L	M	H	H	H
CO 3	M	H	H	M	H	M
CO 4	L	M	H	M	L	H
CO 5	H	H	L	H	M	L
H- High (3), M-Medium (2), L-Low (1)						

Unit I: (18 Hours)

1.1 Gene arrangements in prokaryotes and eukaryotes (K2, K3, K4, K5)

1.2 Gene structure in eukaryotic organisms, introns, exons, pseudogenes, and gene clusters,

spacers, repetitive sequences (K1, K2, K3, K4)

1.3 Single and multiple copy genes in eukaryotes, eg – Histones, Alu, copia, satellite. Mapping of human genes – techniques used, assignment of important genes (K2, K3, K4, K5)

1.4 Gene regulatory mechanisms and cell memory- structure of chromatin - nucleosomes and higher orders of organization (K2, K3, K4, K5, K6)

1.5 Chromosome and genes, chromosomal replication, genetic mapping of chromosomes, chromosome banding (K2, K3, K4, K5, K6)

1.6 Transposition in human chromosome and chromosomal abnormalities (K1, K2, K3, K4)

Unit II: **(18 Hours)**

2.1 DNA replication in prokaryotes (K3, K4, K5, K6)

2.2 DNA replication in Eukaryotes (K3, K4, K5, K6)

2.3 Inhibitors of prokaryotic replication (K1, K2, K3, K4)

2.4 Inhibitors of Eukaryotic replication (K2, K3, K4)

2.5 Replication in RNA virus (K2, K3, K4)

2.6 Plasmid replication (x174, nl3 A. DNA) (K1, K2, K3)

Unit III: **(18 Hours)**

3.1 Prokaryotic Transcription- Promotors, foot-printing experiment, DNA - dependent RNA polymerase -Role of Pribnowbox (K2, K3, K4)

3.2 Prokaryotic transcription – mechanism in prokaryotes (K3, K4, K5, K6)

3.3 Eukaryotic transcription (K3, K4, K5, K6)

3.4 Post-transcriptional modifications of eukaryotic RNAs, RNA splicing, introns and splicing reactions (K1, K2, K3, K4)

3.5 Self-splicing introns - group I and group II, exons, spacer sequences, enhancers (K1, K2, K3, K4)

3.6 Reverse transcriptase, retroviruses (K1, K2, K3, K4)

Unit IV: **(18 Hours)**

4.1 Genetic code: Salient features (K1, K2, K3, K4)

4.2 Wobble mechanism and its significance (K1, K2, K3, K4)

4.3 Prokaryotic protein biosynthesis (K3, K4, K5, K6)

4.4 Eukaryotic protein biosynthesis (K3, K4, K5, K6)

4.5 Inhibitors of protein synthesis (K1, K2, K3, K4)

4.6 Post-translational modifications in prokaryotes and eukaryotes (K1, K2, K3, K4)

Unit V: **(18 Hours)**

5.1 DNA repair – types (K1, K2, K3, K4)

5.2 Regulation of gene expression in prokaryotes: Operon concept- lac operon (K3, K4, K5, K6)

5.3 An overview of Genomics - Structural genomics (K1, K2, K3, K4)

5.4 Functional genomics (K3, K4, K5, K6)

5.5 An overview of Proteomics (K1, K2, K3, K4)
5.6 Human Genome Project, chromosome maps – DNA micro arrays (K1, K2, K3, K4)

Text Books:

1. Lehninger, David Nelson and M. Chael M. Cox - Principles of Biochemistry-W.H Freeman and Company Ltd- 4th Edition,2005
2. David Friefelder - Molecular Biology- Narosa Publishing House-2nd Edition,2005.

Reference Books:

1. Lodish, Darnell and Baltimore - Molecular Cell Biology-W.H. Freeman & Company-4th Edition,2000
2. T. A. Brown. Gene Cloning and DNA analysis- An introduction. John Wiley Publications - 7 edition, 2016.
3. Gerald Karp, Janet Iwasa, Wallace Marshall. Cell and Molecular Biology, Wiley Publications - 9th edition, 2019.
4. Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick. Genes XII. Jones and Barlett Publisher - 12th edition, 2017.
5. Rajeev Tyagi. Genetics, Genomics, Proteomics & Bioinformatics. Manglam Publishers & Distributors, 2012.

Open Educational Resources (OER);

1. https://www.youtube.com/watch?v=3wTAEfjo20c
2. https://www.youtube.com/watch?v=Dc21ml8-_PI
3. https://www.youtube.com/watch?v=exJDso2_yRQ
4. https://www.youtube.com/watch?v=fp9x6TZ_zEY
5. https://www.youtube.com/watch?v=5paHhTq87Ak

SEMESTER - IV

PEBCG20 ELECTIVE – IV A: PLANT BIOCHEMISTRY

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
II / IV	PEBCG20	Plant Biochemistry	Theory	Elective – IV A	3	3	40+60=100
II / IV	PEBCG20	Plant Biochemistry	Theory	Elective – IV A	3	3	40+60=100

Objective:

To help the students to understand the plant metabolites and their application in the field of medicine.

Course Outcomes (CO)

On completion of the course, the students will be able to;

1. Identify various natural and artificial ways to propagate plants
2. Discuss the function and composition of different plant structures
3. Describe the processes of germination and plant growth
4. Explain the role of plant growth regulators and plant tissue culture
5. Perform the calculations to predict expected plants by experiments

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	M	H	H	M	M
CO 2	H	H	H	M	H	M
CO 3	M	H	M	H	H	M
CO 4	H	M	H	M	H	M
CO 5	H	H	H	H	M	M
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	H	M	M	L	H
CO 2	H	M	H	H	H	M
CO 3	H	H	M	M	L	M
CO 4	H	M	M	M	L	M
CO 5	H	H	M	M	L	M
H- High (3), M-Medium (2), L-Low (1)						

Unit I: (9 Hours)

1.1 Photosynthetic Pigment, Light reaction (K2, K3, K4)

1.2 Dark reactions of photosynthesis (K2, K3, K4)

1.3 Proton gradient and ATP synthesis of chloroplast (K2, K3, K4)

1.4 Regulation of photosynthesis - Mode of action of DCMU (K1, K2, K3, K4)
1.5 Bacterio rhodopsin, CAM metabolism, RUBISCO (K2, K3, K4)
1.6 Regulation of photorespiration and crop productivity (K2, K3, K4)

Unit II: **(9 Hours)**

2.1 Nitrogen cycle Disotropes biochemistry of Symbiotic and Nonsymbiotic nitrogen fixation (K2, K3, K4)
2.2 Assimilation of ammonium, carbon- nitrogen ratio (K1, K2, K3, K4)
2.3 Uride metabolism, Nitrate metabolism, Genetics of nitrogen fixation, Genetic manipulation of Nif genes (K2, K3, K4)
2.4 Biosynthesis, Mode of action, transport, distribution and physiological effect of Auxin, Gibberellin, Cytokinin (K2, K3, K4)
2.5 Biosynthesis, Mode of action, transport, distribution and physiological effect of Abscisic acid (ABA) (K2, K3, K4)
2.6 Biosynthesis, Mode of action, transport, distribution and physiological effect of Ethylene (K2, K3, K4)

Unit III: **(9 Hours)**

3.1 Biochemistry of plant disease, defense mechanism of plants (K3, K4)
3.2 Biosynthesis, distribution and biological functions of industrially important secondary metabolite (K2, K3, K4)
3.3 Principles of plant diseases control (K2, K3)
3.4 Methods in phytochemicals: Extraction, fractionation and characterization (K2, K3, K4)
3.5 General properties of plant proteinase inhibitor (K3, K4)
3.6 Proteinase inhibitors-serine proteinase, acid proteinase and metalloproteinase (K2, K3, K4)

Unit IV: **(9 Hours)**

4.1 Water relations of plant, Mechanism of water absorption (K2, K3)
4.2 Aquaporin Symplast - Apoplast concept (K2, K3)
4.3 Ascent of sap (K2, K3)
4.4 Source and sink relationship, Translocation of Inorganic and Organic substances, Bud and Seed dormancy (K2, K3)
4.5 Senescence and Stress response in plant (K2, K3, K4)
4.6 Phytochromes- Properties, Photochemical, Transformation, Mode of action and physiological effect (K2, K3, K4)

Unit V: **(9 Hours)**

5.1 DNA polymorphism – Importance of RFLP and RAPD in plant breeding management (K2, K3, K4)
5.2 Aspects of plant genetic engineering. Tacking, Mapping and Cloning of plant genes, Selectable markers (K2, K3)

5.3 Reporter genes and promoters used in plant vectors. Ti plasmids and Crown gall tumor (K2, K3, K4)
5.4 Genetic engineering of plant for disease resistance, Cytoplasmic Male Sterility, Edible oil, Biodegradable plastics (K2, K3)
5.5 Delay of fruits ripening -Methods (K2, K3)
5.6 Application of plant tissue culture (K2, K3, K4)

Text Books:

1. T.W. Goodwin- Introduction to Plant Biochemistry -Pergamon Press- 2nd Edition,2005.
2. P.J. Lea, L.L. Castle and Lea-Plant Biochemistry and Molecular Biology- John Wiley & Sons- 2nd Editon-2000

Reference Books:

1. R.K. Sinha- Modern Plant Physiology- Narosa Publishing House -2nd Editon,2004.
2. M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Microbiology Tata McGraw Hill Publishing Co. 7th Edition,2013
3. L.M. Prescott, J.P. Harley and D.A. Klein, Microbiology-McGraw Hill Publishers- 6th Edition,2004
4. B.D. Davis, R. Dulbecco, H.N. Eisen and H.S. Ginsberg-Microbiology-3rd Edition,2008
5. P. M. Dey and J. R. Hardorne- Plant Biochemistry-Elsevier Science,1st Edition -2013

Open Educational Resources (OER):

1. https://www.youtube.com/watch?v=VYlsLPwMzFo
2. https://www.youtube.com/watch?v=tCrgTV20BD4
3. https://www.youtube.com/watch?v=_Cbv4MecfA4
4. https://www.youtube.com/watch?v=tIy9ZXP_oz8
5. https://www.youtube.com/watch?v=AUiP9eH-0NI

SEMESTER IV

PEBCH20 ELECTIVE IV- B: HERBAL THERAPY

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
II / IV	PEBCH20	Herbal Therapy	Theory	Elective IV B	3	3	40+60=100

Objective:

To help students to understand the concepts in pharmacognosy and the role of medicinal plants.

Course Outcome (CO)

On completion of the course, the students will be able to;

1. Describe the concepts of Pharmacognosy
2. Explain the classification of medicinal plants
3. Outline the different parts of plant
4. Predict the Herbal medicines for Human ailments
5. Apply the knowledge on the important metabolic pathways in plants

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	M	H	H	M	M
CO 2	H	H	H	M	H	M
CO 3	M	H	M	H	H	M
CO 4	H	M	H	M	H	M
CO 5	H	H	H	H	M	M
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	H	M	M	L	H
CO 2	H	M	H	H	H	M
CO 3	H	H	M	M	L	M
CO 4	H	M	M	M	L	M
CO 5	H	H	M	M	L	M
H- High (3), M-Medium (2), L-Low (1)						

Unit I: **(9 Hours)**

1.1 Pharmacognosy - Definition and history (K1, K2, K3)

1.2 Indian systems of medicine - Siddha, Ayurveda, and Unani systems (K2, K3, K4)

1.3 Taxonomy of locally available medicinal plants (Tulsi, Aloe vera, Neem), their chemical

constituents and medicinal uses (K2, K3, K4)
1.4 Classification of Crude drugs (K2, K3)
1.5 Chemistry of Drugs - Future of pharmacognosy (K2, K3)
1.6 Quality control of drugs of natural origin (K2, K3, K4)

Unit II: **(9 Hours)**

2.1 Classification of medicinal plants - Vernacular name and family (K2, K3)
2.2 Geographical source, cultivation, collection, and processing of crude drugs (K1, K2, K3, K4)
2.3 Morphological, histological studies and chemical constituents of crude drugs (K2, K3, K4)
2.4 Therapeutic and other pharmaceutical uses of underground stem – ginger and Alpinia (K2, K3, K4)
2.5 Therapeutic and other pharmaceutical uses of Roots - Rauwolfia – Belladonna (K2, K3, K4)
2.6 Therapeutic and other pharmaceutical uses of Aerial parts - Bark – Cinchona (K2, K3, K4)

Unit III: **(9 Hours)**

3.1 Leaves - Adathoda, Eucalyptus - Flower - Clove fruits seeds (K1, K2, K3, K4)
3.2 Nux vomica, Nutmegs and Gooseberry (K2, K3)
3.3 Unorganized drugs - Gum, Acacia and Resin (K2, K3, K4)
3.4 Turpentine, fixed oil and castor oil. (K2, K3)
3.5 Propagation of medicinal plants – Micropropagation (K2, K3, K4)
3.6 Macro propagation conservation of rare medicinal plants (K2, K3)

Unit IV: **(9 Hours)**

4.1 Herbal medicines for Human ailments (K2, K3, K4)
4.2 Drugs Acting on Cardiac Diseases, Cerebral Diseases, Nasal disease (K2, K3, K4)
4.3 Depressants. - Stimulants - Respiration and Drugs (K2, K3)
4.4 Urogenital system and drugs - Psychoactive plants (K2, K3)
4.5 Preparation of herbal infusion (K2, K3)
4.6 Toxicity in herbal drugs and their interactions (K2, K3)

Unit V: **(9 Hours)**

5.1 Role of biotechnology in medicinal plants banks (K2, K3)
5.2 Cultivation of medicinal and aromatic plants (K2, K3, K4)
5.3 Drug adulteration - methods of Drug evaluation (K2, K3).
5.4 Herbal food - Food processing - packaging (K2, K3)
5.5 Herbal sale and Export of medicinal plants (K2, K3, K4)
5.6 Marketing, Intellectual property rights and Export laws (K2, K3, K4)

Text Books:

1. T.W. Goodwin-Introduction to Plant Biochemistry- Pergamon Publishers-3 rd Edition,2007
2. Kumar N.C-An Introduction to Medical Botany and Pharmacognosy- 3 rd Edition,2005

Reference Books:

1. George Edward Trease and W.C. Evans – Pharmacognosy-English Language Books Society, Baelliere Tindall- 12 th Edition,2008
2. Handa, S.S. and Kapoor V.K-Pharamcognosy -Vallabh Prakashan Publishers, 2 nd Edition-2004
3. Jain, S.K - Indian Medicinal plants- National book trust -4th Edition,2004
4. Kokate, C.K, Durohit, A.P and Gokhale, S.R- Pharmacognosy - Nirali Prakasham Publishers, Pune-12th Edition-2011
5. Wallis, T.E-Text book of pharmacognosy- CBS publishers and distributors, New Delhi-5th Edition,2008

Open Educational Resource (OER):

1. https://www.youtube.com/watch?v=rde0RSFNuu8
2. https://www.youtube.com/watch?v=QPQ9sZuiOb8
3. https://www.youtube.com/watch?v=5p4NOvF5EX4
4. https://www.youtube.com/watch?v=dOlkogaWF3M
5. https://www.youtube.com/watch?v=fhkvXf5t9lo

INDEPENDENT ELECTIVE I A: ORGANIC FARMING

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I / I	PIBCA20	Organic Farming	Theory	Independent elective	-	2	40+60=100

Objective:
To help students to understand the concepts and importance of organic farming and use it as a source of income generation.

Course Outcomes (CO)
On completion of the course, the students will be able to;

1. Analyze the importance of organic farming
2. Apply the concept of organic farming
3. Relate the importance of plant protection
4. Use the organic methods for plant cultivation
5. Plan the concept of income generation through organic farming and terrace gardening

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	M	H	H	M	M
CO 2	H	L	H	M	H	M
CO 3	M	H	M	L	H	M
CO 4	L	M	H	M	H	M
CO 5	H	H	H	H	M	M
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	H	M	M	L	H
CO 2	H	M	H	L	H	M
CO 3	H	L	M	M	L	M
CO 4	H	M	M	M	L	M
CO 5	L	H	M	M	L	M
H- High (3), M-Medium (2), L-Low (1)						

Unit-I

1.1 Introduction: Farming, basic concepts, principles and development of organic farming. (K1, K2)

1.2 Scope of organic farming Sustainable agriculture (K1, K2)

1.3 Needs for organic farming, types of organic farming (K1, K2)

1.4 Requirement of organic farming (K1, K2)

1.5 Conventional and organic farming (K1, K2, K3)

1.6 Components of organic farming (K1, K2)

Unit -II

2.1 Organic farming system (K1, K2, K3)

2.2 Green manuring (K1, K2)

2.3 Types and stages of composting- vermicomposting, composite quality and marketing (K1,

K2, K3, K4, K5)
2.4 Preparation of organic manure- Bulky organic manure and concentrated organic manure (K1, K2, K3)
2.5 Biofertilizers: Preparation, applications, advantages and disadvantages (K1, K2)
2.6 Soil tillage, land preparation and mulching (K1, K2, K3)

Unit -III
3.1 Plant protection methods- Biopesticides- Formulation- granules, fumigants spray (K1, K2, K3, K6)
3.2 Preparation of pesticides from Chrysanthemum, Neem, Tobacco (K1, K2, K3, K4)
3.3 Advantages of biopesticides (K1, K2)
3.4 Weed management (K1, K2, K3)
3.5 Biocontrol agents (K1, K2, K3)
3.6 Plant natural predators (K1, K2)

Unit-IV
4.1 Organic crop production methods- Rice, Coconut (K1, K2, K4, K5)
4.2 Organic crop production methods- Mango, Banana (K1, K2, K4, K5)
4.3Organic crop production methods - Ginger (K1, K2, K4, K5)
4.4 Organic crop production methods -Pepper, Cardamom (K1, K2, K4, K5)
4.5 Organic crop production methods Medicinal plants- Tulsi (K1, K2, K4)
4.6 Livestock components in organic farming (K1, K2)

Unit-V
5.1 Quality analysis of organic food (K1, K2)
5.2 Organic food and health benefits. (K1, K2)
5.3 Farm economy-cost of production system marketing. (K1, K2, K3, K4)
5.4 Income generation farming: Terrace farming. (K1, K2, K3, K4)
5.5 Income generation farming: Mushroom cultivation. (K1, K2, K3, K4)
5.6 Organic standard, organic certification process (K1, K2)

[Knowledge Level: K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create]

Recommended Reading:

1. SR Reddy. Principles of organic farming. Kalyani publications, 2017
2. Dr. Ranjan Kumar Biswas. Organic Farming in India. N D publisher, 2014
3. Mamta Bansal. Basic of Organic farming. CBS Publishers and Distributors Pvt Ltd, 2017
4. Kolay A.K. Manures and Fertilizers. Atlantic Publisher, 2008
5. RK Sharma. Agriculture at a glance. 20th revised and enlarged edition,2018
6. Chaeles L Mohler, Sue Ellen Johnson. Crop rotation on organic farms. NRAES Publisher, 1st Edition, 2009

Open Educational Resources (OER)

1. https://youtu.be/RFBPStyE9l0
2. https://youtu.be/U1DyKn3lYVk
3. https://youtu.be/TQEaA7ljvIQ
4. https://youtu.be/n1VFLGp1xL8
5. https://youtu.be/V-SDjdTB1nw

INDEPENDENT ELECTIVE I B: FOOD PRESERVATION

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I / I	PIBCB20	Food Preservation	Theory	Independent elective	-	2	40+60=100

Objective:

To enable students to understand the concepts of food preservation and methods involved

Course Outcomes (CO)

On completion of the course, the students will be able to;

1. Outline the role of microbes in food spoilage and methods adopted to overcome microbial food spoilage
2. Apply the general methods for preserving fruits and vegetables
3. Find the methods of food preservation
4. Explain the methods for identifying food spoilage
5. Use the methods for preserving non-vegetarian foods/ meat products

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	H	M	M	L	H
CO 2	H	M	H	H	H	M
CO 3	H	H	M	M	L	M
CO 4	H	M	M	M	L	M
CO 5	H	H	M	M	L	M
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	H	M	M	L	H
CO 2	H	M	H	H	H	M
CO 3	H	H	M	M	L	M
CO 4	H	M	M	M	L	M
CO 5	H	H	M	M	L	M
H- High (3), M-Medium (2), L-Low (1)						

Unit-I

1.1 Types of spoilage in perishables and Nonperishable - Food classification based on spoilage and shelf life (K1, K2, K3)

1.2 Spoilage of by products and factors affecting quality - Storage changes that take place in the food spoiled (K1, K2, K3, K4)

1.3 Preservation of spoilage, storage conditions (K1, K2, K3, K4)
1.4 Types of spoilage in canned food-Definition of canning, steps in the process of canning from Field (K1, K2, K3, K4)
1.5 Types of spoilage in canned food and prevention (K1, K2, K3)
1.6 Causes of spoilage, remedial measures to be taken General spoilage of foods (K1, K2, K3)

Unit-II

2.1 Fruits and vegetable drying/dehydration- General methods of fruits & vegetable drying/dehydration, sun drying, mechanical drying (K1, K2, K3, K4, K5)

2.2 Types of dryers (K1, K2)

2.3 Characteristics of dried fruits and vegetables (K1, K2)

2.4 General process of fruit and vegetable drying (K1, K2)

2.5 Specialized drying operations in fruits and vegetables (K1, K2)

2.6 Pickles: Principle of pickle production-different types of pickles from fruits and vegetables. (K1, K2)

Unit-III

3.1 Method of techniques of proper packaging of finished products &proper storing in cold storages &refrigerator-selection of suitable packaging material (K1, K2, K3, K4, K5)

3.2 Packaging and storage for bakery items- Transportation & marketing (K1, K2, K3)

3.3 Method of techniques of proper packaging of finished products &proper storing in cold storages &refrigerator-selection of suitable packaging material (K1, K2, K3, K4)

3.4 Packaging and storage for company items (K1, K2)

3.5 Transportation & marketing - Food safety like HACCP, ISO 22000, FSSAI (K1, K2)

3.6 Importance of Personal hygiene (K1, K2)

Unit-IV

4.1 Identification of spoilage in fresh fruits and vegetables, application of remedial measures to prevent them (K1, K2, K4, K6)

4.2 Identification of spoilage in preserved fruit and Vegetables and remedial measures (K1, K2, K3, K4)

4.3 Identification of spoilage in food – bacteria, Yeast and Mold – remedial measures. (K1, K2, K3, K4)

4.4 Identification of spoilage in milk and Milk products. (K1, K2, K3, K4)

4.5 Identification of spoilage in food by insects – Identification of insects. (K1, K2, K3, K4)

4.6 Identification of food adulteration and Adulterated food. (K1, K2, K3, K4)

Unit-V

5.1 Fleshy and sea food processing- Meat, Fish (K1, K2, K3, K4)

5.2 Fleshy and sea food processing- Poultry (K1, K2, K3, K4)

5.3 Fleshy and sea food processing-Egg (K1, K2, K3, K4)

5.4 Pre-Processing, processing and preservation- Smoking, Canning, drying (K1, K2, K3,K4)

5.5 Cooling, Dielectric Ohmic and infra-red heating (K1, K2)

5.6 Nutritional losses during processing and storage (K1, K2)

[Knowledge Level: K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create]

Recommended Reading:

1. Siva Sankar, Food Processing and Preservation, Prentice hall of India Pvt Ltd, New Delhi. 3rd Printing, 2005
2. Panda H. The Complete Book on Fruits, Vegetables and Food Processing. NIIR Project Consultancy Service, 2013.
3. B. Srilakshmi. Food Science, New Age Publishers,2002
4. Meyer and Lillian Hoagland. Food Chemistry, New Age publication,2004
5. Bawa. A.S, Raju P.S, Chauhan O.P. Food Science. New India Publishing agency, 2013
6. Frazier WC and Westhoff DC. Food Microbiology, TMH Publication, New Delhi, 2004
7. Subbulakshmi and shoha A Udipi. Food Processing and Preservation. New Age International Publishers. New Age Publishers. 2006

Open Educational Resources (OER):

1. https://youtu.be/cNvIdbH0IaI
2. https://youtu.be/k-KHRJkVaGI
3. https://youtu.be/zh7CACofsio
4. https://youtu.be/pa32TWO5ucY
5. https://youtu.be/4-MBJwNgOak

INDEPENDENT ELECTIVE II A: HORTICULTURE

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I / II	PIBCC20	Horticulture	Theory	Independent elective - III	-	2	40+60=100

Objective:

To emphasis on the significance and concepts of horticulture and the techniques involved.

Course Outcomes (CO)

On completion of the course, the students will be able to;

1. Recall the significance of horticulture
2. Outline the impact of soil nature on horticulture
3. Apply the concept of hybrid to enhance yield
4. Gain knowledge on cropping techniques and harvesting methods
5. Identify the role of gardening in common places

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	H	H	M	M	L	H
CO 2	H	M	H	H	H	M
CO 3	H	H	M	M	L	M
CO 4	H	M	M	M	L	M
CO 5	H	H	M	M	L	M
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	H	M	M	L	H
CO 2	H	M	H	H	H	M
CO 3	H	H	M	M	L	M
CO 4	H	M	M	M	L	M
CO 5	H	H	M	M	L	M
H- High (3), M-Medium (2), L-Low (1)						

Unit-I

1.1 Horticulture – Definition, scope and importance, Division and classification of horticultural crops (K1, K2, K3, K4)

1.2 Propagation – definition, methods, seed propagation, vegetative propagation, micro propagation (K1, K2, K3, K5)

1.3 Planting systems – Protected cultivation (K1, K2)

1.4 Irrigation systems - Weed management – nutrient application methods in horticultural crops – crop regulation (K1, K2, K3, K5)

1.5 Maturity indices – harvesting methods, pre cooling – packaging (K1, K2, K3)
1.6 Storage of horticultural crops. (K1, K2, K3)

Unit-II

2.1 Soil – definition – components – pedology –Edaphology. (K1, K2, K3)
2.2 Physical properties of soil – Color, Texture, structure, Bulk density, Particle density, Pore space; soil water, soil air, soil temperature and their significance in crop production. (K1, K2, K3, K4)
2.3 Soil chemical properties – Soil reaction, EC and CEC. Soil Organic Matter and its importance on soil properties – Essential nutrients for crop plants - Major, secondary and micro nutrients -Soils of Tamil Nadu. (K1, K2, K3, K4, K5)
2.4 Types – Straight, Complex, Compound, Mixed, Fortified and chelated fertilizers and their reactions in soil. (K1, K2, K3, K4, K5)
2.5 Techniques to enhance fertilizer use efficiently. (K1, K2, K3, K4, K5)
2.6 Soil fertility – INM and IPNS – Problem soils – acid, saline and alkaline soils- their formation, reclamation and management. (K1, K2, K3)

Unit-III

3.1 Morphology and general anatomy of medicinally important plant parts: Roots, Stem and its modifications, Barks, Leaves, Flowers, Fruits, Seeds. (K1, K2)
3.2 Study of some medicinally important families (diagnostic features with examples of species of medicinal use): Paparveraceae, Rutaceae (K1, K2)
3.3 Study of some medicinally important families (diagnostic features with examples of species of medicinal use): Rubiaceae, Asteraceae, Solanaceae, Scrophulariaceae (K1, K2)
3.4 Study of some medicinally important families (diagnostic features with examples of species of medicinal use): Lamiaceae, Liliaceae, Fabaceae, Apiaceae (K1, K2)
3.5 Cultivation methods, Herbal pesticides, Harvesting and Storage. (K1, K2)
3.6 Marketing and general aspects of export of medicinally important plants (K1, K2)

Unit-IV

4.1 Dry land horticulture – Importance, scope and distribution- Crops suitable for dry land systems – Important varieties, climate and soil requirements, commercial propagation methods (K1, K2)
4.2 Spacing and planting patterns - Cropping systems and intercropping – mulching - Soil and moisture conservation methods (K1, K2)
4.3 Anti transparent – Management of nutrients, water, weeds and problem soils (K1, K2)
4.4 Regulation of cropping – training and pruning methods - top working and rejuvenation (K1, K2)
4.5 Use of plant growth regulators (K1, K2)
4.6 Post harvest handling – Economics of production. (K1, K2)

Unit-V

5.1 Scope and importance of ornamental gardening and landscaping –principles – formal and informal garden (K1, K2, K3)

5.2 Styles of garden - Features of garden - Garden components and adornments – plant Components - non plant components - garden walls, fencing, steps, garden drives and paths– sunken garden, roof garden, rockeries. (K1, K2, K3)

5.3 Operations in planting and maintenance of public garden, institutional garden, Industrial garden, residential complex garden (K1, K2, K3)

5.4 Operations in landscape maintenance for high ways, bus terminus, airports, city roads and IT parks. (K1, K2)

5.5 Lawn – types of lawn grasses – criteria for selection- methods of lawn establishment – operation and maintenance – problems and remedial management (K1, K2, K3)

5.6 Flower arrangements and dry flowers – suitable plant (K1, K2)

[Knowledge Level: K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create]

Recommended Reading:

1. Kaushal Kumar Mishra and Rajesh Kumar. Fundamentals of Horticulture. Biotech Books, 2014
2. Prasad. Principles of Horticulture. AGROBIOS publisher, 2nd Edition, 2012
3. Ivan A Ross. Medicinal Plants of the World. Humana Publication, 5th Edition, 2005
4. Jitendra Singh. Fundamental to Horticulture. Kalyani Publisher, 2014.
5. Charles Adams, Mike Early, Jane Brook and Katherine Bamford. Principles of Horticulture. Routledge Publication, 2014
6. Kumar N. Introduction to Horticulture, Oxford and IBH Publication, New Delhi, 2011
7. Robert E White. Principles and Practice of Soil Science: The soil as a Natural Resource. Blackwell publishing, 4th Edition, 2005

Open Educational Resources (OER):

1. https://youtu.be/RTR2RgMbJ-g
2. https://youtu.be/MUCk9FqjCBc
3. https://youtu.be/AAy5Z4zjgMU
4. https://youtu.be/iqOQTVGoLuI
5. https://youtu.be/K8a1RkIeick

INDEPENDENT ELECTIVE III A: NANOBIOTECHNOLOGY

Year/ Sem	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
II / III	PIBCE20	Nanobiotechnology	Theory	Independent elective - V	-	2	40+60=100

Objective:

The course aims to provide an interdisciplinary knowledge on Nano materials and their applications in biosciences.

Course Outcome (CO)

On completion of the course, the students will be able to;

1. Apply the essential role of Nanoscience
2. Outline the prospective of Nano biology and Nano sensors
3. Discuss the Nanoparticle drug base delivery systems
4. Create knowledge to develop Nanomaterials
5. Identify the role of plants in Nanoparticle synthesis

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	M	M	L	H	M	M
CO 2	M	H	M	L	H	H
CO 3	L	L	M	H	H	L
CO 4	H	M	H	M	M	H
CO 5	H	L	M	H	M	L
H- High (3), M-Medium (2), L-Low (1)						

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	H	M	L	H	M	L
CO 2	L	H	H	M	L	M
CO 3	M	L	M	H	L	M
CO 4	H	M	L	M	H	L
CO 5	H	L	H	H	M	M
H- High (3), M-Medium (2), L-Low (1)						

Unit I:

1.1 Introduction to Biocompatibility (K2, K3, K4)
1.2 Antibacterial Activity-Principles and Applications (K2, K3, K4)
1.3 Biomaterial Nano Circuitry-Protein based Nano circuity (K3, K4)
1.4 Neurons for network formation of DNA (K2, K4)
1.5 Nanostructures for mechanics and DNA based computation (K3, K4)
1.6 DNA based Nano mechanical devices- Applications (K2, K3)

Unit II:

2.1 Interaction between Biomolecules and Nanoparticle surface (K3, K4)
2.2 Different types of inorganic material used for the synthesis of Hybrid Nano-bio assemblies (K2, K3, K4)
2.3 Analytical applications of Nano in Biology and Nano probes (K3, K4)
2.4 A new methodology in medical diagnostics and biotechnology (K4)
2.5 Current status of Nano biotechnology (K3, K4)
2.6 Future prospective of Nano biology and Nano sensors (K2, K3, K4)

Unit III:
3.1 Development of Nano medicines and Nano systems (K3, K4)
3.2 Protocols for Nano drug administration (K3, K5)
3.3 Materials used in diagnostics and therapeutic applications of nanotechnology (K3, K4)
3.4 Molecular Nano mechanics (K3, K4)
3.5 Molecular devices in Nanotribology (K2, K3, K4)
3.6 Applications of Nanotribology (K3, K4)

Unit IV:
4.1 Molecular and cellular biology applications (K2, K3, K4)
4.2 2-D electrophoresis (K2, K3)
4.3 Mass spectrophotometer of proteins (K3, K4)
4.4 Protein Microarrays -Fabrication-Fluorescence detection (K2, K3)
4.5 Binding assays and Immunosensors (K3, K4)
4.6 Integrated Nano biotechnology systems (K2, K3, K4)

Unit V:
5.1 Use of Bacteria, Fungi in Nanoparticle synthesis (K3, K4)
5.2 Actinomycetes for Nanoparticle synthesis (K3, K4)
5.3 Magneto tactic Bacteria for Natural synthesis of Magnetic Nanoparticles (K2, K3, K4)
5.4 Viruses as components for the formation of Nanostructured Materials (K4)
5.5 Process and applications of Nanostructured materials (K3, K4)
5.6 Role of plants in Nanoparticle synthesis (K2, K3, K4)

]**Recommended Reading:**

1. G. Cao-Nanostructure and Nanomaterial's Synthesis, Properties and Applications-Imperial College Press- 2 nd Edition,2011
2. G. J. Leggett, R. A .L. Jones-Bio nanotechnology in Nano scale and technology- John Willey &Sons- 3 rd Edition,2015
3. D.S. Goodsell- Bionanotechnology-John Willey and Sons- 3 rd Edition,2005
4. 2. H.S. Nalw- Encylopedia of Nanoscience and Nanotechnology- American scientific publishers- 4 th Edition, 2004.
5. Robert. A. Freitas-Nano medicine, Vol-II Biocompatibility-CRC Pres-3 rd Edition, 2003
6. Massimiliano Diventra, Introduction to Nanoscale Science and Technology- 2007
7. Sergey Edward Lyshhevski-Nanoscience and Nanotechnology 4 th Edition,2005

Open Educational Resources (OER):
1.https://www.youtube.com/watch?v=irGJ6dmcZfI
2. https://www.youtube.com/watch?v=uUDWK4MGcr0
3.https://www.youtube.com/watch?v=aFU5Qx-cLu8
4. https://www.youtube.com/watch?v=3wFh0z7so8w
5. https://www.youtube.com/watch?v=EvqAmrIkV1s