KONGUNADU ARTS AND SCIENCE COLLEGE
(AUTONOMOUS)

Re-accredited by NAAC with 'A' Grade Status – 3.64 CGPA out of 4 (3rdCycle)
College of Excellence (UGC)
COIMBATORE – 641029, TAMIL NADU, INDIA.

SCHEME AND SYLLABUS FOR

DEPARTMENT OF BIOCHEMISTRY (PG)

CURRICULUM AND SCHEME OF EXAMINATIONS (CBCS)
(2019 - 2020 and onwards)

VISION AND MISSION OF THE COLLEGE

Vision:

Developing the total personality of every student in a holistic way by adhering to the principles of Swami Vivekananda and Mahatma Gandhi.

Mission:

- Imparting holistic and man-making education with emphasis on character, culture and value - moral and ethical.
- Designing the curriculum and offering courses that transform its students into value added skilled human resources.
- Constantly updating academic and management practices towards total quality management and promotion of quality in all spheres.
- Extending the best student support services by making them comprehensive and by evolving a curriculum relevant to student community and society at large.
- Taking steps to make education affordable and accessible by extending scholarships to the meritorious and economically disadvantaged students.
- Molding the teachers in such a way that they become the role models in promoting Higher Education.

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)

Re-accredited by NAAC with 'A' Grade Status – 3.64 CGPA out of 4 (3rd Cycle)
College of Excellence (UGC)
COIMBATORE – 641029, TAMIL NADU, INDIA.

PG & RESEARCH DEPARTMENT OF BIOCHEMISTRY-VISION & MISSION

Vision:

To identify local and global issues that need intervention by a biochemist and to develop intelligent strategies and Biochemical approaches towards problem- solving.

Mission:

- To provide opportunities to get hands- on experience in Research-oriented education in Biochemistry.
- To provide Entrepreneurship in Biochemistry related areas.
- To give a broad based knowledge in concepts and principles of biochemistry.

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)

Re-accredited by NAAC with 'A' Grade Status – 3.64 CGPA out of 4 (3rdCycle)
College of Excellence (UGC)
COIMBATORE – 641029, TAMIL NADU, INDIA.

PG & RESEARCH DEPARTMENT OF BIOCHEMISTRY

PG PROGRAMME OUTCOMES

PO1: To presume, question and evaluate, solve problems, integrate knowledge and widen perspective.

PO2: To understand that communication comprises attentiveness and listening, reading and comprehension, to communicate and collect information through oral and written formats.

PO3: To apply contemporary research methods, skills and techniques in a scientific discipline.

PO4: To reveal empathetic social concern and national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5: To understand the issues of environmental contexts and sustainable development and to engage in independent and life-long learning.

PO6: To promote interdependence and help reach conclusions in group settings.

PO7: To learn to achieve tasks at hand with proficient skills in teamwork, to master academic integrity and understanding independence.

PO8: To lead a team to successfully complete a project and communicate across teams and set up his/her own venture

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)

Re-accredited by NAAC with 'A' Grade Status – 3.64 CGPA out of 4 (3rdCycle)
College of Excellence (UGC)
COIMBATORE – 641029, TAMIL NADU, INDIA.

PG & RESEARCH DEPARTMENT OF BIOCHEMISTRY

PROGRAMME SPECIFIC OUTCOMES

PSO1: Understanding of structure and metabolism of macromolecules, regulation and disorders of metabolic pathways.

PSO2: Investigate the impact of science in society and plan to pursue research

PSO3: Gain proficiency in laboratory techniques in both biochemistry and molecular biology and be able to apply the scientific method to the processes of experimentation and Hypothesis testing.

PSO4: Understand the application of biochemistry in clinical laboratory.

PSO5: Acquire thorough knowledge in biochemical techniques, immunology, physiology, molecular biology, genetic engineering and biotechnology.

PBC 1

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)

Re-accredited by NAAC with 'A' Grade Status – 3.64 CGPA out of 4 (3rd Cycle)

College of Excellence (UGC)

COIMBATORE – 641029, TAMIL NADU, INDIA.

Course Name: M.Sc. Biochemistry

Curriculum and Scheme of Examination under CBCS

(Applicable for the Students Admitted during the Academic Year 2019-2020)

Semester	Subject code/ Question paper code	Title of the paper	Instruction hours/cycle	Exam Marks			Duration of Exam (Hrs)	Credits
				CIA	ESE	Total		
I	19PBC101	C.P.1 Biomolecules	5	25	75	100	3	4
	19PBC102	C.P.2 Bioanalytical Techniques	5	25	75	100	3	4
	19PBC103	C.P.3 Enzymes and Enzyme Technology	5	25	75	100	3	4
	19PBC104	C.P.4 Cell Biology	5	25	75	100	3	4
	19PBC105	C.P.5 Hormonal Biochemistry	5	25	75	100	3	4
	19PBC1CL	C.Pr.1 Lab in Biomolecules, Bioinstrumentation, Enzymology and Cell Biology	5	40	60	100	6	4
Total Hours			**30**	**140**	**360**	**600**		**24**
II	19PBC206	C.P.6 Plant Biochemistry and Biotechnology	5	25	75	100	3	4
	19PBC207	C.P.7 Intermediary Metabolism	5	25	75	100	3	4
	19PBC208	C.P.8 Genetics and Molecular Biology	5	25	75	100	3	4
	19PBC209	C.P.9 Drug Biochemistry	5	25	75	100	3	4
	19PBC2CM	C.Pr.2 Lab in Plant Biochemistry, Microbiology, Genetics and Molecular Biology	5	40	60	100	5	4
	19PBC2E1	E.P.1 Major Elective- I	5	25	75	100	3	5
Total Hours			**30**	**165**	**435**	**600**		**25**
III	19PBC310	C.P.10. Immunology	5	25	75	100	3	4
	19PBC311	C.P.11 Genetic Engineering	5	25	75	100	3	4
	19PBC312	C.P.12 Clinical Biochemistry	5	25	75	100	3	4
	19PBC313	C.P.13 Biostatistics and Research Methodology	5	25	75	100	3	5
	19PBC3CN	C.Pr.3 Lab in Immunology, Genetic Engineering and Clinical Biochemistry	5	40	60	100	5	4
	19PBC3N1	E.P.1 Non-major Elective –I (On-line)	5	25	75	100	3	5
	19PBC3ST	Summer training*	-	-	-	-	-	-
Total Hours			**30**	**165**	**435**	**600**		**26**
IV	19PBC4E2	E.P.2 Major Elective- II	5	25	75	100	3	5
	19PBC4N2	E.P.2 Non-major Elective –II (On-line)	5	25	75	100	3	5
	19PBC4Z1	Project and Viva-voce	20	40	160*	200	-	5
Total Hours			**30**	**115**	**385**	**400**		**15**
GRAND TOTAL			**120**	**585**	**1615**	**2200**		**90**

*Project record 120 marks + Viva-voce examination 40 marks

PBC 2

**Note: ***The students shall undergo a Summer training for a minimum period of 30 days at the end of the second semester during summer vacation and submit the report in the third semester. The report will be evaluated for 100 marks along with the internal viva voce by the faculty members and HoD. According to their marks, the grades will be awarded as given below.

Marks (%)	Grade
85-100	O
70-84	D
60-69	A
50-59	B
40-49	C
<40	U (Reappear)

ADVANCED LEARNERS COURSE UNDER SELF STUDY SCHEME (Optional)

19PBCOD1	Forensic Sciences
19PBCOD2	Nutraceuticals and Functional foods
19PBCOD3	Stem Cell Biology

JOB ORIENTED COURSE

19PBCOJ1	Bio entrepreneurship
19PBCOJ2	Food safety and Quality control
19PBCOJ3	Clinical and therapeutic nutrition

CERTIFICATE COURSE IN MEDICAL LABORATORY TECHNOLOGY

19PBC0F1	Paper I: Biochemistry
19PBC0F2	Paper II: Clinical Pathology and Microbiology-I
19PBC0F3	Practical I
19PBC0F4	On the Job training

DIPLOMA IN MEDICAL LABORATORY TECHNOLOGY

19PBC0F5	Paper I: Anatomy, Physiology and Laboratory safety
19PBC0F6	Paper II: Clinical Pathology and Medical Microbiology II
19PBC0F7	Practical II
19PBC0F8	On the Job training

Tally Table:

Subjects	Total Marks	Total Credits
Core Paper/Practical/Project (17)	1800	70
Major Elective (2)	200	10
Non – Major Elective (2)	200	10
Grand Total	2200	90

Note: JOC, ALC are offered to the students admitted during the academic year 2019-20 and will be considered as extra credit courses

CBCS - Choice Based Credit System
C.P - Core Paper
C.Pr. - Core Practical

PBC-3

JOC - Job Oriented Course
ALC - Advanced Learners Course
CIA - Continuous Internal Assessment
ESE - End of Semester Examination

25 % CIA is applicable for all theory papers
40% CIA is applicable for all practical papers

Major Elective Papers

1. Nanobiotechnology
2. Microbiology
3. Bioinformatics
4. Bioethics, Biosafety and IPR

Non – Major Elective Papers (On-line exam)

1. Environmental Management
2. Competitive Sciences
3. Bioprocess Technology
4. Cancer Biology

Students must select two major electives and two non-major electives from the above list of papers.

PBC 4

19PBC101

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC101		**Title:** Core Paper 1 – Biomolecules		
Batch 2019-2020	Semester I	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

1. To learn about the chemistry and structures of biomolecules
2. To know the properties of different biomolecules
3. To know the physiological functions of biomolecules

Course Outcomes (CO)

K1	CO1	The students recollect the classification and functions of biomolecules
K2	CO2	The students will grasp the scope of biological chemistry
K3	CO3	The students also know about execute of biomolecules in human health
K4	CO4	The students will analyse and study the chemical and biochemical properties of biomolecule. They will be able to enter into drug design and pharmacogenetics field

19PBC101

Syllabus

Unit I **(15 Hours)**

Carbohydrates: Structure, occurrence, properties and biological functions of Monosaccharides, Disaccharides, O-linked and N-linked oligosaccharides, Polysaccharides: Homoglycans: Structure, occurrence, properties and biological functions of chitin, starch and celulose. Heteroglycans: Structure, occurrence, properties and biological functions of glycosaminoglycans. Structure and biological role of peptidoglycans, lipopolysaccharides and proteoglycans.

Unit II **(15Hours)**

Amino acids: Classification, structure and physical and chemical properties of amino acids (Ionization & Biuret reaction), Amphoteric molecule, Zwitterion, pK values; Isoelectric point, Electrophoresis, acid-base and UV-light absorption properties of amino acids. Non-protein amino acids. Aminoacid derivatives.

19PBC101

Unit III **(15 Hours)**

Proteins: Structural organization of protein: Primary structure. Determination of protein structure: Ramachandran plot. Polypeptide synthesis. Secondary structures – α-helix, β-sheet and β-turns, Pauling and Corey model for fibrous proteins, Reverse turns and super secondary structures, Collagen triple helix. Tertiary structure – α and β domains. Conformational properties of silk fibroin. Quarternary structure of proteins: Structure and functions of Myoglobin and haemoglobin.

Unit IV **(15 Hours)**

Lipids: *Classification, structure, functions and properties of lipids. Fatty acids-saturated and unsaturated. Structure and functions: Phospholipids and glycolipids. Eicosanoids-structure and biological role of prostaglandins, thrombaxanes and leucotrienes. Steroids: structure and functions of cholesterol. Lipoproteins-classification and composition. Amphipathic lipids-emulsions and liposomes.

Unit V **(15 Hours)**

Nucleic acids: Structure of nucleic acids, DNA double helical structure – Watson and Crick model. A, B and Z DNA, Palindromes, Inverse repeats, cruciform and hairpins, Triple and quadruple structures. DNA sequencing procedures – Maxam Gilbert method and Sanger's Dideoxy chain termination method. Properties of DNA: UV absorption spectra, buoyant density, denaturation and renaturation, cot curves, DNA hybridization, DNA supercoiling and linking number. Chemical synthesis of DNA. Structure and biological functions of major forms of RNA: mRNA, rRNA and tRNA.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Nelson, David L. and Cox. (2017). Lehninger Principles of Biochemistry. 7th edition, W.H.Freeman and Co., NY
2. U.Sathayanarayana. (2017). Biochemistry. 5th edition, Books and allied (P) Ltd., India

Reference Books.

1. Voet, D, Voet, J.G. and Pratt, C.W. (2013). Principles of Biochemistry. 4th edition, John Wiley & Sons, New Delhi - 10002.
2. Garrette R.H and Grisham, C. M. (2013). Principles of Biochemistry. 5th edition, Saunders college publishers.
3. Eric E.Conn, P.K. Stumpf, G.Brueins and Ray H.Doi, John. (2005). Outlines of Biochemistry. 5th edition. Wiley and sons, Singapore.
4. Zubay GL. (1988). Biochemistry. 4th edition, W M C Brown publishers

PBC 6

19PBC101

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	S	M	H
CO2	M	H	H	S	M
CO3	S	M	S	H	H
CO4	S	H	S	M	H

S – Strong **H** – High **M** – Medium **L** – Low

PBC 7

19PBC102

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC102		**Title:** Core Paper 2 – Bioanalytical Techniques		
Batch 2019-2020	Semester I	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

1. To learn the principle and instrumentation of various separation techniques
2. To know the applications of various separation techniques in biological fields
3. To learn the concept of radioactivity and explore its role in various fields.

Course Outcomes (CO)

K1	CO1	The students recall the principle and applications of bioinstrumentation
K2	CO2	The students will discern the principle, Instrumentation of different types of bioanalytical techniques
K3	CO3	The students also discern about applying the instrumentation techniques of Centrifugation, Electrophoresis and Chromatography in various research fields
K4	CO4	The students will determine the knowledge and practice concerning modern analytical instrumentation and students can able to enter into large scale industries.

19PBC102

Syllabus

Unit I **(15 Hours)**

Chromatography: Principle, technique and applications of paper, TLC, HPTLC, column, ion-exchange, affinity, gel-filtration chromatography. Principle, instrumentation and applications of GLC and HPLC. Principle and applications of GC-MS, HPLC-MS, LC-MS/MS, Reverse phase chromatography and FPTLC.

Unit II **(15 Hours)**

Electrophoresis: Principle, technique and applications of paper, Agarose gel, SDS-PAGE, 2D-PAGE electrophoresis, Immunoelectrophoresis. Isoelectric focusing-technique and application. Principle, instrumentation, technique and applications of capillary electrophoresis and pulse-field gel electrophoresis.

PBC 8

19PBC102

Unit III **(15 Hours)**

Spectroscopy: Principle, technique, instrumentation and applications of UV-Visible, FTIR spectroscopy, spectro-fluorimetry, flame photometry, molecular luminescence, atomic absorption spectrophotometry, Electron spin resonance (ESR), Nuclear Magnetic Resonance (NMR), Matrix assisted LASER desorption/ionization time of flight-mass spectroscopy (MALDI-TOF MS), X-ray crystallography, XRD.

Unit IV **(15 Hours)**

Centrifugation: Types of rotors- swing bucket, fixed angle, vertical. Types of centrifuge: Micro centrifuge, High speed and Ultracentrifuges Principle, technique, instrumentation and applications of ultracentrifuge: preparative and analytical centrifugation, differential centrifugation, density gradient centrifugation, Rate zonal and isopycnic centrifugation. Methods of disrupting cells and tissues – homogenization and Fractionation.

Unit V **(15 Hours)**

Microscopy and Radioactivity: Principles, instrumentation and applications of microscopy: Bright field, phase-contrast, fluorescence and confocal microscopy. Electron microscope – SEM and TEM. Radioactivity: nature, types of Radioactive decay, Units of radioactivity (Curie, Rutherford and Becquerrel), detection and measurement of radioactivity by GM and scintillation counter. Autoradiography and its applications. Therapeutic application of radioisotopes and its safety measures. ***Radio Immuno Assay**.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom/Google Classroom

Text Books

1. Upadhyay, Upadhyay and Nath. (2012). Biophysical Chemistry – Principles and Techniques, 4th Revised edition, Himalaya Publishing House Pvt. Ltd.
2. Keith Wilson, John Walker. (2000). A biologist's guide to Principles and Techniques of Practical Biochemistry, 5th edition, Cambridge University Press, New York.

Reference Books

1. D.J. Homie and H. Peck. (2003). Analytical Biochemistry. 1st edition, Rastogic CBS Publisher.
2. Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch. (2008). Fundamentals of Analytical Chemistry. 4th edition, Barkha Nath Printers, India.
3. Keith Wilson and John Walker. (2011). Principles and Techniques of Biochemistry and Molecular Biology. 7th edition, Cambridge University Press, New York.
4. Chatwal, G and Anand, S. (2005). Instrumental methods of chemical analysis. Himalaya Publishing House
5. Holme. D. J. and Peck. H. (1998). Longman Analytical Biochemistry, 3rd edition, Longman Scientific & Technical

PBC 9

19PBC102

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	S	H	M
CO2	H	S	M	M	S
CO3	H	M	S	H	M
CO4	M	S	S	H	S

S – Strong **H** – High **M** – Medium **L** – Low

PBC 10

19PBC103

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC103		**Title:** Core Paper 3 – Enzymes and Enzyme Technology		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	I	5	75	4

Course Objectives

1. To know the classification and properties of enzymes
2. To learn about the mechanism of enzyme action
3. To know the applications of enzymes in clinical and diagnostic fields

Course Outcomes (CO)

K1	CO1	The students remember the fundamentals of enzyme properties
K2	CO2	The students conceive the different procedures involved in enzyme technology
K3	CO3	The students will be able to assay the enzyme and their kinetics and also apply to this in the industry and other technological field
K4	CO4	The students estimate enzyme technology for the commercialization purpose of biotechnological products

19PBC103

Syllabus

Unit I **(15 Hours)**

Enzymes: Introduction, nomenclature and ***classification of enzymes**, Factors affecting enzyme activity. Unit of enzyme: Katal and IU. Measurement of enzyme activity: Active site- Definition, investigations of 3D structure of active site. Mechanism of enzyme action-Lock and key, induced fit model enzyme modification by treatment with proteases, Isoenzymes-LDH, CPK and ALP.

Unit II **(15 Hours)**

Enzyme catalysis and regulation: Acid base catalysis, covalent catalysis, Mechanisms of reaction catalyzed by enzyme lysozyme, chymotrypsin, carboxy peptidase A and ribonuclease. Metal activated enzymes and metallo enzyme. Enzyme regulation: feed forward stimulation, feedback inhibition and its types. Covalent modification of enzyme activities. Multienzyme complex and reactions: Structure and mechanism of action and regulation of pyruvate dehydrogenase complex.

19PBC103

Unit III **(15 Hours)**

Enzyme kinetics and Inhibition: Kinetics of single substrate catalyzed reaction-MM equation and turnover number, LB plot, Eadie-Hofstee plot and Hanes plot. Importance of K_m, V_{max} and MM equation. Allosteric enzymes- Cooperavity, Hill plot, K & V series of Enzyme. Bisubstrate reaction. Enzyme inhibition: Reversible inhibition-competitive, uncompetitive, noncompetitive, mixed, substrate and allosteric inhibition.

Unit IV **(15 Hours)**

Co-enzymes: Prostatic group and cofactors. Structure, functions and mode of action of TPP in oxidative decarboxylation, FMN, FAD, NAD, NADP in redox reactions, PALP and PAMP in transamination, Co A in acetylation reactions, biotin in carboxylation, THF in one carbon transfer, cobalamine coenzymes-cyano, hydroxol, methyl and deoxy adenosyl cobalamine- role in methyl group transfer and mutase reactions. Co-enzymic functions of vitamin C, lipoic acid and Co Q in metabolic reactions.

Unit V **(15 Hours)**

Enzymes application: Industrial application of enzymes: Enzymes as analytical reagents, Enzymes in Textile, Food and detergent industry. Enzymes used in diagnosis and various diseases. Immobilization techniques and applications: Adsorption, microencapsulation, entrapment, covalent and ionic bonding. Biosensors: Calorimetric, Potentiometric, Amperometric, immunosensors and optical biosensors. Ribozyme, abzyme.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Trevor Palmer. (2001). Enzymes: Biochemistry, Biotechnology and Clinical Chemistry. Horwood Chemical Science Series. Horwood Publishers.
2. Lewis Stevens and Nicholas C. Price. (1998). Fundamentals of Enzymology. 2nd edition, Oxford University Press.
3. Balasubramanian et al., (2015). Concepts in Biotechnology, Universities Press India Ltd.

Reference Books

1. Dixon , E.C Webb, CJR Thorne and K.F. Tipton. (1979). Enzymes. 3rd edition, Longmans, London.
2. Chapline and Bucke. (1990). Enzyme Technology 1st edition. Cambridge University Press.
3. Robert J. Whitehurst, Maarten Van Oort. (2010). Enzymes in Food Technology. 2nd edition, John Wiley and Sons Ltd.
4. David L Nelson, Micheal M Cox. (2013). Lehninger's Principles of Biochemistry, 6th edition, Replika Press (P) Ltd, India.
5. Julio Polaina and Andrew P. (2007). Industrial Enzymes: Structure, Function and Applications (Springer). MacCabe (Editors).

PBC 12

19PBC103

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	M	H	S
CO2	S	H	M	S	H
CO3	M	S	H	M	M
CO4	S	H	S	H	S

S – Strong **H** – High **M** – Medium **L** – Low

PBC 13

19PBC104

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC104		**Title:** Core Paper 4 – Cell Biology		
Batch 2019-2020	Semester I	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

1. To learn the models and functions of biological membrane
2. To learn about the structure and functions of cytoplasmic organelles
3. To learn the mechanism of membrane transport in cells

Course Outcomes (CO)

K1	CO1	The students will be able to elicit the basic concepts of cell biology
K2	CO2	The students will understand the knowledge of cell structure and function
K3	CO3	The students will apply their knowledge of cell biology to selected examples of changes or losses in cell function.
K4	CO4	The students analyse the cell structure, cell signaling and cell functions

19PBC104

Syllabus

Unit I **(15 Hours)**

Membrane structure and function: Membrane bilayer Models, Fluid mosaic model-composition and functions. Membrane lipids- fluidity, Asymmetry phase transition, Liposome experiments. Membrane proteins - Types, Orientation, Mobility Experiments, flippases, proteins of RBC membrane, Bacteriorhodopsin, Porins-aquaporin. RBC ghosts, solubilisation of proteins, lipid anchored proteins. Cell surface carbohydrates-Lectins, selectins. Blood group antigens.

Unit II **(15 Hours)**

Endoplasmic reticulum: history, occurrence, morphology, components, types, enzymes associated, functions and biogenesis. **Ribosomes:** history, occurrence, location, ultrastructure, chemical composition, biogenesis. Association and dissociation of ribosomal subunits, functions of ribosomes. **Golgi bodies:** history, origin, occurrence, morphology, polarity, compartmentalization, chemical composition and functions. **Centriole:** origin, occurrence, ultrastructure and functions.

19PBC104

Unit III **(15 Hours)**

Nucleus: occurrence, structure: nuclear envelope (nuclear transport, disassembly & reassembly, nuclear pores, pore complex, nucleocytoplasmic transport), nucleoplasm, nucleolus, nuclear reticulum (euchromatin, heterochromatin and functions) and its functions. Cell cycle, cell division, amitosis, mitosis, meiosis, salient features of meiosis, mechanism of crossing over.

Unit IV **(15 Hours)**

Mitochondria: history, ultrastructure, electron transport chain, mt DNA, mtRNA, ribosomes and protein synthesis in mitochondria. Semi-autonomous nature of mitochondria (symbiont hypothesis). Biogenesis, degeneration and functions of mitochondria. **Membrane transport:** Overview, Passive transport: osmosis, simple diffusion and facilitated diffusion; active transport: Ca^{2+} ATPase, $Na^{+}K^{+}$ATPase, Gastric $H^{+}K^{+}$ATPase. Ion concentration gradients. Bulk transport: exocytosis, phagocytosis and Receptor mediated endocytosis.

Unit V **(15 Hours)**

Cytoskeleton: Microfilaments–Actin-Structures, Assembly, Myosin. Microtubules-Organization and dynamics, Kinesin and dynein. Striated muscle -structure, excitation-contraction. **Cell signaling:** Cell-Cell signaling-Signaling molecules and their receptors: functions of cell surface receptors, pathways of intracellular signal transduction, second messengers-G-protein coupled receptors, neurotransmitters, receptor tyrosine kinases, Ras, MAP kinases. Signal transduction: cAMP, cGMP, phosphatidyl inositol, Ca^{2+}.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. A Textbook of Cell Biology and Genetics. Dr.Veer Bala Rastogi. KNRN Publishers. Meerut.2018.
2. P.S. Verma and V.K. Agarwal. (2014). Cell Biology, Genetics, Molecular biology, Evolution and Ecology, S. Chand and Company, New Delhi.

Reference Books

1. Harvey Lodish, Arnold Berk et al., (2007). Molecular Cell Biology. 6th edition, W H Freeman and Company, New York.
2. Garrette R.H and Grisham, C. M. (2013). Principles of Biochemistry. 5th edition, Saunders College Publishers.
3. Alberts et al., (2014). Molecular biology of the cell. 6th edition, Garland Publishers.
4. David E Sadava. (2004). Cell Biology-Organelle structure and Function. Panima publishing Corporation, New Delhi.
5. G. Karp. (2001). Cell and Molecular Biology. 3rd edition, John Wiley & Sons publisher.
6. Geoffrey M.Cooper and Robert E. Hausman. (2009). The Cell: A Molecular Approach. 5th edition, ASM Press, Washington D.C.

PBC 15

19PBC104

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	H	M	S
CO2	H	S	S	M	M
CO3	S	H	S	S	M
CO4	S	M	M	H	S

S – Strong **H** – High **M** – Medium **L** – Low

PBC 16

19PBC105

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC105		**Title:** Core Paper 5 – Hormonal Biochemistry		
Batch 2019-2020	Semester I	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

1. To learn about the system of hormonal functioning in biological systems
2. To know the regulation and action of different hormones at different conditions
3. To get an in depth knowledge on diabetes mellitus

Course Outcomes (CO)

K1	CO1	The students know about the diverse group of hormones and their specific mechanism of action in the bodily metabolism
K2	CO2	The students learn the regulatory functions of various hormones and their interrelationship in the endocrine disorders
K3	CO3	The students acquire knowledge on the pathophysiology, diagnosis, treatment and management of endocrine disorders
K4	CO4	The students will be made equipped with the hormonal concepts and disease predictions

19PBC105

Syllabus

Unit I **(15 Hours)**

Principles of endocrinology: Scope of Endocrinology, Nature of Hormones and its types, Receptor Families, Synthesis and Processing, Hormone Secretion, Transport, and Degradation. Hormone Action through Receptors – Membrane, Nuclear and Cytosolic Receptors. Functions of Hormones – Growth, Maintenance of Homeostasis and Reproduction. Hormonal Feedback Regulatory Systems - Paracrine and autocrine control, Hormonal Rhythms.

Unit II **(15 Hours)**

Hypothalamus and pituitary hormones: Hypothalamic and pituitary axis hormones- Chemistry & biochemical functions; Hypothalamic releasing factors. Pituitary gland: hormones of the pituitary gland- Chemistry& biochemical functions - neurovascular hypothesis; pineal gland- hormones of the pineal gland- Chemistry& biochemical functions.

PBC 17

19PBC105

Unit III **(15 Hours)**

Pacreatic hormones: Chemistry and biochemical functions. Parathyroid hormone: Calcitonin and its functions. Pancreatic hormone: Insulin, glucagon, somatostatin, pancreatic polypeptide-chemistry and biochemical functions.

Unit IV **(15 Hours)**

Adrenal gland: Hormones of adrenal gland-chemistry and biochemical functions; FSH, TSH, Gastrointestinal hormones-cholecystokinin, Substance P, summary of the neuroendocrine control of GI; Neurohormones- the brain-renin-angiotensin and urotensin.

Unit V **(15 Hours)**

Reproductive endocrinology: Male reproductive system: androgens: Source, synthesis, chemistry, metabolism, Physiological roles, mechanism of action and pathophysiology. Female reproductive system: Synthesis, physiological role and mechanism of action of ovarian steroid hormones. Neuroendocrine control of ovarian function, Pathophysiology. Endocrinology of pregnancy, parturition and lactation, Hormonal contraception, menopause and pathophysiology.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Mac E. Hadley (1996). Endocrinology. 4th edition. Prentice Hall International Inc
2. .
3. Harrison's Endocrinology, (2002). 2nd edition, Edited by J. Larry Jameson, The McGraw-Hill Companies, Inc. USA.

Reference Books

1. A. Longstaff. (2002). Instant notes: Neuroscience. 1st Indian edition, BIOS Scientific Publishers Ltd, UK John E. Hall, Mario Vaz, Anura Kurpad, Tony Raj. (2016).
2. Guyton & Hall Textbook of Medical Physiology. 2nd South Asian edition, Elsevier publications.
3. Shlomo Melmed et al., (2011). William's Textbook of endocrinology. 12th edition, Philadelphia: Elsevier/Saunders.

PBC 18

19PBC105

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	S	M	H
CO2	M	H	H	S	M
CO3	S	M	S	H	H
CO4	S	H	S	M	H

S – Strong **H** – High **M** – Medium **L** – Low

PBC 19

19PBC1CL

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC1CL		**Title:** Core Practical 1 – Lab in Biomolecules, Bioinstrumentation, Enzymology and Cell Biology		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	I	5	75	4

Course Objectives

1. To get practical experience in analyzing the biochemical metabolites in biological samples, bioinstrumentation, enzyme technology and cell biology techniques
2. To have hands on experience on chromatography, electrophoresis, enzyme and cell biology techniques
3. To develop familiarity with bioanalytical techniques and applications of enzyme and cell biology in research and industries

Course Outcomes (CO)

K1	CO1	The students will learn how to standardize various Biomolecules, enzyme and cell biology.
K2	CO2	The students conceive the amount of Biomolecules, isolation, purification and determination of enzyme, preparation of buccal smears
K3	CO3	The students apply the enzyme technology and cell biology skill in basic research projects
K4	CO4	The students also assign the principles of Biomolecules, enzyme and cell biology techniques to discovery novel drug development

19PBC1CL

Biomolecules

1. Estimation of Starch in potato
2. Estimation of Fructose in Fruits
3. Estimation of Glycogen in liver
4. Estimation of Ascorbic acid
5. Estimation of Total Free Aminoacids by ninhydrin method
6. Extraction of total carotenoids and estimation of β-Carotene
7. Separation of plant pigments by paper chromatography

8. Separation of Amino acids by Thin Layer Chromatography
9. PCR and Agarose gel electrophoresis (Demo)
10. Gel Documentation (Demo)
11. GC and HPLC (Demo)
12. Determination of Alanine transaminase activity
13. Determination of Lactate dehydrogenase activity
14. Isolation of mitochondria and estimation of succinate dehydrogenase
15. Animal cell types (Demo)
16. Cell Counting – RBC and WBC
17. Buccal smear – Identification of Barr body
18. Mitosis in onion root tip

Teaching Methods

Demonstration/Video lectures/Laboratory visits/Institutional visits

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	H	M	M
CO2	H	S	S	M	M
CO3	M	H	H	S	S
CO4	M	M	M	S	S

S – Strong **H** – High **M** – Medium **L** – Low

PBC 21

19PBC206

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC206		**Title:** Core Paper 6 – Plant Biochemistry and Biotechnology		
Batch 2019-2020	Semester I	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

1. To learn the mechanism and importance of photosynthesis in plants
2. To learn the role of hormones in the growth metabolism of plants
3. To know the latest genetic engineering techniques for plant development

Course Outcomes (CO)

K1	CO1	The students recall the biosynthesis of primary and secondary metabolites, nitrogen metabolism involved in plants
K2	CO2	The students understand the concept of plant tissue culture and plant transformation techniques
K3	CO3	The students also know about applications of phytoconstituents in development of new drug
K4	CO4	The students can device new technologies involving plant biotechnology

19PBC206

Syllabus

Unit I **(15 Hours)**

Photo synthesis: Overview, Pigments and factors affecting photosynthesis. Light reactions: Red drop and Emerson's enhancement effect, Hill's reaction, Arnons work, pigment systems I and II, photo oxidation of water, production of assimilatory powers, electron transport chain, cyclic and non-cyclic photophosphorylation. Dark reactions: C3, C4 and CAM pathway. Photorespiration.

Unit II **(15 Hours)**

Nitrogen metabolism: Significance of nitrogen. Ammonification, nitrification, nitrate reduction, Physical and biological nitrogen fixation-symbiotic, non-symbiotic. Symbiotic nitrogen fixation in leguminous plants, biochemistry of nitrogen fixation, denitrification and nitrogen cycle.

19PBC206

Unit III **(15 Hours)**

Plant hormones: Factors affecting the growth of plants, characteristics and classification of plant hormones. Chemistry, biosynthesis, physiological effects, applications of auxins, gibberellins, cytokinins, abscicic acid, ethylene.

Unit IV **(15 Hours)**

Secondary metabolites and plant tissue culture: Biosynthesis and functions of ms and terpenoids. Functions of alkaloids, anthocyanins, Tannins and lignin. Applications of secondary metabolites. Plant tissue culture-Micropropagation, Callus induction, cell and protoplast culture, organogenesis and somatic embryogenesis. Haploid production-Anther, pollen, embryo and ovule culture and their applications. Applications of plant tissue culture. ***Soma clonal variation.**

Unit V **(15 Hours)**

Techniques for plant transformation: Agrobacterium mediated gene transfer and its applications, Ti plasmid, the process of T-DNA transfer to plants: Mechanism. Agrobacterium mediated gene transfer in tobacco. Bt crops and golden rice production. Drought and herbicide resistance. Transformation methods: Particle bombardment, polyethyleneglycol (PEG) mediated transformation and electroporation. Validation of transformation – resistance genes, marker genes and transgene DNA.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. V.K. Jain. (2016). Fundamentals of Plant Physiology, 18th edition, S.Chand and Company Pvt.Ltd, New Delhi.
2. S.K. Verma and Mohit Verma. (2008). A Textbook of Plant Physiology, Biochemistry and Biotechnology. 2nd edition. S.Chand and Company Pvt.Ltd, New Delhi

Reference Books

1. Plant Biochemistry, Dev J.B. Harborne, 2000. Academic Press.
2. Adrian Slater, Nigel W. Scott, Mark R. (2008). Plant Biotechnology: The genetic manipulation of plants. Fowler Oxford University Press.
3. C. Neal Stewart. (2008). Plant Biotechnology and Genetics-Principles, Techniques and Applications. Jr. John Wiley and sons Publishers, UK.
4. William G. Hopkins. (2008). Introduction to Plant Physiology, 2nd edition, John Wiley and sons Publishers, UK.
5. Razdan M.K. (2003). An introduction to Plant Tissue culture. 2nd edition, Oxford & IBH Publishing Co, New Delhi.

PBC 23

19PBC206

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M	S	H	S	M
CO2	H	S	M	M	M
CO3	M	H	M	S	S
CO4	S	M	S	H	M

S – Strong **H** – High **M** – Medium **L** – Low

PBC 24

19PBC207

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC207		**Title:** Core Paper 7 – Intermediary Metabolism		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	II	5	75	4

Course Objectives

1. To learn the metabolism of various biomolecules in our system
2. To provide a basic understanding of the biochemical reactions of molecules
3. To study the interrelationship of various metabolic pathways

Course Outcomes (CO)

K1	CO1	The students remember commemorate the overall concept of cellular metabolism
K2	CO2	The students perceive the metabolism of biochemical pathways
K3	CO3	The students execute the diseases associated with defective nucleotide biosynthesis
K4	CO4	To analyze the role of fat in energy production and membrane synthesis

19PBC207

Syllabus

Unit I **(15 Hours)**

Carbohydrate Metabolism and regulation: An overview, energetics and regulation of glycolysis and gluconeogenesis. TCA cycle: steps: amphibolic nature of the Citric acid cycle-Anaplerotic mechanism. Electron transport chain and ATP production. Glycogen metabolism and its regulation. HMP shunt, Cori's cycle.

Unit II **(15 Hours)**

Lipid metabolism and regulation: An overview of fatty acid metabolism. Oxidation of fatty acid: alpha, beta and omega. Biosynthesis of fatty acid. Regulation of fatty acid metabolism. Metabolism of Ketone bodies - Formation, Utilization, Excretion and significance. Metabolism of triacyl glycerol and phospholipids. Biosynthesis of cholesterol and its regulation. Metabolism of lipoproteins.

19PBC207

Unit III **(15 Hours)**

Amino acid metabolism and regulation: Amino acid degradation: transamination, oxidative and non-oxidative deamination, decarboxylation. An overview on ɣ-glutamyl cycle. An overview: Methionine as methyl donor (SAM pathway). Urea cycle and its regulation. Catabolism of asparagine, glutamine, proline, cysteine and cysteine. Conversion of amino acids to Histamine, Serotonin, epinephrine and nor-epinephrine: Metabolism and function. Synthesis and regulation of pyruvate family, 3-Phosphoglycerate family and aspartate family of amino acids. Allosteric regulation of glutamine synthetase.

Unit IV **(15 Hours)**

Nucleic acid metabolism and regulation: *Fate of dietary nucleic acids, Purines and pyrimidines biosynthesis (both de novo and salvage pathways) and degradation. Regulation of purine biosynthesis: PRPP aminotransferases. Regulation of pyrimidine biosynthesis: Aspartate carbamoyl transferase. Regulation of deoxyribonucleotides by activators and inhibitors.

Unit V **(15 Hours)**

Integration of metabolism: Interconversion of food stuffs. Metabolic profile of the liver, adipose tissue and brain. Altered metabolism in starvation. Compartmentalization of metabolic pathway in the cell. Metabolic fuels: definition. Caloric value of metabolic fuels, metabolic relationship of tissues in various nutritional and hormonal states.

***denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Satyanarayana, U and Chakrapani, U. (2013). Biochemistry. 4th edition, Books and Allied Pvt. Ltd, Kolkata, 700 010.
2. Robert K. Murray, Daryl K. Granner and Victor W. Rodwell. (2008), Harper's Illustrated Biochemistry. 29th edition, McGraw Hill Companies, Inc. New Delhi.

Reference Books

1. Voet, D., Voet, J.G. and Pratt, C.W. (2013). Fundamentals of Biochemistry, Life at the Molecular Level. 4th edition, John Wiley & Sons, New Delhi, 110002
2. Garrette R.H and Grisham, C. M. (2012), Principles of Biochemistry. 5th edition, Saunders college publishers.
3. David L. Nelson, Micheal M. Cox. (2008). Lehninger's Principles of Biochemistry. Replika press (P) Ltd, India
4. Jeremy M. Berg and Lubert Stryer. (1994). Biochemistry. 3rd edition, Ubert W H freeman and co, Sanfrancisco.

PBC 26

19PBC207

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	S	M	S
CO2	S	H	M	S	M
CO3	M	S	H	S	S
CO4	H	S	S	M	H

S – Strong **H** – High **M** – Medium **L** – Low

PBC 27

19PBC208

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC208		**Title:** Core Paper 8 –Genetics and Molecular Biology		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	II	5	75	4

Course Objectives

1. To understand the molecular organization of genes and chromosomes
2. To learn the process of DNA synthesis, repair and function
3. To learn the various molecular events occurring in DNA with proposed theories

Course Outcomes (CO)

K1	CO1	The students recognize about the basic concepts of gene
K2	CO2	The students understand the different processes involved in replication, transcription and translation
K3	CO3	The students can be able to integrate scientific and technological knowledge on the use of genetics and molecular biology for industrial products on the cell and process level
K4	CO4	The students will examine the molecular mechanisms behind DNA damage and repair

19PBC208

Syllabus

Unit I **(15 Hours)**

Concept of gene: Molecular structure of gene and chromosomes. Mendelian Principles: Mono and dihybrid cross. Incomplete Dominance, Overdominance, Codominance, Epistasis. Linkage and crossing over, Sex determination and Sex linkage in diploids. Polygenic inheritance. Chromosomal aberrations. Karyotyping. Human Genetic Diseases - Down's syndrome, Turner's syndrome, Klinefelter's syndrome.

Unit II **(15 Hours)**

Gene mutation and recombination: Gene Mutation-Classification of mutations, DNA as a genetic material (Transformation, Conjugation and Transduction). Genetics of viruses: Lytic and Lysogenic life cycles of phages. Genetic Recombination (Homologous recombination-Holliday model). Modern concept of genes. Population genetics: Hardy-Weinberg law. Quantitative genetics and multifactorial interactions, causes of variation and artificial selection.

19PBC208

Unit III **(15 Hours)**

Replication: Universal genetic code, ***Wobble hypothesis**, Degeneracy. Replication: Mechanism in Prokaryotes and eukaryotes, Theta and rolling circle model, Enzymology of replication. Replication of RNA genome-replicase and reverse transcriptase. Termination of replication-circular and linear replications.

Unit IV **(15 Hours)**

Transcription and Translation: Prokaryotic and eukaryotic transcription. RNA processing and post-transcriptional modification. Regulatory sequences in protein coding genes. Transcription initiation by RNA polymerase I, II and III. Processing of eukaryotic pre mRNA, hnRNA proteins, RNA splicing, snRNA, spliceosome. RNA editing.

Translation-activation of aminoacids, initiation, elongation, termination in prokaryotes and eukaryotes. Translational proof-reading-Posttranslational processing of protein.

Unit V **(15 Hours)**

Regulation of transcription and translation: Positive and negative control, Repressor and Inducer, concept of operon, lac-, ara-, trp operons. Catabolic repression, attenuation, anti- termination and methylation. Macromolecular transport across the nuclear envelope. Synthesis and targeting of peroxisomal proteins. Overview of secretory pathway. Translocation of secretory products across ER membrane.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. P.S. Verma and V.K. Agarwal. (2014). Cell Biology, Genetics, Molecular biology, Evolution and Ecology. S. Chand and Company, New Delhi.
2. Lodish, D. *et al*., (2007). Molecular Cell Biology. 6th edition, Scientific American Books, Inc.

Reference Books

1. De Robertis. (2001). Cell and Molecular Biology. 8th Edition, Dhanpat Rai Publisher.
2. Nalini Chandar, Susan Viselli. (2010). Lippincott Illustrated Reviews: Cell and Molecular Biology. LWW: North American Edition.
3. Robert Franklin Weaver. (2011). Molecular Biology. 5th edition, Mc-Graw Hill science.
4. Alberts *et al.,* (2014). Molecular Biology of the Cell. 6th edition, Garland Publishers.
5. Benjamin Lewin. (2007). Genes IX. 9th edition, Jones & Bartlett Learning.

PBC 29

19PBC208

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	S	M	S
CO2	S	M	M	S	H
CO3	S	M	M	H	S
CO4	M	S	H	M	S

S – Strong **H** – High **M** – Medium **L** – Low

PBC 30

19PBC209

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC209		**Title:** Core Paper 9 –Drug Biochemistry		
Batch 2019-2020	Semester II	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

1. To learn the mechanism of drug action in various diseases
2. To learn about different drugs available for treatment
3. To learn about the designing mechanisms for drug development

Course Outcomes (CO)

K1	CO1	The students will learn the concept of pharmacology
K2	CO2	The students can know about the mechanism of action of drug inside the system
K3	CO3	The students will know about the drug discovery and drug design procedures
K4	CO4	The students will know the treatment of various disorders using drug molecules

19PBC209

Syllabus

Unit I **(15 Hours)**

Pharmacology: Classification of drugs, sources and preparation; natural source, synthetic drugs, drug preparation: crude drug, pure drug compounds, pharmaceutical preparations. Routes of drug administration: sublingual, buccal, oral, rectal, intravenous, intramuscular, subcutaneous, transdermal, inhalational and topical administration. Pharmacokinetics: Overview, drug absorption, drug distribution, drug biotransformation (role, formation and phases), drug excretion: quantitative pharmacokinetics, drug-plasma concentration curve, bioavailability, volume of distribution, drug clearance. Single dose pharmacokinetics, continuous and multiple dose kinetics, dosage calculations.

Unit II **(15 Hours)**

Pharmacodynamics: Definition. Drug receptors: Types, classification, drug-receptor interaction (binding and affinity, signal transduction, efficacy, receptor regulation and drug tolerance). Dose-response relationships (gradal and quantal). Drug development and safety: Drug discovery and characterization, preclinical studies, clinical trials, drug

safety and efficacy laws, drug abuse prevention laws. Adverse effects of drugs. Factors affecting drug safety and efficacy. Antidepressant drugs: Overview and mechanism. Mechanism of action, therapeutic uses, kinetics and adverse effects of tricyclic antidepressants and monoamine oxidase inhibitors.

Unit III **(15 Hours)**

Pharmacokinetics: Mechanism of action, therapeutic uses, pharmacokinetics and adverse effects of Anti-inflammatory drugs -aspirin and colchicine, Anti-peptic ulcer drugs -H_2 receptor antagonists and inhibitors of H^+K^+ ATP-ase pump. Antihypertensive drugs: Overview, mechanism of controlling blood pressure, treatment strategies. Action, therapeutics uses, kinetics, adverse effects of β-adrenoceptor-blocking agents and ACE inhibitors.

Unit IV **(15 Hours)**

Treatment of neurodegenerative diseases: Overview, neurotransmission in CNS, synaptic potentials, overview and drugs used for Alzheimer disease and Parkinson disease. Mechanism of action, therapeutic uses, kinetics and adverse effects of Hypnotic drug(barbiturates). Anesthetics: patient factors in selection of anesthesia, induction, maintenance and recovery from anesthesia, features, potency, uptake, distribution, action and adverse effects of inhalation anesthetics. ***Intravenous and local anesthetics.**

Unit V **(15 Hours)**

Anticancer drugs: overview and principles of chemotherapy, treatment strategies, treatment regimens and scheduling, limitations of chemotherapy. Mechanism of action, therapeutic uses, pharmacokinetics and adverse effects of antimetabolites(Methotrexate and 5–fluorouracil), antibiotics (Dactinomycin and Bleomycin), alkylating agents (Cyclophosphamide), microtubule inhibitor (Vincristine and Vinblastine), steroid hormones and their antagonist (Tamoxifen), monocloncal antibody (Rituximab) and interferons.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text books:

1. Richard.D.Howland, Mary. J.Mycek. Lippincott William and Wilkins. (2006). Lippincott's illustrated reviews: pharmacology. 3rd edition, Wolters Kluwer health (India) Pvt. Ltd., New Delhi.
2. R.S.Satoskar, Nirmala N. Reje, S. D.Bhandarkar. (2011). Pharmacology and Pharmacotherapeutics. 22nd edition, Popular PrakashanPvt. Ltd.

Reference Books:

1. H L Sharma and K K Sharma. (2011). Principles of Pharmacology 2ndedn. Paras Medical Publisher, India. 2011.
2. George M.Brunner, Craig W. Stevans. (2011). Pharmacology. 3rd edition, Saunders, an imprint of Elsevier Inc.

PBC 32

19PBC209

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	S	M	S
CO2	S	M	S	H	L
CO3	H	S	M	S	M
CO4	S	H	M	M	H

3. **S** – Strong **H** – High **M** – Medium **L** – Low

PBC 33

19PBC2CM

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC2CM		**Title:** Core Practical 2 –Lab in Plant Biochemistry, Microbiology, Genetics and Molecular Biology		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	II	5	75	4

Course Objectives

1. To learn the techniques of plant tissue culture
2. To get an hands-on-training on molecular techniques
3. To implement the applications of plant tissue culture, microbes, genetics and molecular techniques in research and industries

Course Outcomes (CO)

K1	CO1	The students know about the principles of plant biochemistry, microbes, molecular biology and genetic techniques
K2	CO2	The students gain the technical skills involved in plant tissue culture, counting cells, identification of gene and its expressions
K3	CO3	The students develop and apply the modern technology of plant biochemistry, microbial techniques, molecular biology and genetics in industries and research
K4	CO4	The students will examine the results obtained using plant biochemistry, sterilization techniques, molecular biology and genetics

19PBC2CM

Plant Biochemistry

1. Preparation of plant tissue culture media and sterilization*
2. Initiation of callus culture*
3. Estimation of chlorophyll
4. Estimation of flavonoids
5. Estimation of total phenols
6. Maintenance of microbial cultures

7. Isolation and biochemical identification of bacteria from soil
8. Motility test
9. Bacterial growth curve (Demo)
10. Antibiotic susceptibility test by Kirby-Bauer method
11. Isolation of Genomic DNA from onion and Agarose gel electrophoresis*
12. Isolation of Plasmid DNA from bacteria*
13. Extraction of total RNA *
14. Estimation of DNA by Diphenylamine method
15. Estimation of RNA by Orcinol method
16. SDS-PAGE*
17. Blotting techniques (any one)*
18. Animal housekeeping, care, feed preparation and breeding of common laboratory animal-mice
19. Laboratory ethics (IAEC guidelines)

*Denotes group experiments

Teaching Methods

Demonstration/Video lectures/Laboratory visits/Institutional visits

PBC 35

19PBC2CM

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	H	M	M
CO2	H	S	M	H	M
CO3	M	H	H	S	S
CO4	H	M	M	S	H

S – Strong **H** – High **M** – Medium **L** – Low

PBC 36

19PBC310

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC310		**Title:** Core Paper 10 – Immunology		
Batch 2019-2020	Semester III	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

1. To learn about the various cells of immune system and their functions
2. To know about the specificity of antigen-antigen interaction and their possible mechanisms
3. To know the role of immunological cells in the treatment of different diseases

Course Outcomes (CO)

K1	CO1	The students can learn the types and functions of different immune cells
K2	CO2	The students can know the mechanism of action of different immune cells and their resultant reaction responses
K3	CO3	The students will understand the underlying causes of inherited or autoimmune diseases and consequences
K4	CO4	The students can device new technologies involving immune cells in treating many diseases

19PBC310

Syllabus

Unit I **(15 Hours)**

Cells of the immune system: Macrophages, B and T lymphocytes, Dendritic cells, Natural killer and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells. Organs of the immune system: Thymus, Bone marrow, Spleen, lymph nodes, MALT, GALT. Haemopoiesis and differentiation, lymphocyte trafficking. Antigen-biology, structure and functions of different classes of Immunoglobulin. Biology of Superantigens.

Unit II **(15 Hours)**

Antigen and antibody: Antibody types and structural properties, characteristics of antigen. ***Antigen antibody reactions**, Applications of Immunological techniques, genetic control of immune response, effector mechanisms, MHC, antigen recognition and presentation, activation of B and T lymphocytes.

Unit III **(15 Hours)**

Humoral and cell mediated immunity: Cell mediated Cytotoxicity: Mechanism of T cell and NK Cell mediated lysis, Antibody dependent cell mediated Cytotoxicity and macrophage mediated Cytotoxicity. Cytokines and their role in immune regulation, Biology of Complement system, Complement fixation test and assessment of immune complexes in tissues. Immune suppression and immune tolerance.

Unit IV **(15 Hours)**

Hyper sensitivity reactions: Autoimmune disorders, Transplantation immunology- MLR, HLA Typing, Bone marrow transplantation, Organ transplants. Immunity to Infectious agents - Bacteria, Viruses, Malaria, and Helminthes. Tumor immunology, Tumor antigens, immune response to tumors, cancer immunotherapy, Vaccines. AIDS and other immunodeficiencies, Structure of HIV, envelope glycoproteins, destruction of T cells: immunologic symptoms of AIDS, AIDS vaccine.

Unit V **(15 Hours)**

Vaccine technology: recombinant vaccines, Identification of B and T epitopes for vaccine development. *In situ* characterization of cells from tissues, Immunoscreening of Recombinant library, Hybridoma – Monoclonal Antibody production and applications; MAbs in diagnosis and therapy.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. J.Kuby. (2003). Immunology. 5th edition, W.H. Freeman and Company, Newyork.
2. C.V.Rao. (2002). An Introduction to Immunology. Narosa Publishing House, Chennai.

Reference Books

1. K.M.Pavri. (1996). Challenge of AIDS, National Book Trust, India.
2. I.R.Tizard. (1995). Immunology: An Introduction. 4th edition, Saunders College Publishers, New York.
3. I.Roitt. (1994). Essential Immunology. Blackwell Science, Singapore. A. Bul and K.Abbas, 1994, Cellular and Molecular immunology.

PBC 38

19PBC310

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	S	M	H
CO2	M	H	H	S	M
CO3	S	M	S	H	H
CO4	S	H	S	M	H

S – Strong **H** – High **M** – Medium **L** – Low

PBC 39

19PBC311

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC311		**Title:** Core Paper 11 –Genetic Engineering		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	III	5	75	4

Course Objectives

1. To learn the cloning strategies and genetic manipulation with devised technologies
2. To enable the students to learn the principle and application of genetic engineering
3. To implement and transmission of a genetic material at molecular and cellular levels.

Course Outcomes (CO)

K1	CO1	The students enshrine the principles of genetic engineering and the vectors used in cloning and expression
K2	CO2	The students will grasp the different cloning strategies and their expression
K3	CO3	The students also know about implementation of genetic engineering for different purposes
K4	CO4	The students will investigate the different strategies of rDNA technology and resolve the problems encountered

19PBC311

Syllabus

Unit I **(15 Hours)**

Genetic engineering: Introduction and its applications. Properties and applications of Restriction enzymes (Type I, Type II, Type III, Type IV and Type V), DNases, Polymerases, Modifying enzymes and Ligases. Linkers, Adaptors and Homopolymer tailing. Benefits of gene cloning. Isolation of nucleic acids, characterization and purification of plasmid, bacteriophage genomic DNA for cloning purpose

Unit II **(15 Hours)**

Cloning vectors: Plasmids (pBR322 and pUC18), Phages (l phage and M13 vectors), Phagemids (pBluescript, pGEM), Cosmids (pJB8) and Artificial Chromosomes (BAC and YAC). Plant and Animal viruses as vector, binary and shuttle vectors, expression vectors for prokaryotes and eukaryotes, expression cassettes.

19PBC311

Unit III **(15 Hours)**

cDNA libraries: Construction of genomic and cDNA libraries, selection and screening of recombinants, probes types, synthesis and uses of probes. Blotting techniques (Southern, Northern and Western), PCR types and applications. Chromosome walking, jumping, DNA finger printing and foot printing. Screening with antibodies, rescreening and sub cloning

Unit IV **(15 Hours)**

Gene transfer methods in animal cells: Microinjection, electroporation, particle bombardment gun, ultrasonication, liposome mediated and direct transfer. Restriction analysis of DNA, molecular markers: ***RFLP,** RAPD, VNTR, SSR, AFLP, STS, SCAR, SNP. Microarrays. Human genomic project and applications.

Unit V **(15 Hours)**

Application: Transgenic animals as models in the prevention of human diseases like muscular dystrophy and anticancer therapy. Production of recombinant insulin, vaccines and growth hormone. Gene therapy: Stem cell gene therapy, Somatic cell gene therapy, Antisense RNA therapy, gene therapy for inherited diseases; familial hypercholesterolemia, hemophilia, ADA deficiency (SCID) and Cystic fibrosis.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Glover D.M. and Hames B.D. (1995). P Cloning 1 and 2. IRL Press.
2. Primrose et al., (2001). Principles of gene manipulation. 6th edition, Blackwell Scientific Publishers.

Reference Books

1. T.A. Brown. (2010). Gene cloning and DNA analysis: an introduction. 6th edition, Brown, T.A. (Terence A.), Wiley Blackwell.
2. Watson, J. D. *et al*., (1992). Recombinant DNA. 2nd Edition, Scientific American Books, New York.
3. Winnacker, E.L. (2003). From Genes to Clones. Panima Publishing Corporation, New Delhi.
4. Old *et al*. (2001). Principles of Gene Manipulation, 6th Edition. Blackwell Science, London.
5. Glick, B. R. and J.J. Pasternak. (1998). Molecular Biotechnology. 2nd Edition, ASM Press, Washington

PBC 41

19PBC311

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	H	S	M
CO2	H	S	H	M	M
CO3	M	H	H	H	H
CO4	M	S	M	S	M

S – Strong **H** – High **M** – Medium **L** – Low

PBC 42

19PBC312

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC312		**Title:** Core Paper 12 – Clinical Biochemistry		
Batch 2019-2020	Semester III	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

1. To learn the methodologies for the detection of abnormalities in blood
2. To learn the process of different sample collection and processing
3. To know about the markers in the various metabolic disorders like cancer

Course Outcomes (CO)

K1	CO1	The students will be knowing the important laboratory biochemical tests
K2	CO2	The students will be introduced to methods of specimen collection and processing and analyzing the results
K3	CO3	The students will be learning the role of enzymes in clinical diagnosis of diseases
K4	CO4	The students will be knowing the diagnostic procedures for tumor development

19PBC312

Syllabus

Unit I **(15 Hours)**

Specimen collection and processing: Collection of blood vein puncture, skin puncture, arterial puncture. **Collection of urine:** Timed urine specimens, urine preservatives. Clinical significance of urinary components with reference to sugars, proteins, ketone bodies, bilirubin and porpyrins. Microscopic examination of urine, Abnormal and normal constitute of urine. Body fluids-CSF, gastric juice, ascitic fluid, synovial fluid and amniotic fluid: Composition, collection and analysis. Quality control in clinical laboratory.

Unit II **(15 Hours)**

Serology and hematology: Introduction. Anti serum, anti sera raising, chick and snake venom antibody. Principle of agglutination and precipitation. C-reactive protein and pregnancy test, Rhumatoid arthritis (RA) test. ESR, Coagulation test, prothrombin test. WIDAL test, ELISA, chemiluminescence, CMIA, ECLIA, flow cytometry. **Hemoglobin:** Normal and abnormal Hb, Separation of hemoglobin by electrophoresis. Hemoglobinopathies and its types. Glycated Hb. Erythrocyte metabolic pathways, Disorder of erythrocyte metabolic pathways, Porphyrins and porphyrias.

PBC 43

19PBC312

Unit III **(15 Hours)**

Clinical enzymology and endocrinology: Factors affecting enzyme levels in blood. Principle, assay and clinical significance of liver markers: AST, ALT, gamma-glutamyl transferase, amylase and lipase. Cardiac markers: creatine kinase, CKMB, lactate dehydrogenase, troponin (I and T). Bone markers: ALP. Prostate marker: ACP. Clinical significance of steroid, protein and thyroid hormones.

Unit IV **(15 Hours)**

Organ function test and related disorders: Jaundice, cirrhosis, hepatitis (HBV virus), fatty liver and gall stones. **Renal function test and related disorder**: Acute renal failure, glomerular disease, tubular diseases, analysis of urinary calculi. Gastric and pancreatic function test. Estimation of GFR and cystatin C in serum. Hyper and hypo lipoproteinemias and diagnostic test for lipoprotein disorders.

Unit V **(15 Hours)**

Free radicals in diseases: Introduction, ***Types of free radicals**. Free radical induced lipid peroxidation and antioxidants (Enzymic: SOD, Catalase, Glutathione Peroxidase, Glutathione Reductase; Non Enzymic: Vitamin A, Ascorbic acid, Tocopherol, Reduced Glutathione).

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Teitz. (1994). Fundamentals of Clinical Chemistry. W.B.Saunders company,
2. Stevans, C.D. (2016). Clinical Immunology and Serology: A Laboratory Perspective. 4th edition. F.A. Davis Company

Reference Books

1. Day A, Mayne P. (1994). Clinical chemistry in diagnosis and treatment. 6th edition, Mayne, ELBS Publications.
2. Varley *et al.*, (1980). Practical Clinical Biochemistry. volume I and II, 5th edition, CBS Publishers.
3. Teitz. (1999). Textbook of Clinical Biochemistry. 3rd edition Burtis et al., William Heinmann Medical Books Ltd.
4. Marshall W et al., (1995). Clinical biochemistry-Metabolic and clinical aspects, 3rd edition, Pearson Professional Ltd.
5. Larry Jameson et al., (2015). Harrison's Principles of internal medicine Vol. I and II. 14th edition, McGraw Hill Publishers

PBC 44

19PBC312

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	S	M	H
CO2	M	H	H	S	M
CO3	S	M	S	H	H
CO4	S	H	S	M	H

S – Strong **H** – High **M** – Medium **L** – Low

PBC 45

19PBC313

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC313		**Title:** Core Paper13-Biostatistics and Research Methodology		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	III	5	75	4

Course Objectives

1. To learn the different methods of collecting data and processing
2. To know about the different statistical methods to interpret the collected statistical data
3. To know the concept of article writing, report writing and thesis making so on

Course Outcomes (CO)

K1	CO1	The students get an idea on choosing the appropriate method of collecting data
K2	CO2	The students learn how to select the statistical method and process the collected data
K3	CO3	The students can device and standardize the statistical methods
K4	CO4	The students will be well versed in preparing a report, publishing an article and writing a project thesis

19PBC313

Syllabus

Unit I **(15 Hours)**

Research: Definition, Introduction, objectives, motivation, types, approaches, significance. Research Methods versus Methodology. **Research process:** formulating the research problem, extensive literature survey, developing the hypothesis, preparing the research design, determining sample design, collecting the data, execution of the project, analysis of data, hypothesis testing, generalisations and interpretation, and preparation of the report or presentation of the results. Criteria of a good research. Problems encountered by researchers in India.

Unit II **(15 Hours)**

Research problem: Selection, necessity and techniques (statement of the problem in a general way, understanding the nature of the problem, surveying the available literature, developing the ideas through discussions and rephrasing the research problem into a working proposition). **Research design:** Introduction, necessity, features, concepts relating to research design, types of research design, basic principles of experimental design (Principle of Replication, Principle of Randomization and Principle of Local Control).

19PBC313

Unit III **(15 Hours)**

Methods of Data Collection: Collection of Primary Data: Observation Method, Interview Method, questionnaire method (merits, demerits and main aspects), schedules, difference between questionnaire and schedules. Other methods of primary data collection (Warranty cards, Distributor or store audits, Pantry audits, Consumer panels, Use of mechanical devices, Projective techniques). **Collection of Secondary Data:** characteristics, Selection of appropriate method, Case Study method.

Unit IV **(15 Hours)**

Classification and tabulation of data*. Diagrammatic & graphic presentation of data. Problems involving arithmetic mean, median, mode, quartiles, deciles and percentiles. **ANOVA:** Principle, technique, setting ANOVA table, short cut method, coding method (necessary illustrations) for one way ANOVA. Two way ANOVA: Principle, technique, setting ANOVA table (necessary illustrations). ANOVA in Latin-Square design (necessary illustrations).

Unit V **(15 Hours)**

Interpretation and Report Writing: Introduction, Techniques and precautions in interpretation, Report writing – significance, different steps, layout, types (technical and popular), mechanics (with examples) and precautions. Publication in a scientific journal. Project proposal writing to funding agencies, Career opportunities in research.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. C. R. Kothari. Research Methodology: Methods and Techniques (2004). New Age International (P) limited. Publishers.
2. N.Gurumani. Introduction to Biostatistics. MJP Publishers.
3. S.P.Gupta. (2009). Statistical Methods, 28th edition, Sultan Chand & Sons

Reference Books

1. Sundar Rao, Jesudian Richard. (2006). An Introduction to Bio-Statistics. 4th edition, Prentice-Hall of India Pvt.Ltd
2. Alwi E. Lewis. (1984). Bio-statistics. Van Nostrand Reinhold.
3. S.P.Gupta. (2016). Fundamentals of Statistics. 6th edition, Sultan Chand.
4. Snedecor GW and Cohran WG. (1972). Statistical methods. 6th edition, Oxford and IBH publishing CO Pvt. Ltd.

PBC 47

19PBC313

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	S	M	H
CO2	M	H	H	S	M
CO3	S	M	S	H	H
CO4	S	H	S	M	H

S – Strong **H** – High **M** – Medium **L** – Low

PBC 48

19PBC3CN

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC3CN		**Title:** Core Practical 3 – Lab in Immunology, Genetic Engineering and Clinical Biochemistry		
Batch 2019-2020	Semester III	Hours / Week 5	Total Hours 75	Credits 4

Course Objectives

1. To enhance the students to have practical experience on techniques in immunological tests
2. To learn the methods of estimation of clinical parameters
3. To have hands on experience in genetic engineering

Course Outcomes (CO)

K1	CO1	The students recall the basic principles involved in immunology, clinical biochemistry and genetic engineering
K2	CO2	The students demonstrate the techniques involved in immunology, clinical biochemistry and genetic engineering
K3	CO3	The students develop and apply the recent technology involved in diagnostic techniques of immunology, clinical biochemistry and genetic
K4	CO4	The students examine and analyze the results involved in immune techniques, clinical biochemistry and genetic engineering

19PBC3CN

Immunology

1. ELISA method
2. WIDAL test
3. Single radial immunodiffusion
4. Double immunodiffusion
5. Ouchterlony double diffusion

6. Immunoelectrophoresis
7. Rocket immunoelectrophoresis
8. Restriction digestion and ligation*
9. cDNA synthesis*
10. Bacterial transformation*

Estimation of the following parameters in urine

11. Urea
12. Uric acid
13. Creatinine
14. Glucose by Benedicts method
15. Bilirubin
16. Sodium

Estimation of the following parameters in blood

17. Hemoglobin
18. Total cholesterol
19. Glucose tolerance test
20. Glucose by GOD/POD method

*Denotes group experiments

Teaching Methods

Demonstration/Video lectures/Laboratory visits/Institutional visits

PBC 50

19PBC3CN

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	S	M	S
CO2	H	S	S	S	M
CO3	M	M	H	M	S
CO4	S	H	M	H	M

S – Strong **H** – High **M** – Medium **L** – Low

PBC 51

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: NA		**Title:** Major Elective: Nanobiotechnology		
Batch 2019-2020	Semester NA	Hours / Week 5	Total Hours 75	Credits 5

Course Objectives

1. To get an idea about the application of nanotechnology in biological research
2. To learn the properties and functions of nanomaterials in biological systems
3. To learn the applications of nanomaterials in drug delivery and treatment

Course Outcomes (CO)

K1	CO1	The students will get an insight about the nanotechnology concepts
K2	CO2	The students will learn the methods of nanoparticle synthesis
K3	CO3	The students will learn the properties of nanoparticles
K4	CO4	The student can know the application of nanotechnology in biological research

Syllabus

Unit I **(15 Hours)**

Introduction to Nanotechnology: Introduction to nano particles. Nanoscience and its importance. Definition: Nanotechnology - Nanobiotechnology - Nanomaterial - Nanocomposites - Classification of nanostructures – Top down and Bottom Up approach - Quantum dots - Bio-inspired nanomaterials.

Unit II **(15 Hours)**

Herbonanotechnology: Physical synthesis - Ball Milling - Thermal evaporation - Chemical synthesis - Solgel Process - Hydro thermal Synthesis - Biological Synthesis – Plant, Microbial compound based synthesis

Unit III **(15 Hours)**

Properties of Nanomaterials: Physical properties - Optical, Magnetic, Surface Plasmon resonance - Electrochemical Properties of Nanoscale Materials, Intramolecular bonding, Inter-molecular bonding, ***Nanocatalysis**, Self-assembly – DNA, Protein.

19PBC3CN

Unit IV **(15 Hours)**

Characterization methods: UV - Visible Spectrophotometer, X-ray diffraction (XRD), Scanning Electron Microscope (SEM) Transmission, Electron Microscope (TEM), Fourier Transform InfraRed Spectrometer (FTIR), EDAX, Dynamic Light Scattering (DLS).

Unit V **(15 Hours)**

Applications of Nanoparticles: Nanoparticles in waste water treatment, cancer therapy, Biosensors - DNA Microarrays - Cell Biochips - Nanoparticles for Bioimaging – Textile and pharma industries. Application in environment, agriculture and pesticide diagnosis. Nanorobotics. Military applications of Nanotechnology - Nanomaterials for food Applications. Diagnosis and nanoToxicity of Nanoparticles - Future Perspectives.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1 T.Pradeep. (2008). Nano: The Essentials: Understanding Nanoscience and Nanotechnology. Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan. (2005). Nanoscale Science and Technology. John Wiley & Sons, Ltd., UK.

Reference Books

1. Guozhong Gao. (2004). Nanostructures & Nanomaterials: Synthesis, Properties & Applications, Imperial College Press.
2. Richard Brundle, Charles A. Evans Jr., Shaun Wilson C. (1992). Encyclopedia of Materials Characterization. Butterworth-Heinemann Publishers.
3. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse. (2005). Nanotechnology: Basic Science and Emerging Technologies. Overseas Press.
4. Vladimir P Torchilin. (2006). Nanoparticles as Drug carriers. Imperial College Press, USA.
5. M.Niemeyer, Chad A.Mirkin. (2004). Nanobiotechnology: Concepts, Applications and Perspectives. Wiley-VCH, Weinheim.

PBC 53

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	L	M	M	M
CO2	S	M	H	S	H
CO3	H	S	M	M	S
CO4	S	M	S	S	M

S – Strong **H** – High **M** – Medium **L** – Low

PBC 54

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: NA		**Title:** Major Elective – Microbiology		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	NA	5	75	5

Course Objectives

1. To learn about the microbiological techniques for microbial studies
2. To learn the energy process taking place in microbes
3. To learn about the food poisoning and pathogenicity of microbes

Course Outcomes (CO)

K1	CO1	The students commemorate the general bacteriology and microbial techniques.
K2	CO2	The students understand the basic microbial structure and function
K3	CO3	The students also implement the handling techniques and staining procedures in laboratory
K4	CO4	The students resolve the microbial techniques and its applications

Syllabus

Unit I **(15 Hours)**

Morphology and Ultrastructure: History of microbiology. Classification of microbes. Ultra structure and characteristics of fungi, algae and protozoa. Bacterial morphology and fine structure; cell wall, cell membrane, intra cytoplasmic structures and external structures-bacterial growth curve, synchronous growth, continuous culture. Factors affecting bacterial growth. Staining techniques-simple Differential Special staining techniques and negative staining.

Unit II **(15 Hours)**

Microbiological techniques: Culture techniques: Isolation of microbes from various sources, serial dilution techniques, pure culture techniques, Anaerobic culture methods-chemical and physical methods. Culture preservation techniques. Nutritional requirements: different kinds of media, composition of media-carbon sources, nitrogen sources, vitamin and growth factors, mineral, inducers, precursors and inhibitors. Sterilization methods. Anaerobic fermentation-Alcoholic fermentation, propionic acid fermentation, formic acid fermentation.

PBC 55

Unit III **(15 Hours)**

Food Microbiology: Food poisoning – Food borne diseases- Bacterial and Non-Bacterial. Microbial quality and safety – Determining microorganisms in food culture, Microscopy and sampling methods-Chemical and immunological methods. Principles of food preservations: Asepsis, Preservation by use of High temperature, Low temperature, Canning, Drying, Radiation and Food additives.

Unit IV **(15 Hours)**

Medical Microbiology: Infectious Diseases process-Diagnosis-Process of sample collection, transport and examinations of the specimens. Antibiogram. Bacteriology: Morphology, cultural characteristics, pathogenicity and laboratory diagnosis of Gram positive organisms-*Staphylococcus aureus*, Mycoplasma; Gram negative organisms: *E.coli*.

Unit V **(15 Hours)**

Pathogenicity and Laboratory Diagnosis: ***Virology-Basic concepts of virology**. General properties of Human viruses, Approaches to viral diagnosis-Serological and Molecular techniques of viral infections-Hepatitis. Mycology: General properties and approaches to laboratory diagnosis. Mycosis-Superficial, Subcutaneous and Systemic infections-*Candida allbicans*. Parasitology: Pathogenicity and laboratory diagnosis of *Plasmodium vivax*.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Prescott. (2003). Microbiology. 3rd edition, Magraw hill, Boston
2. Pelczar M.J., Ried, RD and Chan, ECS. (2000). Microbiology. 5th edition, Mc Graw Hill

Reference Books

1. Ananthanarayanan and Jayaram Paniker. (2005). Text Book of Microbiology. 6th edition Orient Longman, Hyderabad.
2. Standby and Wittaker. (2008). Principles of Fermentation Technology. 2nd edition.
3. AH Rose. (1976). Chemical microbiology-An introduction to microbial physiology. 1st edition, Springer, US.
4. Frazier and Westhoff. (1998). Food Microbiology. 4th edition, Tata McGrew Hill publisher.
5. Davis *et al*., (2001). Microbiology. 4th edition, Lippincott Williams and Wilkins.

PBC 56

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	S	S	H
CO2	S	H	S	H	H
CO3	M	S	M	H	S
CO4	H	M	H	S	M

S – Strong **H** – High **M** – Medium **L** – Low

PBC 57

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: NA		**Title:** Major Elective: Bioinformatics		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	NA	5	75	5

Course Objectives

1. To learn the role of computer programmes in studying the biological processes
2. To know about the different software's for data analysis
3. To learn about the methods of data retrieval from various databases

Course Outcomes (CO)

K1	CO1	The students will learn about the basics and beginning developments in computer usage
K2	CO2	The students will know the basics of bioinformatics
K3	CO3	The students will learn about the different bioinformatics softwares
K4	CO4	The students will learn about the application of bioinformatics in biological science research

Syllabus

Unit I **(15 Hours)**

Bioinformatics: Introduction, fields related to bioinformatics, objectives, scope, genome mapping as a source of bioinformatics. Applications of bioinformatics in various fields*. Chronological history of events in bioinformatics. Role of computers in bioinformatics. Major categories of bioinformatics tools. Applications of programmes in bioinformatics.

Unit II **(15 Hours)**

Biological databases: database, database management system and its advantages. Biological databases and information resources. Classification of biological databases: general databases, protein families & sequence motif database, signal sequence databases, protein –protein interaction databases, pathways databases, structural databases, SNPs database, histology database, standards, PUBMED, ENTREZ. Searching and retrieving data from databases- FASTA and BLAST. Linking databases with sequence retrieval systems (SRS). Advantages of SRS. OMIM, ExPASy, EMBL-Bank, ENSEMBL and its advantages.

Unit III **(15 Hours)**

Genomics: gene, genome, genomics: genome mapping & genome projects, methods of gene sequence analysis: Genbank, Genbank assembly, genome annotation, genome similarity. Types of genomics: comparative, structural and functional genomics. Gene functions: analysis of gene expression, DNA microarray or DNA chip, serial analysis of gene expression.

Unit IV **(15 Hours)**

Proteomics: Introduction, methods of studying proteins: determining the post translationally modified proteins, determining the existence of proteins in complex mixtures, establishing protein-protein interactions. Protein structure classification: CATH, SCOP, DALI, FSSP, SSAP, protein structure bioinformatics resource. Protein structure prediction: ROSETTA, protein folding, protein folding disorders. Protein function prediction: automated protein function prediction, diversity in protein function.

Unit V **(15 Hours)**

Human Genome Project: Milestones, types of sequences in Human Genome Project, impact, potential benefits, ethical, legal and social issues. **Gene therapy:** Principles, current status of gene therapy research. Factors affecting gene therapy. Recent developments in gene therapy. **Drug designing:** Objectives, rational drug design, computer assisted drug design, drug development. **Pharmacogenomics:** prospects, uses, barriers to progress.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Prakash S.Lohar (2009). Bioinformatics. MJP Publishers.
2. Jean-Michel Claverie and Cedric Notredame. (2012) Bioinformatics-A beginner‟s guide. 1st edition, Wiley- Dream Tech India Pvt. Ltd.

Reference Books

1. T.K. Attwood and D.J. Parry –smith. (1999). Introduction to bioinformatics. Pearson Education Asia.
2. David. W. Mount. (2001). Bioinformatics. CBS publishers and distributers.
3. D.R. Westhead, J. H. Parish and R. M. Twyman. (2002). Instant notes in bioinformatics. Oxford, UK.

PBC 59

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	S	M	S
CO2	S	M	S	M	S
CO3	S	H	M	S	H
CO4	H	M	H	M	M

S – Strong **H** – High **M** – Medium **L** – Low

PBC 60

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: NA		**Title:** Major Elective - Bioethics, Biosafety and IPR		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	NA	5	75	5

Course Objectives

1. To learn about the demerits of biotechnological applications in recent research
2. To know the ethical issues to be concerned in the course of biological research
3. To know about the intellectual property rights of individual researchers

Course Outcomes (CO)

K1	CO1	The students can know about the ethical issues of scientific research
K2	CO2	The students can learn the various regulations in biosafety and bioethics
K3	CO3	The students will be aware of the intellectual property rights
K4	CO4	The students will move into secured and ethical way of research

Syllabus

Unit I **(15 Hours)**

Ethics/bioethics: Introduction, framework for ethical decision making; biotechnology and ethics-benefits and risks of genetic engineering-ethical aspects of genetic testing-ethical aspects relating to use of genetic information-genetic engineering and biowarfare.

Unit II **(15 Hours)**

Ethical implications of cloning: Reproductive cloning, therapeutic cloning; Ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research-GM crops and GMO's – biotechnology and biopiracy – ELSI of human genome project.

Unit III **(15 Hours)**

Biosafety: Introduction, biosafety issues in biotechnology – risk assessment and risk Management – safety protocols: risk groups – biosafety levels – biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations – types of biosafety containment.

PBC 61

Unit IV **(15 Hours)**

Introduction to intellectual property and intellectual property rights: types: patents, copy rights,Trade marks, design rights, geographical indications – importance of IPR - world intellectual Property rights organization (WIPO).

Unit V **(15 Hours)**

What can and what cannot be patented?: Patenting life – legal protection of biotechnological Inventions – Patenting in India: ***Indian patent act.**

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Book

1. Jose Cibelli, Robert P. lanza, Keith H. S. (2002). Principles of cloning,. Campbell, Michael D.West, Academic Press.
2. Sasson A. (1993). Biotechnologies in developing countries present and future, UNESCO Publishers

Reference Books

1. Singh, K. (2000). Intellectual Property Rights on Biotechnology. BCll, New Delhi.
2. Shantharam S. and Jane F. Montgomery. (1999). Biotechnology Biosafety, and Biodiversity, Scientific and Ethical Issues for Sustainable Development, CC Now Science Publishers.
3. Drucker, P.F. (1999). Innovation and entrepreneurship: Practice and Principles, - Butterworth-Heinemann, Harper Business, NY.
4. Singh M. P., Bijay S. Singh and S. Dey. (2004). Conservation of Biodiversity and Natural Resources, Daya Publications, Delhi

PBC 62

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	M	M	S
CO2	S	S	H	M	H
CO3	H	M	S	H	M
CO4	S	M	S	H	S

S – Strong **H** – High **M** – Medium **L** – Low

PBC 63

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: NA		**Title:** Non Major Elective – Environmental Management		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	NA	5	75	5

Course Objectives

1. To learn the various issues pertaining to the environment
2. To combat the environmental issues with efficient strategies
3. To assess the various existing environmental risk issues

Course Outcomes (CO)

K1	CO1	The students will learn about the subject of environmental management
K2	CO2	The students learn the issues concerned with environmental management
K3	CO3	The students can analyse the various issues of importance
K4	CO4	The students can take a right decision on combating upcoming environmental issues

Syllabus

Unit I **(15 Hours)**

Concept and scope of Environmental Management: Environmental Management of Resources - Water, forest, biological, mineral and agricultural; Environmental management of chemical, mining and manufacturing industries –petroleum, coal, cement, paper, fertilizer. Analysis and prediction of Environmental issues: Environmental Planning, Establishment of Health and Environmental standards, measuring Sustainable Development, Life Cycle Assessment, Material Flow Analysis, Environmental Auditing and Environmental Management Systems and Accounting for Eco-efficiency.

Unit II **(15 Hours)**

Principles of Risk Assessment: Human Health Risk Assessments, Ecological Risk Assessment, Probabilistic Risk Assessments, Determination of acceptable risk based limits for Environmental chemicals and development of risk based remediation goals.

Unit III **(15 Hours)**

The role of Risk Assessment in Environmental Management decisions: Evaluation of Human Health Risks Associated with airborne exposures to asbestos, a diagnostic

human health risk assessment for a contaminated site problem and a risk based strategy for developing a corrective action, Response plan for petroleum – contaminated sites, Risk Management and Risk Communication.

Unit IV **(15 Hours)**

Basic concepts of Environmental Economics: International Trade and its Environmental Integrity, Ecolabelling, responsible care, design for the Environment and full-cost accounting for municipal solid waste management, Waste lands and their reclamation, Desertification and its control. Soil erosion, Formation and reclamation of user, alkaline and saline soil, Terra Preta [black carbon] soil in Amazon forests for sustainability in soil; Biochars for energy production and as mitigation measures for global warming and ***soil rejuvenation.**

Unit V **(15 Hours)**

Environmental Education and Communication: Environmental Conflict Management, Sustainable development-concept, and growth of the idea, indicators of sustainability, Sustainability of Water Resources, Sustainable Management of Forests, Sustainability in Industry, Ecosystem Management: Coastal Environments, River and Inland Water Environments, Wetlands, Desert margins, Rural and Urban Environments. Current environmental issues in India – Case studies: Narmada Dam, There Dam, Almetti Dam.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Sally L. Benjamin and David, A. Bullock. (2001). Practical Guide to Understanding Management and Reviewing Environmental Risk Assessment Reports. Lewis Publishers, Washington D.C
2. Peter Calow. (1998). Hand Book of Environmental Risk Assessment and Management. Blackwell-Synergy, London.

Reference Books

1. Nath, B., Hens,L., Compton, P and D. Devuyst. (1998). Environmental Management in Pactice,Volume-I to III Instruments for Environmental Management. Routledge, London and New York.
2. Kart A, Frantzen. (2001). Risk based analysis for Environmental Managers. Lewis Publishers Washington D.C.
3. D.Kofi Asante – Duah. Risk Assessment in Environmental Management. John Willey and Sons, New York.

PBC 65

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	S	M	S
CO2	S	M	S	M	S
CO3	H	S	M	S	M
CO4	S	H	M	M	H

S – Strong **H** – High **M** – Medium **L** – Low

PBC 66

19PBC104

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: NA		**Title:** Non Major Elective – Competitive Science		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	NA	5	75	5

Course Objectives

1. To insist the various facts of life sciences in detail
2. To learn the various information regarding the biological processes
3. To expose the students to the online examination

Course Outcomes (CO)

K1	CO1	The students can learn the subjects in detail
K2	CO2	The students can get a consolidated view of life science subjects
K3	CO3	The student can develop the analytical capability by learning the objective type questions
K4	CO4	The students can undertake competitive examinations will necessary preparation

19PBC104

Syllabus

Unit I **(15 Hours)**

Molecules and their Interaction relevant to Biology: Structure of atoms, molecules and chemical bonds - Composition, structure and function of biomolecules - Stabilizing interactions - Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties) - Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers - Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes - Conformation of proteins - Conformation of nucleic acids - Stability of proteins and nucleic acids - Metabolism of carbohydrates, lipids, amino acids nucleotides and ***vitamins.**

Unit II **(15 Hours)**

Cellular Organization: Membrane structure and function - Structural organization and function of intracellular organelles - Organization of genes and chromosomes - Cell division and cell cycle - Microbial Physiology. Fundamental Processes: DNA

replication, repair and recombination - RNA synthesis and processing - Proteinsynthesis and processing - Control of gene expression at transcription and translation level.

Unit III **(15 Hours)**

System Physiology –Plant: Photosynthesis -Respiration and photorespiration – Nitrogen metabolism - Plant hormones – Sensory photobiology - Solute transport and photoassimilate translocation – Secondary metabolites - Stress physiology.

System Physiology –Animal: Blood and circulation - Cardiovascular System - Respiratory system - Nervous system - Sense organs - Excretory system - Thermoregulation -Stress and adaptation - Digestive system - Endocrinology and reproduction.

Unit IV **(15 Hours)**

Cell Communication and Cell Signalling: Host parasite interaction - Cell signalling - Cellular communication - Cancer - Innate and adaptive immune system. Methods in Biology: Molecular Biology and Recombinant DNA methods - Histochemical and Immunotechniques- Biophysical Methods - Statistical Methods - Radiolabelling techniques - Microscopic techniques - Electrophysiological methods - Methods in field biology.

Unit V **(15 Hours)**

Applied Biology: Microbial fermentation and production of small and macro molecules - Application of immunological principles, vaccines, diagnostics - Tissue and cell culture methods for plants and animals - Transgenic animals and plants, molecular approaches to diagnosis and strain identification - Genomics and its application to health and agriculture, including gene therapy - Bioresource and uses of biodiversity - Breeding in plants and animals, including marker – assisted selection - Bioremediation and phytoremediation-Biosensors.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Textbooks:

1. Upkar's CSIR UGC NET/JRF/SET life Sciences. UpkarPrakasham, Agra.
2. UGC-CSIR NET (JRF & LS) Life Science. Ashish Nagesh, Quaisher J. Hossain, Prashant
3. Kumar. (2016). Arihant Publications. 3rd edition.

PBC 68

19PBC104

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M	H	S	M	S
CO2	S	S	M	H	M
CO3	M	M	S	S	H
CO4	S	S	M	S	M

S – Strong **H** – High **M** – Medium **L** – Low

PBC 69

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: NA		**Title:** Non Major Elective – Bioprocess Technology		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	NA	5	75	5

Course Objectives

1. To understand the basics of fermentation techniques
2. To learn the concepts of screening, optimization and maintenance of cultures
3. To provide the basics of bioprocess technology

Course Outcomes (CO)

K1	CO1	The students can remember the basics of bioreactors
K2	CO2	The students can understanding of the various aspects of bioprocess techniques
K3	CO3	The student can employ in biotechnological industries
K4	CO4	The students can examine the fermentation process and its kinetics

Syllabus

Unit I **(15 Hours)**

Introduction: Basic principles*, Historical development in fermentation, strain improvement and inoculum development. Types of fermentation: batch, fed batch and continuous. Isolation, screening, and maintenance of microbes for industrial process. Strain selection and improvement methods.

UNIT II **(15 Hours)**

Bioreactor: Components design, parts and its functions. Types of bioreactors: CSTR, packed bed, batch, Air lift bioreactor, Bioreactors for immobilized cells, animal cells, waste water and effluent treatment. Specialized bioreactors: pulsed, fluidized and photobioreactors.

UNIT III **(15 Hours)**

Upstream processing: Introduction, principles of microbial nutrition, Media formulation and optimization. Sterilization: Methods of sterilization- Batch and continuous sterilization. Air sterilization, design and air filters, aseptic operation of fermentor. Inocula development for Industrial fermentations. Scale up and scale down.

UNIT IV **(15 Hours)**

Transport phenomena: Mass and heat transfer mechanism. Mass, heat and oxygen transfer coefficients. Rheological properties of a fermentation broth. Bioprocess monitoring and control: On-line and Off-line analysis. Monitoring variables: pH, temperature, DO_2, agitation and foam level. PID control and computer aided control.

UNIT V **(15 Hours)**

Downstream processing: Overview. Primary separation - Cells, Solid matter and foam-precipitation, filtration, centrifugation, cell disruptions (Mechanical, enzymatic and chemical). Product isolation - solvent extraction, adsorption, aqueous two-phase system and precipitations. Purification techniques: Chromatography (ion-exchange, gel-permeation and affinity), membrane separation (microfiltration, Ultrafiltration and reverse osmosis). Product recovery; product polishing (drying and crystallization).

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Textbooks:

1. El – Mans, E.M.T., and Bryce, C.F.A. (2002). Fermentation Microbiology and Biotechnology. Taylor & Francis group
2. Stanbury, P. F. & A. Whitaker. (2003). Principles of Fermentation Technology. Pergamann Press, Oxford.

Reference books:

1. M.L. Shuler and F. Kargi. (2003). Bioprocess engineering: Basic Concepts. Prentice Hall, Engelwood Cliffs.
2. W. Cruger & A. Cruger. (2003). A Textbook of Industrial Microbiology. Panima Pub. Corp., New Delhi.
3. R.K. Rajput. (2003). Heat and Mass Transfer in SI units. S Chand and Co. Ltd., New Delhi.
4. L.E. Casida. (1999). Industrial Microbiology. New Age International Pvt. Ltd., New Delhi.
5. S.B. Primrose. (1994). Molecular Biotechnology. 2nd edition, Blackwell Scientific Publishers, Oxford.

PBC 71

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	M	S	S
CO2	H	S	S	H	M
CO3	S	H	S	M	S
CO4	M	S	H	S	S

S – Strong **H** – High **M** – Medium **L** – Low

PBC 72

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: NA		**Title:** Non Major Elective – Cancer Biology		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	NA	5	75	5

Course Objectives

1. To know the biology of cancer development
2. To know the features of various cancer types
3. To know about the mechanism of cancer cell cycle
4. To learn the screening and diagnosis methods for cancers
5. To learn the treatment strategies for various cancers

Course Outcomes (CO)

K1	CO1	To remember the basic knowledge on cancer development
K2	CO2	To understand the molecular mechanisms of cancer cell cycle
K3	CO3	The student can apply the techniques for diagnosis of various cancers
K4	CO4	The students can evaluate the role of different treatment strtegies and its application

Syllabus

Unit I **(15 Hours)**

Cancer: Introduction, Normal cells and tissues, Control of growth in normal Tissues, Tumour growth, the process of carcinogenesis*, Genes involved in carcinogenesis, Factors influencing the development of cancers. **Risk factors for cancer:** Tobacco, infections, dietary-related factors, reproductive and hormonal factors, radiation, occupational carcinogens, medical carcinogens (non-radiation), environmental pollution, genetic predisposition, mutagens and mutational spectra in relation to cancer types.

Unit II **(15 Hours)**

Epidemiology, Etiology, pathology, Clinical Features, Diagnosis and Evaluation, Management of breast, oral, cervical, gastric, lung and skin cancer. Role of tumour suppressor genes (Rb, p53, NF1, BRCA 1 & 2) in cancer prevention and the mechanism leading to loss of function.

Unit III **(15 Hours)**

Cancer cell cycle: Introduction, cell cycle events in normal and neoplastic cells, restriction point control and its loss, initiation of DNA replication, completion of DNA replication, checkpoint responses to DNA damage in G1 and S phase, from G2 to mitotic metaphase, checkpoints controlling mitotic entry, centrosome duplication and the maintenance of ploidy, the metaphase–anaphase transition and exit from mitosis, cell cycle proteins as prognostic markers and drug targets.

PBC 73

Unit IV **(15 Hours)**

Screening of cancer: Introduction, Types of screening tests, Safety and acceptability, Evaluation of screening (Evaluating the test, Potential biases, Randomized trials, Screening programmes), Types of screening test (Visual inspection, Palpation, Analysis of exfoliated cells, Imaging, Serum and urine markers, screening for and treatment of infections), Screening for specific cancers (Cervix cancer, Breast cancer, Colorectal cancer, Prostate cancer).

Unit V **(15 Hours)**

Local treatment of cancer: Introduction, Skin cancers, Breast cancer, Lung cancer, Prostate cancer, Colo-rectal cancer. **Chemotherapy:** Mechanisms of action and resistance to traditional cytotoxic drugs, Therapeutic principles of traditional cytotoxic chemotherapy. **Radiotherapy. Immunotherapy of cancer:** Introduction, Specific Immunotherapy (Human tumour antigens & Genetically enhanced T cells), Non-specific immunotherapy (Immunotherapy with cytokines).

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/GoogleClassroom

Textbook:

1. Introduction to the Cellular and Molecular Biology of Cancer. Margaret A. Knowles Peter J. Selby. Oxford University Press 2005, Fourth Edition

Reference books:

1. Textbook of Medical Oncology. Fourth Edition Franco Cavalli, Stan B. Kaye, Heine H. Hansen, James O. Armitage, Martine J. Piccart-Gebhart, Informa Healthcare.2009.
3. Cancer Biology Fourth Edition Raymond W. Ruddon, Oxford University Press, 2007.
4. The Biology and Treatment of Cancer. Understanding Cancer. Arthur B. Pardee. Gary S. Stein 2009 by John Wiley & Sons, Inc.
5. Harvey Lodish, Arnold Berk et al., (2007). Molecular Cell Biology. 6th edition, W H Freeman and Company, New York.

PBC 74

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	S	M	S
CO2	M	H	M	H	M
CO3	S	M	S	M	H
CO4	S	H	M	H	M

S – Strong **H** – High **M** – Medium **L** – Low

PBC 75

KONGUNADU ARTS AND SCIENCE COLLEGE
(AUTONOMOUS)
Re-accredited by NAAC with 'A' Grade Status – 3.64CGPA out of 4 (3rdCycle)
College of Excellence (UGC)
COIMBATORE – 641029, TAMIL NADU, INDIA.

QUESTION PAPER PATTERN FOR CIA & END OF SEMSTER EXAMINATION

M. Sc., BIOCHEMISTRY

1. THEORY Max Marks = 75

Time = 3.00 hrs

SECTION - A (10 x 1=10 marks)

Choose the correct answer type.

Q.No. 1 to 10: Multiple choice type ***alone*** *.*

Questions with four alternative (distracter) answers each (Two questions from each unit).

SECTION - B (5 x 5=25 marks)

Short answer questions

Q.No. 11-15: Either (a) or (b) short note type (One question 'a' or 'b' from each unit)

SECTION - C (5 x 8=40 marks)

Essay type of questions:

Q.No. 16-20: Either (a) or (b) essay type (One question 'a' or 'b' from each unit)

2. BREAK UP OF INTERNAL MARKS (25 marks)

Internal marks (25) = CIA (out of 15**) + Attendance (**out of 5**) + Assignment/Google Classroom (**out of 5**)**

***CIA marks (out of 15 marks) = I CIA marks + II CIA marks / 150 X 15**

PBC 76

3. PRACTICALS – Question Pattern & Break-up of marks

END OF SEMESTER PRACTICAL EXAMINATION

Max. Marks: 60
Duration: 3hrs

I. Major	(One question)	(1 x 20 = 20)
II. Minor	(One question)	(1 x 10 = 10)
III. Spotters		(3 x 5 = 15)

Examine, identify and critically comment on the spotters A, B, C, D and E.

IV. Viva	(05)
V. Record / Observation*	(10)

**Record for ESE; Observation for CIA exam.*

INTERNAL - PRACTICAL MARKS

From Model Practical Examination	-	25
Observation	-	10
Attendance	-	5
Total	**-**	**40**

PBC 77

PRACTICALS – Question Pattern & Break-up of marks

END OF SEMESTER PRACTICAL EXAMINATION

Max. Marks: 60
Duration: 3hrs

I. Major	(One question)	(1 x 20 = 20)
II. Minor	(One question)	(1 x 10 = 10)
III. Spotters		(3 x 5 = 15)

Examine, identify and critically comment on the spotters A, B, C, D and E.

IV. Viva	(05)
V. Record / Observation*	(10)

**Record for ESE; Observation for CIA exam.*

INTERNAL - PRACTICAL MARKS

From Model Practical Examination	-	25
Observation	-	10
Attendance	-	5
Total	**-**	**40**

PBC 78

PROJECT VIVA-VOCE EXAMINATION

Maximum marks: 200

Continuous Internal Assessment (CIA)

Project review I	– 15 marks
Project review II	– 15 marks
Regularity	– 10 marks
Total	– 40 marks

End of Semester Examination (ESE)

Project report	– 120 marks
Viva-voce	– 40 marks
Total	– 160 marks

==========

CIA	– 40 marks
ESE	– 160 marks
Total	– 200 marks

PBC 79

19PBCOD1

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC0D1		**Title:** ALC – Forensic Science		
Batch 2019-2020	Semester NA	Hours / Week NA	Total Hours NA	Credits 4

Course Objectives

1. To deals with the forensic aspects like legal procedures and types of trauma.
2. To prop up and develops regulation in forensic science
3. To give students with a sound basis in forensic science

Course Outcomes (CO)

K1	CO1	The students will use the basic concepts of forensic science
K2	CO2	The students will understanding of identification procedures employed under forensics science
K3	CO3	The students will apply the fingerprint analysis and interpretations in research fields
K4	CO4	The students examine and analyze the results involved in fingerprinting technique

19PBCOD1

Syllabus

Unit I

Crime scene management and investigation: Collection, preservation, packing and forwarding of physical and trace evidences for analysis. Legal and court procedure related to expert testimony. Consumer Protection Act: rights and liabilities of doctors, medical indemnity insurance; human rights and violation; duties of medical practitioners to victims of torture; Human organ transplantation Act.

Unit II

Identification of the living and the dead: Forensic thanatology; death; causes of death; mechanism and manner of death; changes after death; artifacts; medico legal death investigation; exhumation. Examination and identification of hair, semen, saliva, urine, faecal matter and milk. DNA fingerprinting and HLA typing.

Unit III

Physical analysis: Soil, glass, paints, lacquers, cement, inks, paper, tool and tyre marks

shoe prints. Forensic examination of vehicles in cases of accident. Identification of individualization from foot prints and teeth.

Unit IV

Injuries: Mechanical injuries; injuries due to electricity, lightning and radiation; train and road traffic accidents; firearm and explosion injuries; medico legal aspects of wounds. General aspects; patho-physiology and classification; mechanical asphyxia; hanging; strangulation; drowning; smothering, choking, garroting, burking, yoking.

Unit V

Medico legal aspects: Medico legal aspects of wounds. Post mortem examination and changes, asphyxia death, sexual offences, infanticide, forensic psychiatry and lye detection. History, classification, search, lifting and examination of fingerprints. Various methods for the development of latent fingerprints, ***Crime records and computerization.**

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Narayanareddy K. S. (2007). The Essentials of Forensic Medicine & Toxicology. 26th edition, K. Sugana Devi publishers, Hyderabad.
2. Basu, R. (2009). Fundamentals of forensic medicine and toxicology. 2nd Edition, Books and Allied (P) Ltd. Kolkata.

Reference Books

1. Keith Simpson, Bernard Knight. (1988). Forensic Medicine. 9th Edition, ELBS.
2. Pillay V.V. (2009). Text book of Forensic Medicine, Paras Publication. Hyderabad.
3. Eckert WG and RK. Wright. (1997). Introduction to forensic science. 2nd edition, W.G. Eckert (ED), and CRC press, Boca Raton.
4. JB Mukherjee's. (2007). Forensic Medicine and Toxicology-Volume I and II (combined)-edited by Karmakar, 3rd edition.
5. R. Saferstein. (2004). Criminalistics. 8th edition, Prentice Hall, New Jersey.

PBC 81

19PBCOD1

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	S	M	M	S
CO2	S	H	M	S	H
CO3	H	S	S	M	H
CO4	M	S	H	M	M

S – Strong **H** – High **M** – Medium **L** – Low

PBC 82

19PBCOD2

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBCOD2		**Title:** ALC – Neutraceuticals and Functional Foods		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	NA	NA	NA	4

Course Objectives

1. To learn the concept of nutraceuticals and functional foods
2. To know the available biochemical compounds in our system
3. To prepare functional foods from nutraceutical compounds

Course Outcomes (CO)

K1	CO1	The students will learn the complete history of nutraceuticals
K2	CO2	The students will learn the different neutraceuticals
K3	CO3	The students will learn the formulation methods of functional foods
K4	CO4	The students will learn about the role of functional foods in disease prevention and management

19PBCOD2

Syllabus

Unit I

Introduction to Nutraceuticals as Science: Nutraceutical- Definition, Classification - Dietary supplements, Functional foods, Historical perspective, scope & future prospects. Applied aspects of the Nutraceutical Science. Sources of Nutraceuticals. Relation of Nutraceutical Science with other Sciences: Medicine, Human physiology, genetics, food technology, ***chemistry and nutrition (brief description).**

Unit II

Classification, Properties and structure of various Nutraceuticals: Alkaloids, Terpenoids, Glycosides, Natural phenols, Isoprenoid derivaties, Glucosamine, Octacosanol, flavonoids, carotenoids, polyunsaturated fatty acids, lecithin, choline and spingolipids, Lycopene, Carnitine, Melatonin and Ornithine alpha ketoglutarate as neutraceuticals. Use of proanthocyanidins, grape products, flaxseed oil as Nutraceuticals.

Unit III

Nutraceuticals of plant and animal origin: Plant metabolites - Functions, sources - Alkaloids, phenols, Terpenoids. Applications with specific examples with reference to skin, hair, eye, bone, muscle, heart, brain, liver, kidney, general health and stimulants. Concept of cosmoceuticals and aquaceuticals. Animal metabolites – Functions, Sources - chitin, chitosan, glucosamine, chondroitin sulphate and other polysaccharides of animal origin. Uses and applications in preventive medicine and treatment.

Unit IV

Functional Foods: Definition. Applications of herbs to functional foods. Concept of free radicals and antioxidants; Nutritive and Non-nutritive food components with potential health effects. Soy proteins and soy isoflavones in human health; Role of nuts in cardiovascular disease prevention. Functional foods from wheat and rice and their health effects. Role of Dietary fibers in disease prevention. Vegetables, Cereals, milk and dairy products as Functional foods. Health effects of common beans, Capsicum annum, mustards, Ginseng, garlic,citrus fruits, fish oils, and sea foods.

Unit V

Food as remedies: Nutraceuticals bridging the gap between food and drug, Nutraceuticals in treatment for cognitive decline, Nutraceutical remedies for common disorders like Arthritis, Bronchitis, circulatory problems, hypoglycemia, Nephrological disorders, Liver disorders, Osteoporosis, Psoriasis and Ulcers etc. Brief idea about some Nutraceutical rich supplements e.g. Bee pollen, Caffeine, Green tea, Lecithin, Mushroom extract, Chlorophyll, Kelp and Spirulina etc.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books:

1. Swaminathan M. (1985). Essentials of Food and Nutrition. 2nd edition, Ganesh and Co.
2. Gopalan C., et al. Dietary Allowances for Indians, NIH, Hyderabad.

Reference Books:

1. Todd and others. Clinical Diagnosis and Management. 17th edition, W.B.Saunders, Philadelphia.
2. Anita F.P. (1997). Clinical Dietetics and Nutrition. 4th edition, Oxford Univ Press.
3. Mahan, L.K. & Ecott-Stump, S. (2000). Krause's Food, Nutrition and Diet Therapy. 10th edition, W.B. Saunders Ltd.
4. Sizer, F. & Whitney, E. (2000). Nutrition-Concepts & Controversies. 8th edition, Wadsworth Thomson Learning.

PBC 84

19PBCOD2

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	H	S	S
CO2	M	S	S	M	M
CO3	S	H	M	S	H
CO4	M	S	H	H	S

S – Strong **H** – High **M** – Medium **L** – Low

PBC 85

19PBCOD3

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBCOD3		**Title:** ALC –Stem Cell Biology		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	NA	NA	NA	4

Course Objectives

1. To learn about the technology of stem cells preparation
2. To learn the properties of stem cells
3. To prepare stem cells for gene therapy

Course Outcomes (CO)

K1	CO1	The students will recall the different types of stem cells and its applications
K2	CO2	The students also understand the importance of gene therapy in various diseases
K3	CO3	The students will implement the stem cell in therapies
K4	CO4	The students examine the molecular concepts of stem cell

19PBCOD3

Syllabus

Unit I

Introduction and Scope of stem cells: Definitions, Concepts of stem cells, differentiation, maturation, proliferation, pluripotency, self maintenance and selfrenewal, significations in measuring stem cells, preservation and storage protocols

Unit II

Types of stem cells: Intestinal stem cells, Mammary stem cells, Skeletal muscle stem cell,keratinocyte stem cells of cornea, skin and hair follicles, tumor stem cells. Factors influencing proliferation and differentiation of stem cells. Role of hormone in differentiation.

Unit III

Embryonic stem cells: Blastocyst, inner cell mass, Culturing of ES cells in lab, laboratory tests to identify ES cells, stimulation ES cells for differentiation, properties of ES cells,human ES cells, Monkey and Mouse ES cells.

PBC 86

19PBCOD3

Unit IV

Application of stem cell: Identification, Manipulating differentiation pathways, stem cell therapy vs cell protection, stem cell in cellular assays for screening, stem cell based drug discovery platforms, drug screening and toxicology, stem cell banking.

Unit V

Gene therapy: Genetically engineered stem cells, stem cells and animal cloning, transgenic animals and stem cells, Therapeutic applications, Parkinson's disease, Neurological disorder, limb amputation, heart disease, spinal cord injuries, diabetes, burns. Matching the stem cell with transplant recipient, HLA typing Alzheimer's disease, spinal cord injuries tissue engineering application, production of complete organ, kidney, eyes, heart, and brain. ***Stem cell case study.**

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Kursad and Turksen. (2002). Embryonic Stem cells, Humana Press.

Reference Books

1. Stem cell and future of regenerative medicine. By committee on the Biological and Biomedical applications of Stem cell Research. (2002). National Academic press.
2. Stem cells, Elsevier: CS Potten.

PBC 87

19PBCOD3

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	M	S	H	S
CO2	S	S	M	H	S
CO3	M	H	S	M	H
CO4	H	S	S	M	M

S – Strong **H** – High **M** – Medium **L** – Low

PBC 88

19PBCOJ1

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBCOJ1		**Title:** JOC – Bio-Entrepreneurship		
Batch 2019-2020	Semester NA	Hours / Week 2	Total Hours 30	Credits 4

Course Objectives

1. To learn about the concepts of entrepreneurship
2. To study the various opportunities in launching and running a business
3. To know the various strategies of effective entrepreneurship

Course Outcomes (CO)

K1	CO1	The students will come to know about the concepts of entrepreneurship
K2	CO2	The students will learn the different strategies adopted for a better entrepreneurship
K3	CO3	The students will learn about the various biological entrepreneurship programmes
K4	CO4	The students will be equipped enough to become an entrepreneur

19PBCOJ1

Syllabus

Unit I (6 Hours)

Basics of Bioentrepreneurship Introduction to bioentrepreneurship – Biotechnology in a global scale, Scope in Bioentrepreneurship, Importance of entrepreneurship. Meaning of entrepreneur, function of an entrepreneur, types of entrepreneur, advantages of being entrepreneur. Innovation – types, out of box thinking, opportunities for Bioentrepreneurship. Entreprenuership development programs of public and private agencies (MSME, DBT, BIRAC, Startup and Make in India). Patent landscape, IP protection and commercialization strategies.

Unit II (6 Hours)

Management, Accounting and Finance Management principles of Henry Fayol. Business plan preparation: business feasibility analysis by SWOT, socio-economic costs benefit analysis, Sources of financial assistance – making a business proposal, approaching loan from bank and other financial institutions, budget planning and cash flow management, basics in accounting practices - balance sheet, P&L account, double entry

book keeping, estimation of income, expenditure and Income tax. Collaborations and partnerships, information technology for business administration and expansion.

Unit III (6 Hours)

Knowledge Centre and R&D Knowledge centers - Universities, innovation centre, research institutions and business incubators. R&D - technology development and upgradation, assessment of technology development, managing technology transfer, industry visits to successful bio-enterprises, regulations for transfer of foreign technologies, quality control, technology transfer agencies, Understanding of regulatory compliances and procedures (CDSCO, NBA, GLP, GCP & GMP)

Unit IV (6 Hours)

Medium & Small Scale Industry Definition, characteristics, need and rationale, objectives, scope and advantages of small scale industries. Types of bioindustries – Pharma, Agri and Industry. Biofertilizers production - ***Azospirillium**, Azolla, Cyanobacteria and its applications. Biopecticides production - Bacterial, fungal, viral and plant insecticides. Sericulture. Apiculture. Dairy farming. Single Cell ProteinProduction and applications. Vermicomposting and its applications. Mushroom cultivation and its application. Ancillary and tiny industries

Unit V (6 Hours)

Marketing and Human Resource Development Assessment of market demand for potential product(s) of interest, Market conditions, segments, prediction of market changes, identifying needs of customers including gaps in the market. Branding issues, developing distribution channels – franchising policies, promotion, advertising, branding and market linkages. Marketing of agro products. Recruitment and selection process, leadership skills, managerial skills, organization structure, training, team building and teamwork.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Principles of Management", PC Tripati, PN Reddy,–Tata Mc Graw Hill.
2. "Dynamics of Entrepreneurial Development & Management" Vasant Desai Himalaya Publishing House.
3. "Entrepreneurship and Business of Biotechnology", S. N. Jogdand, Himalaya Publishing Home, 2007.

Reference Books

1. Management Fundamentals, Robert Lusier-Concepts, Application, Skill Development" Thomson .
2. Entrepreneurship Development" S S Khanka, S Chand & Co .
3. Stephon, Robbins. (2003). Management. 17th edition, Pearson Education.

PBC 90

19PBCOJ1

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	S	M	M
CO2	H	S	M	S	H
CO3	S	M	S	H	S
CO4	H	M	M	M	S

S – Strong **H** – High **M** – Medium **L** – Low

PBC 91

19PBC0J2

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC0J2		**Title:** JOC - Food Safety and Quality Control		
Batch 2019-2020	Semester NA	Hours / Week 2	Total Hours 30	Credits 4

Course Objectives

1. To learn the principles of food quality control
2. To learn the methodologies to standardize and ensuring food safety
3. To gain knowledge on the framed food safety regulations

Course Outcomes (CO)

K1	CO1	The students will learn about the various steps in the quality control of food items
K2	CO2	The students will learn about the various food standards
K3	CO3	The students will learn about the various methods to determine the quality of foods
K4	CO4	The students will be aware of the various regulations concerned with the food quality issues

19PBC0J2

Syllabus

Unit I (6 Hours)

Principles of Quality control of food: Raw material control, processed control and finished product inspection. Leavening agents, classification, uses and optimum levels. Food additives - Preservatives, colouring, flavouring, sequestering agents, emulsifiers, antioxidants.

Unit II (6 Hours)

Standardisation systems for quality control of foods: National and International standardization system, Food grades, Food laws-compulsory and voluntary standards. Food adulteration - Common adulterants in foods and tests to detect common adulterants.

Unit III (6 Hours)

Standards for foods: Cereals and pulses, sago and starch, milk and milk products, Coffee, tea, sugar and sugar products.

19PBC0J2

Unit IV (6 Hours)

Methods for determining quality: Subjective and objective methods. Sensory assessment of food quality-appearance, color, flavour, texture and taste, different methods of sensory analysis, preparation of score card, panel criteria, sensory evaluation room.

Unit V (6 Hours)

Food safety, Risks and hazards: Food related hazards, Microbial consideration in food safety, HACCP-principles and structured approach. Chemical hazards associated with foods**. *FSSAI.**

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Food Chemistry-Lee
2. Food Science-Srilakshmi (2001). 2nd edition, New age international publishers-(2001)

Reference Books

1. Food Science-Norman potter
2. Food Technology-Presscott. S.C.and Procter
3. Food Chemistry-Meyer
4. Food Science, Chemistry and Experimental Foods-M. Swaminathan

PBC 93

19PBC0J2

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M	S	S	M	M
CO2	H	S	S	M	S
CO3	M	M	M	S	H
CO4	S	S	M	M	M

S – Strong **H** – High **M** – Medium **L** – Low

PBC 94

19PBCOJ3

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBCOJ3		**Title:** JOC –Clinical and Therapeutic Nutrition		
Batch 2019-2020	Semester NA	Hours / Week 2	Total Hours 30	Credits 4

Course Objectives

1. To enable the basic principles of clinical nutrition
2. To understand the clinical significance of biochemical findings
3. To develop skills in planning and preparation of therapeutic diets for various diseases

Course Outcomes (CO)

K1	CO1	The students commemorate the basics of nutritional care
K2	CO2	The students will discern the relation between nutrition and health
K3	CO3	The students will apply lifestyle and nutritional assessment techniques
K4	CO4	The students analyze the main nutrients and its functions in the body

19PBCOJ3

Syllabus

Unit I (6 Hours)

Guidelines for dietary planning: ***Weights and Measures.** Nutritional Assessment. Nutritional care process. Nutritional intervention: Objectives of diet therapy, Therapeutic modification of the normal diet: diet prescription. Routine Hospital diet - regular diets, clear fluid diet, full fluid diet, soft diet, modifications of food and nutrient intake, Enteral nutrition, parenteral nutrition, Refeeding syndrome, Transitional feeding. Medical and nutritional care record types and uses, Format for medical and nutrition charting and documentation record.

Unit II (6 Hours)

Dietician and Nutrition counselling: Role of dietician on hospitalized and outdoor patients and development of nutritional care plan. Specific functions of a therapeutic, administrative and consultant dietician. Team approach in patient care. Psychological considerations in feeding the patients. Inter personal relationship with patients. Nutrition counseling- concept, components, activities for behaviour changes, intervention counseling models, types of counselling session in patients.

Unit III (6 Hours)

Weight imbalances, anorexia nervosa and Bulimia nervosa, cardio vascular disorders, Diabetes mellitus-Type I, II, GI Tract Disorders, Liver and gall bladder, Pancreatic disorders, renal disorder, gout, cancer, Musculo -skeletal disorders (Rheumatoid Arthritis, Osteoarthritis, Osteoporosis), Respiratory problems, hyper metabolic conditions- Burns, Sepsis, Surgery.

Unit IV (6 Hours)

Pro and prebiotics: Probiotics: Taxonomy and important features of probiotic microorganisms. Health effects of probiotics with mechanism of action. Probiotics in various foods: fermented milk products, non-milk products etc. **Prebiotics**: Definition, chemistry, sources, metabolism and bioavailability, effect of processing, physiological effects, effects on human health and potential applications in risk reduction of diseases. perspective for food applications for the-Non-digestible carbohydrates/oligosaccharides, Dietary fibre, Resistant starch, Gums. Palliative diet and nutritional care.

Unit V (6 Hours)

Food- Drug Interaction: Effect of Food on Drug Therapy. Effect of Drug on Food and Nutrition. Modification of Drug Action by Food and Nutrition. Effect of Drug on Nutritional Status. Excipients and Food-Drug Interaction. ***Medical nutritional therapy**.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Mahan, L.K. and Escott-Stump, S. (2008). Krause's Food Nutrition and Diet-Therapy. 12th edition, W-13 Saunders Ltd., Canada.
2. Garrrow J.S, James W. P.T, Ralph A. (2000). Human Nutrition and Dietetics. 10th edition, Churchill Livingston, London.

Reference Books

1. Antia F.P. And Philip Abraham. (2001). Clinical Nutrition and Dietetics. Oxford Publishing Company, New Delhi.
2. Williams, S.R. (2003). Nutrition and Diet Therapy. 7th edition, Times Mirror/Mosby College Publishing
3. Esther A. Winter feldt, Margret L. Bogle, Lea L. Ebro. (2011). Dietetics: Practice & Future Trends. 3rd edition, Jones and Barlet Publishers.U

PBC 96

19PBCOJ3

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	H	S	S
CO2	M	S	S	M	M
CO3	S	H	M	S	H
CO4	M	S	H	H	S

S – Strong **H** – High **M** – Medium **L** – Low

PBC 97

CERTIFICATE COURSE IN
MEDICAL LABORATORY TECHNOLOGY

PBC 98

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)

Re-accredited by NAAC with 'A' Grade Status – 3.64 CGPA out of 4 (3rd Cycle)

College of Excellence (UGC)

COIMBATORE – 641029, TAMIL NADU, INDIA.

Course Name: M.Sc. Biochemistry

Curriculum and Scheme of Examination under CBCS

(Applicable for the Students Admitted during the Academic Year 2019-2020 onwards)

Subject code/ Question paper code	Title of the paper	Instructions hours/cycle	Exam Marks			Duration of Exam (Hrs)	Credits
			CIA	ESE	Total		
19PBC0F1	Paper I: Biochemistry	2	-	100	100	3	4
19PBC0F2	Paper II: Clinical Pathology and Microbiology-I	2	-	100	100	3	4
19PBC0F3	Practical I	2	-	100	100	3	4
19PBC0F4	On the Job training and Viva voce	2	-	100	100	3	8

PBC 99

19PBC0F1

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC0F1		**Title:** Paper I-Biochemistry		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	-	2	60	4

Course Objectives

1. To acquire the knowledge on laboratory safety and measures
2. To know the techniques of biochemistry and clinical chemistry
3. To obtain information about various enzymes analysis and analytical techniques

Syllabus

Unit I **(12 Hours)**

Laboratory safety and Specimen processing: General approach to medical laboratory sciences. Safety in laboratory. General laboratory instruments and equipments. Basic chemistry and laboratory chemicals. Specimen processing for biochemical analysis: blood, urine, CSF.

Unit II **(12 Hours)**

Biochemical techniques: Principles of analytical techniques. Basic concepts in analytical chemistry, colorimetry, spectrophotometry, titrimetry, flame photometry, chromatography, electrophoresis, PCR, Real time PRR. Immunochemistry: ELISA, RIA, CLIA, flow cytometry and biochips.

Unit III **(12 Hours)**

Clinical chemistry: Biochemical tests: glucose, protein, albumin, urea, creatinine, uric acid, bilirubin and cholesterol. Enzymes: ***SGOT**, SGPT, ALP, ACP, LDH, creatinine kinase, lipase, amylase, choline esterase. Hormones: Insulin, T3, T4, TSH, cortisol, FSH, progesterone and estrogen. Electrolytes and blood gases. Biochemical profile test: liver function test, renal function test, gastric function test, pancreatic function test and endocrine function test.

Unit IV **(12 Hours)**

Automation in clinical laboratory: Basic concepts, automation of the analytical processes, steps of automation in biochemical analysis, computers in the clinical laboratory, types of automated analysers, commonly used analysers of biochemical laboratories. Statistical procedures: Arithmetic mean, median, standard deviation, coefficient of correlation, t test and ANOVA

Unit V **(12 Hours)**

Laboratory management: Clinical laboratory informatics, computer systems, laboratory information systems. Laboratory management: Basic concepts, financial management, quality management-fundamentals, total quality management of clinical laboratory.

Reference Books

1. Mukherjee KL. (1988). Medical Laboratory Technology-A procedure manual for routine diagnostic tests, Vol I, II, III. Tata McGraw Hill Publishing Company Limited.
2. Ochei Jand Klohatkar A. (2000). Medical Laboratory Science-Theory and Practice. Tata McGraw Hill Publishing Company Limited.
3. Henry JB. (1988). Clinical Diagnosis and Management by Laboratory methods. 7th edition, WB Saunders Company.
4. Chatterjee MNand Shinde R. (2002). Text book of Medical Biochemistry. 5th edition. Jaypee Brothers Medical Publishers.
5. Burtis CA, Ashwood ER. (1999). Teitz Textbook of Clinical Chemistry. 3rd edition, WB Saunders Company.
6. Varley S. (1988). Practical Clinical Biochemistry. 6th edition, CBS Publishers and Distributors.

PBC 101

19PBC0F2

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC0F2		**Title:** Paper II-Clinical Pathology and Microbiology		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	-	2	60	4

Course Objectives

1. To acquire the knowledge on microbial techniques
2. To know the techniques of serological procedures
3. To obtain information on hematological processing

Syllabus

Unit I **(12 Hours)**

Microbiology: Introduction to diagnostic microbiology and microbiological techniques. Role of microbiology in laboratory, specimen handling, laboratory records maintenance, safety regulations, basic procedures of diagnostic microbiology, culture environment of microbes and quality control in microbiology.

Unit II **(12 Hours)**

Diagnostic Bacteriology: Systemic grouping of pathogenic bacteria, laboratory identification of infectious agents, diagnosis of anaerobic infection, identifying characteristics of common pathogenic bacteria. Anti microbial susceptibility test. Diagnostic of mycotic infection: Introduction to fungi, parasitic fungi, specimen collection, laboratory diagnosis of mycotic infection, diagnostic mycology.

Unit III **(12 Hours)**

Serology: Serology and serodiagnostic procedures: Principles of immunological reactions, serodiagnosis. Laboratory procedures in serology: Collection and preparation of specimen. CRP test, RA test, ASO test, HIV, immunologic test for pregnancy.

Unit IV **(12 Hours)**

Clinical Pathology: Clinical pathology and urine analysis: Urine analysis, routing examination of urine, rapid chemical test of urine. Laboratory examination of miscellaneous body fluids: CSF, serous fluids, synovial fluids and gastric juices. Semen analysis: Clinical examination, specimen collection, laboratory investigation. Stool examination: Clinical significance, collection of faecal specimen and laboratory investigations.

PBC 102

Unit V **(12 Hours)**

Hematology: Components of blood and their function, specimen collection. Routine haematological test: RBC, WBC, DC, TC, platelet, ***Hb**, EST, PCV. Bleeding disorders: Bleeding time, clotting time, routine coagulation test. Blood banking: Human blood grouping system, transfusion reactions, collection and processing of blood for transfusion.

Reference Books

1. Mukherjee KL. (1988). Medical Laboratory Technology-A procedure manual for routine diagnostic tests, Vol I, II, III. Tata McGraw Hill Publishing Company Limited.
2. Ochei Jand Klohatkar A. (2000). Medical Laboratory Science-Theory and Practice. Tata McGraw Hill Publishing Company Limited.
3. Henry JB. (1988). Clinical Diagnosis and Management by Laboratory methods. 7th edition, WB Saunders Company.
4. Chatterjee MNand Shinde R. (2002). Text book of Medical Biochemistry. 5th edition. Jaypee Brothers Medical Publishers.
5. Burtis CA, Ashwood ER. (1999). Teitz Textbook of Clinical Chemistry. 3rd edition, WB Saunders Company.
6. Varley S. (1988). Practical Clinical Biochemistry. 6th edition, CBS Publishers and Distributors.

PBC 103

19PBC0F3

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC0F3		**Title:** Practical I		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	-	2	60	4

Course Objectives

1. To attain the knowledge on serum and urine analysis
2. To know the principles and techniques of microbiology
3. To acquire knowledge on pathological techniques

Biochemistry:

1. Analysis in serum:
   Glucose, creatinine, uric acid, cholesterol, urea, bilirubin, total protein, albumin, total lipids, triglycerides, HDL
2. Analysis in urine:
   Glucose, creatinine, uric acid, urea
3. Analysis in CSF: Sugar and protein
4. Enzymes: SGOT, ALP, LDH, CK, lipase, amylase and choline esterase
5. Hormones: Insulin, TSH, estrogen
6. Electrolytes in serum and urine: Sodium, potassium, chlorides, calcium
7. Routine complete urine analysis

Microbiology:

8. Sterilization and media preparation
9. Staining procedures: Simple, differential, negative and acid fast staining
10. Identification of pathological organism
11. Biochemical analysis of microbial strains
12. Processing of clinical specimens: Urine, pus, blood and other body fluids

Clinical Pathology:

13. CRP
14. ASO
15. RA
16. HIV
17. VDRL
18. WIDAL
19. Blood banking: Sample collection and storage

Reference Books

1. Mukherjee KL. (1988). Medical Laboratory Technology-A procedure manual for routine diagnostic tests, Vol I, II, III. Tata McGraw Hill Publishing Company Limited.
2. Burtis CA, Ashwood ER. (1999). Teitz Textbook of Clinical Chemistry. 3rd edition, WB Saunders Company.
3. Varley S. (1988). Practical Clinical Biochemistry. 6th edition, CBS Publishers and Distributors.

PBC 105

Question paper pattern

(External only)

1. THEORY Max Marks = 100

Time = 3.00 hrs

SECTION - A (5 x 5=25 marks)

Short answer questions

Q.No. 1-5: Either (a) or (b) short note type (One question 'a' or 'b' from each unit)

SECTION - C (5 x 15=75 marks)

Essay type of questions:

Q.No. 6-10: Either (a) or (b) essay type (One question 'a' or 'b' from each unit)

2. PRACTICALS – Question Pattern & Break-up of marks

END OF SEMESTER PRACTICAL EXAMINATION

Max. Marks: 100
Duration: 3hrs

I. Major (One question) (1 x 20 = 20)

II. Minor (One question) (1 x 10 = 10)

III. Spotters (3 x 5 = 15)

Examine, identify and critically comment on the spotters A, B, C, D and E.

IV. Viva (05)

V. Record / Observation* (10)

**Record for ESE; Observation for CIA exam.*

PBC 106

DIPLOMA IN MEDICAL LABORATORY TECHNOLOGY

PBC 107

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
Re-accredited by NAAC with 'A' Grade Status – 3.64 CGPA out of 4 (3rd Cycle)
College of Excellence (UGC)
COIMBATORE – 641029, TAMIL NADU, INDIA.
Course Name: M.Sc. Biochemistry
Curriculum and Scheme of Examination under CBCS
(Applicable for the Students Admitted during the Academic Year 2019-2020)

Subject code/ Question paper code	Title of the paper	Instructions hours/cycle	Exam Marks			Duration of Exam (Hrs)	Credits
			CIA	ESE	Total		
19PBC0F5	Paper I: Anatomy, Physiology and Laboratory safety	2	-	100	100	3	4
19PBC0F6	Paper II: Clinical Pathology and Medical Microbiology II	2	-	100	100	3	4
19PBC0F7	Practical II	2	-	100	100	3	4
19PBC0F8	On the job training and Viva voce	2	-	100	100	3	8

PBC 108

19PBC0F5

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC0F5		**Title:** Paper I-Anatomy, Physiology and Laboratory safety		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	-	2	60	4

Course Objectives

1. To learn the anatomy of different organs in human body
2. To know the structure and functions of organs
3. To acquire the knowledge on laboratory safety and measures

Syllabus

Unit I **(12 Hours)**

Gross Anatomy: Introduction to Anatomy and its Nomenclature-Different systems of Human body, Cell- Structure and function; Body Tissue – their functions, Common anatomical terms (Anterior/Ventral, lateral, medial, median, posterior/dorsal etc.), Anatomical Position & Planes (Supine, prone, recumbent, lithotomy) planes- coronal, sagittal.

Unit II **(12 Hours)**

Cardiovascular and Respiratory system: Structure of Heart & its coverings, Major Blood vessels- arteries and veins, Pulmonary circulation-portal and systemic circulation. Cardiovascular diseases-hypertension, Cardiac Failure, Ischemic heart disease. Respiratory system: Respiratory tract structure, Lungs structure, Mechanism of respiration. Introduction to Respiratory Diseases like Tuberculosis, Pneumonia, Asthma, ARDS, Respiratory failure, ***carcinoma**.

Unit III **(12 Hours)**

Digestive and Central Nervous system: Structure of Digestive system- physiology of digestion. Introduction to bowl diseases like - Gastric ulcer, Carcinoma, Inflammatory Bowel disease, Liver – Cirrhosis, Cholelithiasis and Pancreatitis. Brain – Central and peripheral nervous system. Introduction to central nervous system diseases - Stroke, Alzheimer's disease, Epilepsy, Myasthenia Gravis, Parkinson's disease.

Unit IV: **(12 Hours)**

Urinary, Reproductive and Endocrine system: Structure and functions of kidney- Mechanism of urine formation, Introduction to common kidney diseases like Urolithiasis and Renal failure. Reproductive system: Structure of male and female reproductive system. Testis- Vas deferens, prostate, Seminal vesicles; Ovaries, uterus,

vagina Diseases- Menopause, carcinoma. Hormones: Classification – Mechanism of action – Hypothalamic hormones – Pituitary – Anterior, posterior – Thyroid, Adrenal cortex, Adrenal medulla – Gonadal hormones-GI hormones.

Unit V: (12 Hours)

Laboratory safety: General principles of safety programmes: First aid and safety measures for Mechanical, Electrical, Chemical, Radioactive and Biological hazards; Universal safety precautions. General Principles: Care and Cleaning of Glassware, Care of equipment and apparatus, Laboratory chemicals-Proper use, care, storage and labeling, Specimen handling, Appropriate container, Method of collection, Method of transportation, Method of preservation and disposal of laboratory waste. ***Designing of laboratory sections**.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Standring S. (2016). Gray's Anatomy: The Anatomical Basis of Clinical Practice. Elsevier, pp. 1584.
2. Ranganathan TS. (2000). A Textbook of Human Anatomy. 5th edition, S Chand & amp; Co Ltd.

Reference Books

1. Guyton AC and Hall JE. (2000). Text Book of Medical Physiology, 10th edition, Saunders Publishers.
2. Greishcimer EM. Physiology and Anatomy with practical considerations. JP Lippincott, Philadelphia.
3. Chaursia BD and Garg K. (2012) Human Anatomy Regional and Applied. CBS Publications: New Delhi.
4. Fattana. (1991). Human anatomy (Description and applied). Saunders & C P Prism Publishers, Bangalore.
5. Solomon EA. (2008). Introduction to Human Anatomy and Physiology. 3rd edition, Saunders: St Louis.

PBC 110

19PBC0F6

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC0F6		**Title:** Paper II-Clinical Pathology and Medical Microbiology		
Batch	Semester	Hours / Week	Total Hours	Credits
2019-2020	-	2	30	4

Course Objectives

1. To learn the principles and applications of hemotolotical techniques
2. To acquire a knowledge on antigen-antibody reactions
3. To know the microbial techniques and how to establish the laboratory

Syllabus

Unit I

Clinical Pathology: Routine analysis and examination of urine, body fluids, semen and stool. Mantoux test: Blood coagulation test-BT, CT, PT, PTT. Histopathology: Reception of specimen-cytology, fluid cytology, FNAC, PAP smear and histopathological examination preparation and processing, fixing, dehydration, impregnation with paraffin wax, embedding, block making, section cutting, mounting and staining, documentation, slide filling, wax block preservation.

Unit II

Haematology: Introduction, haemotopoietic system of body, specimen collection, routine haematolotical test: special tests, estimation of foetal Hb, screening for sickle cell anemia, Heinz body preparation, lupus erythematous preparation, preparation of bone marrow smear, cytochemical test. Blood banking: Preparation for blood collection, laboratory preparation in blood bank, ABO blood grouping, Rh typing, anti-human globulin (AHG) or coomb's test, compatibility test/cross matching, blood transfusion process and transfusion reactions.

Unit III

Immunology: Immunity-Definition, classification, mechanism of innate and acquired immunity vaccines. Antigen: Definition, properties and types. Antibodies: Definition, structure, classification and functions. Complement system. Antigen-antibody reaction, different types of reaction, principle and application of antigen-antibody reactions.

PBC 111

Unit IV:

Medical Microbiology: Introduction to Medical Microbiology-Common methods of sterilization and disinfection-Common media and culturing methods used for bacterial growth. Antimicrobial susceptibility test. Virology: Morphology, pathogenicity and laboratory diagnosis of Hepatitis, AIDS and oncogenic viruses. Mycology: Morphology and laboratory diagnosis of superficial mycosis and deep Mycosis. Parasitology: Morphology, Life-cycle, Pathogenicity and Laboratory diagnosis of E. histolytica, Giardia, Trichomonas, Toxoplasma, Plasmodia and Leishmania.

Unit V:

Laboratory establishment and management: Space, ventilation, light, water, working benches, arrangement of rooms, laboratory safety, maintenance of records, students code, personal care. Computer laboratory information systems. Laboratory management: Balance sheet, profit loss statement, equity and cash flow, cost accounting. Total quality management of clinical laboratory. Laboratory statistics.

*** denotes Self study**

Teaching Methods

Powerpoint presentation/Seminar/Quiz/Discussion/Assignment/Google Classroom

Text Books

1. Sood Ramnik. (2009). Textbook of Medical Laboratory Technology, 6th Ed, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.
2. Orchard G and Nation B. (2018). Histopathology. 2nd edition. Oxford University Press, Oxford, United Kingdom.

Reference Books

1. Shirley Mitchell Lewis, Barbara J. Bain, Imelda Bates (2006) Dacie And Lewis Practical Haematology, 10th Ed, Churchill Livingstone/Elsevier.
2. Carson FL and Cappellano CH. (2015). Histotechnology: A Self Instructional Text. 4th edition. American Society of Clinical Pathologists Press,C hicago, United States
3. Saunders WB. (2014). Cytology : Diagnostic Principles and Clinical Correlates. 4th edition. Elsevier Health Sciences, W B Saunders Co Ltd, London, United Kingdom
4. Teitz, Clinical Chemistry. W.B. Saunders Company Harcourt (India) Private Limited New Delhi.
5. Ananthanarayanan and Jayaram Paniker. (2005). Text Book of Microbiology. 6th edition Orient Longman, Hyderabad.

PBC 112

19PBC0F7

Programme Code: 07		**Programme Title:** M.Sc Biochemistry		
Course Code: 19PBC0F3		**Title:** Practical II		
Batch 2019-2020	Semester -	Hours / Week 2	Total Hours 60	Credits 4

Course Objectives

1. To accomplish the information on routine analysis of blood and urine
2. To know the techniques of microbiology and immunology
3. To acquire knowledge on pathological techniques

Clinical pathology, Immunology and Microbiology:

1. Haemoglobin Estimation – Sahli's and Drabkin's method
2. Total RBC and WBC Count
3. Differential Count
4. E.S.R. determination by Westergrener's method
5. Platelet Count
6. Prothrombin time / Partial Thromboplastin time
7. Lupus Erythematosus (L.E) Cell Preparation
8. ABO Grouping: Slide technique
9. Cross matching
10. Rh typing – Slide/tube test
11. Coombs test: Direct and Indirect coombs test
12. Routine examination of urine
13. Routine examination of stool
14. Routine examination of sputum
15. Fixation, Processing, Embedding, Section cutting and preparation of slides
16. Sharpening of Knives
17. Preparation of fixative and decalcifying fluid
18. Principles and working of laboratory instruments (Demonstration)
19. Preparation of buffer solutions and measurement of their pH
20. Estimation of Blood glucose – GOD-POD method
21. Estimation of Urea- DAM method
22. Estimation of Plasma protein – Biuret method
23. Estimation of serum Bilirubin- Diazo method, Uric acid, Creatinine, Cholesterol, HDL Cholesterol
24. Estimation of serum Chloride
25. Estimation of serum Sodium and Potassium (by flame photometer)

PBC 113

26. Estimation of SGOT
27. Estimation of serum Amylase
28. Estimation of serum ALP
29. Hanging drop technique for motility
30. Biochemical tests for identification of pathogens
31. Demonstration of malarial parasites

PBC 114

Question paper pattern

(External only)

1. THEORY Max Marks = 100

Time = 3.00 hrs

SECTION - A (5 x 5=25 marks)

Short answer questions

Q.No. 1-5: Either (a) or (b) short note type (One question 'a' or 'b' from each unit)

SECTION - C (5 x 15=75 marks)

Essay type of questions:

Q.No. 6-10: Either (a) or (b) essay type (One question 'a' or 'b' from each unit)

2. PRACTICALS – Question Pattern & Break-up of marks

END OF SEMESTER PRACTICAL EXAMINATION

Max. Marks: 100
Duration: 3hrs

I. Major (One question) (1 x 20 = 20)

II. Minor (One question) (1 x 10 = 10)

III. Spotters (3 x 5 = 15)

Examine, identify and critically comment on the spotters A, B, C, D and E.

IV. Viva (05)

V. Record / Observation* (10)

**Record for ESE; Observation for CIA exam.*