PRAVARA INSTITUTE OF MEDICAL SCIENCES
(DEEMED TO BE UNIVERSITY)
Loni, Tal. Rahata, Dist. Ahmednagar 413736
NAAC Re-accrediated with 'A' Grade

SYLLABUS
B.Sc. + M.Sc. (Integrated) Medical Biotechnology
(Center for Biotechnology)
(Academic Council Meeting Dated 20th March 2019)

B. Sc + M. Sc (Integrated) Medical Biotechnology

RULES AND REGULATIONS

FOR THE BACHELOR INTEGRATED PROGRAM IN MEDICAL BIOTECHNOLOGY

1. General:
These rules and regulations are framed as per the directives of UGC and P.I.M.S. – Deemed University.

2. Faculty:
This course will be under the Faculty of Allied Health Sciences.

3. Nomenclature of Degree:

Bachelor and Master of Science - Integrated Degree in Medical Biotechnology (B.Sc. + M.Sc.)

4. Conditions for admission to the Bachelor and Master of Science - Integrated Degree Program in Medical Biotechnology:

4.1 Candidate should have completed 17 years of age at the time of admission or will complete this age on 31st December of the year of admission.

4.2 Candidate who have passed 12th standard examination under 10+2 system of Maharashtra State Higher Secondary Board or any equivalent examination of any recognized Board or any statutory University with English, Physics, Chemistry & Biology or Physics, Chemistry and Mathematics or Physics, Chemistry, Biology and Mathematics in one and the same attempt with not less than 40% marks taken together.

4.3 Candidates who have appeared for and are expecting their results on or before 31st May of year of admission, of the respective final qualifying examinations.

5. Duration of the Program:

Duration of this program will be five calendar years. Upon successful completion of three years, the candidate will be awarded B.Sc. Degree in Biotechnology. Such candidates who acquire the B.Sc. Degree in Biotechnology have an option of either continuing their Master's program at P.I.M.S.

6. Selection of Students for the Bachelor and Master of Science - Integrated Degree Program in Medical Biotechnology:

6.1 The selection of the students will be based on the merit of the 12^{th} marks obtained in the examination.

7. Program Objective:

7.1 Candidates will be trained in the basic art of biotechnology and in the skills of self education, critical evaluation, problem recognition and problem solving in science. There is an emphasis on integrating theory with extensive practical training.

7.2 Candidates will have:

1. Excellent skills in the science of medical biotechnology
2. Generic skills including teamwork and oral and written presentation
3. An awareness of the social, economic and ethical aspects of Biotechnology, Management

8. Program Structure:

B. Sc (6 semesters)

SEMESTER I

Subject Code	Subject	Lecture / Practical hours/wk
BU 101	Basic Chemistry	3
BU 102	Mathematics & biostatistics	3
BU 103	Evolutionary Biology	3
BU 104	Introduction to Biotechnology	3
BU 110	Practical Course	12

SEMESTER II

BU 105	Biophysics	5
BU 106	Cell Biology	6
BU 107	Basic Laboratory Methods	3
BU 108	Computational Methods in Biotechnology	3
BU 111	Practical Course	7

SEMESTER III

BU 201	Genetics – A	4
BU 202	Medical Microbiology – A	4
BU 203	Human Biochemistry – A	4
BU 204	Enzyme Technology	4
BU 210	Practical Course	8

SEMESTER IV

BU 205	Genetics – B	4
BU 206	Medical Microbiology – B	4
BU 207	Human Biochemistry – B	4
BU 208	Biomembrane	4
BU 211	Practical Course	8

SEMESTER V

BU 301	Molecular Biology	6
BU 302	Fermentation Technology	6
BU 303	Research Methodology	4
BU 310	Practical Course	9

SEMESTER VI

BU 304	Ethical issues and Biosafety	4
BU 305	Basic Immunology	6
BU 306	Project Work	6
BU 311	Practical Course	5

M. Sc (4 Semesters)

SEMESTER VII

BP 101	**Advance Cell Biology**	**4**
BP 102	**Advance Molecular Biology**	**4**
BP 103	**Animal Tissue Culture**	**4**
BP 410	**Practical Course**	**8**

SEMESTER VIII

BP 104	**Human Physiology**	**4**
BP 105	**Bioinformatics**	**4**
BP 106	**Biopharmaceutical Biotechnology**	**4**
BP 411	**Practical Course**	**8**

SEMESTER IX

BP 201	**Genetic Engineering**	**4**
BP 202	**Advance Immunology**	**4**
BP 203	**Clinical Research**	**4**
BP 510	**Practical Course**	**12**

SEMESTER X

BP 511	**M.Sc. Dissertation Project: Each candidate needs to complete a short dissertation project. Prior to proposing a project, the students must have identified a research topic and a mentor who is familiar with their prospective inquiry and who is willing to provide guidance and oversee the project.**

1 unit = 20 hours

9. Eligibility for Appearing for P.I.M.S. Examination

9.1.1 No students shall be allowed to appear for the Final University Examination unless he/she satisfies the requirement of attendance: 75% Lectures, 100% practical

10. Scheme of Examination

The Examination will be conducted to assess the conceptual understanding of the Candidate of the subject matter that was taught in the corresponding semester. Furthermore, whether the candidate can apply his understanding for practical use.

10.1 The Examination will be conducted at end of each semester.

10.2 The students desirous of appearing for the University examination shall submit the application form duly filled along with the prescribed examination fee. Incomplete application forms or application form submitted without prescribed fee or application form submitted after due date will be rejected and student shall not be allowed to appear for the examination.

10.3 **Theory**: Paper for each subject heading - 100 marks, 3 – hours

Theory Question Paper pattern:

- Total of 6 Questions
- solve any five questions
- **Diagrams:** color pencils allowed

10.4 **Practical:** One long experiment of 3 hours - 50 marks.
Two Short experiments, each of
1.5 hours (25 marks each)- 50 marks

10.5 **Viva Voce:** based on practical and theory - 50 marks.

10.6 **Internal:**

Seminar	– 10 marks
Internal Exam	- 20 marks
Viva voce	- 10 marks
Journal	- 10 marks

(Based on timely completion, representation and results)

11. Rules of Passing

11.1 The candidates must secure a minimum of 50% marks in each head of passing in the University Examination and 50% marks in the aggregate; i.e. in the University examination, the candidate should secure 50 marks in the theory paper and 50 marks in the practical.

The gradation will be as follows:

75% marks or more	= pass with distinction or A+
60% - 74% marks	= pass with first class or A
55% - 59% marks	= pass with second class or B+
50% marks – 54%	= pass with second class or B
less than 50%	= fail.

11.2 The candidate will be distinction if he/she secures 75% more than 75% marks in a examination.

11.3 Any candidate who fails in two or more subject headings by end of the two semester in an academic year, will not be permitted to attend the ensuing semester.

11.5 The candidate declared fail as per section 11.3 will have to clear the relevant subject headings before he /she is allowed to attend the ensuing semester.

12. Detailed Syllabus
Appended

Semester I

BASIC CHEMISTRY (BU 101)

Course Code	Category	Course Name	L	T	Total Hr
BU 101	Major	Basic Chemistry	4	0	46

Objective:

The main objective of the paper is to expose students to basics and advanced chemistry.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Atoms & Molecules	Structure of atoms & molecules: Concept of orbital's, aufbau principle, periodic trends inm atomic properties, atomic spectra. Molecules: PE diagram, diatomic molecules, valence bond theory, hybridization, VSEPR theory, linear combination of atomic orbitals, homo and heteronuclear molecules, bond orders, magnetic properties, polyatomic molecules.	8
Unit II	Periodic Table	Periodic table- group and periods, s and p block elements, transition metals, d orbitals splitting in octahedral, tetrahedral and square planar environment – spectral and magnetic properties.	10
Unit III	Thermodynamics	Thermodynamics- second law of thermodynamics, entropy, spontaneous change, free energy, enthalpy, adiabatic demagnetization, reactions at equilibrium, interpretation of equilibrium constants, acid and bases, solubility equilibria, biological activity, thermodynamics of ATP.	10
Unit IV	Electrochemistry	Electrochemical cells, half cell reactions, reduction potentials, the electrochemical series, thermodynamic functions from cell potential measurements, liquid junction potentials, Debye Huckel Theory, over voltage	8
Unit V	Classification of organic compounds	Nomenclature structural and constitutional isomers, functional group chemistry (alcohol, aldehydes, ketones, esters, amines, amides etc.)	10

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

1. Physical Chemistry- A molecular approach by Mcquairee and Simon
2. Physical Chemistry by G M Barrow
3. Concise Inorganic Chemistry by J D Lee
4. Inorganic Chemistry by Shriven and Atkin
5. Physical Chemistry by P W Atkin
6. Physical Chemistry by Venullapalli
7. Physical Chemistry for Life Science and Biosciences by R Chang
8. Organic Chemistry by R T Morrison and R N Boyd
9. Organic Chemistry by P Y Bruice

MATHEMATICS & BIOSTATISTICS (BU 102)

Course Code	Category	Course Name	L	T	Total Hr
BU 102	Major	Mathematics & Biostatistics	4	0	48

Objective:

- The objective of this course is learning and understanding basic concepts of Mathematics and Biostatistics.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Elements of mathematics-I	**Derivatives:** derivative of function, Derivatives of First Principles, Derivatives of inverse, exponential functions and trigonometric functions, Integration: **Methods of Integration: direct integration, integration by parts**	8
Unit II	Elements of mathematics-II	**Determinant:** determinant of order 2 or 3, expansion of determinant, properties of determinant, Crammer rule **Matrix:** Types of matrix, Algebra of matrices, Inverse matrix. Logarithm : **Fundamentals of logarithm, natural logarithm and logarithm to other bases, significance of logarithmic scales**	8
Unit III	Basic concepts in Statistics	Terms and Definitions in Statistics, Population and Sample, Raw Data, Types of variables, Numerical variable (Continuous and discrete), Categorical variables (Nominal and ordinal), Outcome and exposure variables, Display of data for 1 variable, For categorical data: Bar Chart and Pie Chart, For numerical data: Histogram (different shapes) and Frequency Polygon Measurements of central tendency: Mean, Median, quartiles, percentiles, Mode Measures of spread: Range, Variance and Standard Deviation and its interpretation **Normal deviation and its characteristics**	12
Unit IV	Probability and combinations	Probability: Definition and basic formula, Probability of an event not occurring, Multiplicative rule to calculate the probability of occurrence of both of two events. Independent events, Non-independent events (conditional probability), Additive rule to calculate the probability of occurrence of at least on of two events, mutually exclusive events.	10

Sr. No.	Topic	Detail of syllabus	Hrs.
		Combinations: Definition and basic formula (nCr = n!/r!(n-r)!), Application in biology (pedigree analysis), Problems involving Combinations and Probability	
Unit V	Sampling, Hypothesis and significance	Sampling Variation, Population mean and standard error, Concept of Hypothesis test and null-hypothesis, t-test (concept and calculation), ANOVA, One way Anova (concept and calculation), SPSS and its application	10

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

1. Introduction to Mathematics for life scientist – by Edward Batschelet
2. Discrete Mathematics- Semyour Lipschutz & Marc Lipson-McGraw Hill
3. S. C. Gupta and V. K. Kapoor : Mathematical Statistics, Sultan Chand & Sons
4. Introduction to Biostatistics, Le and Chap (2009), Wilay and Sons.
5. Fundamentals of Biostatistics, B. Rosner (2005), Duxbury Press.
6. Medical Statistics from Scratch, Bowers (2008), Wiley and Sons.
7. Introduction to Bioinformatics, Arthur M. Lesk, Oxford University Press

EVOLUTIONARY BIOLOGY (BU 103)

Course Code	Category	Course Name	L	T	Total Hr
BU 103	Major	Evolutionary Biology	4	0	48

Objective:

This is a course in evolutionary biology that uses Flora and fauna examples to exemplify fundamental concepts in evolution. The course will concentrate on basic evolutionary mechanisms and its theory.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction	History of Life, theories of Evolution and Extinction Chemogeny, Biogeny, RNA World, Major Events in History of Life; Lamarckism; Darwinism; Neo-Darwinism; Background of extinction, Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail) and Role of extinction in evolution.	10
Unit II	Fossils and molecular phylogeny evidences	Evidences of Evolution Fossils and its types; Dating of fossils, Phylogeny of horse and human; Molecular evidences (Globin gene families as an example) and Molecular clock concept.	6
Unit III	Natural Selection	Processes of Evolutionary Change Organic variations; Isolating mechanisms; Natural selection (Industrial melanism, Pesticide / Antibiotic resistance); Types of natural selection (Directional, Stabilizing, Disruptive), Sexual Selection and Artificial selection.	12
Unit IV	Evolution in classes	Evolution in Plants and Fungi- Terrestrial algae, bryophytes, from swamps to uplands, angiosperm, fungi From Protozoa to Metazoa–The Cambrian explosion, protistan ancestry, the coelom,metamerism.	6
Unit V	Evolution in higher classes	Evolution Among Invertebrates The Origin of Vertebrates Evolution of Mammals Primate Evolution and Human Origins	12
Unit VI	Social and cultural expects of Evolution	Culture and the Control of Human Evolution – Learning society & culture, cultural & biological evolution, Eugenics.	2

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

Evolution – by Monroe W. Strick berger

INTRODUCTION TO BIOTECHNOLOGY (BU 104)

Course Code	Category	Course Name	L	T	Total Hr
BU 104	Major	Introduction to Biotechnology	4	0	48

Objective:

The objective of the course is to enlighten the student with knowledge of biotechnology with techniques involved in Biotechnology and its use in the field of Medical and health care.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Modern Biotechnology	What is biotechnology? Ancient Biotechnology Classical Biotechnology The Foundation of Modern Biotechnology	6
Unit II	The DNA Revolution: Promise and Controversy	The First Recombinant DNA Experiments Concerns about Safety Drafting the NIH Guidelines Current and Future Concerns	6
Unit III	Microbial Biotechnology	Commercial Production of Microorganisms Bioconversion Microorganisms and Agriculture Products from Microorganisms Bioremediation	6
Unit VI	Animal Biotechnology	Gene Transfer Methods in Animals Transgenic Animals Animal Diseases Animal Propagation Conservation Biology Regulation of Transgenic Animals	6
Unit V	Marine Biotechnology	Aquaculture Marine Animal Health Algal Products Fuels from Algae Algal Cell culture Medical Application Transgenic Fish	8
Unit VI	The Human Genome Project	Goals of the human genome Genetic Linkage Maps Polymorphic DNA Markers Ethical, legal, and social implications	4
Unit VII	Medical Biotechnology	Gene Therapy Gene Delivery Methods Viral Delivery Models Commercialization	8

Sr. No.	Topic	Detail of syllabus	Hrs.
		Vaccines Tissue Engineering Xenotransplantation Drug Delivery	
Unit VIII	Forensic and DNA Profiling	Satellite DNA Single and Multi-locus VNTRs, RFLPs DNA Profiling, PCR,	4

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

1. Biotechnology: An Introduction - by Susan R. Barum
2. Biotechnology A Laboratory course - by Jeffrey M. Becker, Guy A. Caldwell, Eve Ann Zachgo
3. Basic of Biotechnology – by Dr. A. Jayakumaran Nair
4. Biotechnology – by Keshav Trehan

Semester II

BIOPHYSICS (BU 105)

Course Code	Category	Course Name	L	T	Total Hr
BU 105	Major	Biophysics	4	0	48

Objective:

To introduce the concepts in Biophysics and allied subjects

• To enrich students' knowledge

• To help the students to build interdisciplinary approach

• To inculcate sense of scientific responsibilities and social and environment awareness

• To help students build-up a progressive and successful career

The restructured syllabus combines basic principles of Biophysics in light of advancements in technology. The syllabus aims to impart basic knowledge with emphasis on its applications to make the students industry ready.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction	Concept of biophysics, divisions of biophysics	**1**
Unit II	Thermodynamics	Thermodynamics terms and basic concepts, laws of thermodynamics and living organisms. First law of thermodynamics; enthalpy. Second law of thermodynamics, entropy , comparison of living and non-living system as thermodynamic system	**2**
Unit III	Transport across the cell membrane	Structure of the cell membrane, ECF and ICF, pores and channels of the cell membrane, Types of transport: diffusion, active transport, osmosis. Importance of various transport mechanisms.	**4**
Unit IV	Membrane potentials	Resting membrane potential and action potentials, definition, generation, propagation in tissues (nerve, muscle), ionic basis for development of potentials	**3**
Unit V	Nerve	Structure, classification of nerve fibers, properties of nerve fibers, strength duration curve,saltatory conduction in myelinated and unmylinated fibers	**5**
Unit VI	Muscle	Structure of skeletal muscle-contractile proteins, molecular basis of muscle contraction, types of muscle fibers, properties of skeletal muscle – all or none law, types of contraction, refractory period. Neuormuscular junction and impulse transmission across NMJ and factors affecting neuromuscular junction impulse transmission.EMG.	**6**
Unit VII	Haemodynamics	Composition of blood, functions of blood, plasma proteins-types, functions, formed elements of blood, blood flow resistance, factors affecting haemodynamics, Poiseullie' law.	**3**

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit VIII	C.V.S.	Structure of cardiac muscle, properties, cardiac cycle-pressure-volume changes, heart sounds, correlation of pressure volume, ECG, heart sound, cardiac output-factors affecting cardiac output, methods to determine cardiac output. Generation and conduction of cardiac impulse, ECG: lead arrangement, normal waves and their significance with reference to lead II.	**6**
Unit IX	Biophysics of vision	Properties of light, basics of optics, structure of the eye, errors of refraction, colour vision, functions of rods and cones, colour blindness, ERG.	**4**
Unit X	Bioacoustics	Physics of sound, decibel system, Structure of the ear, sound perception. Ultrasound and its application.	**3**
Unit XI	Structure of atom, isotopes and isobars, application of isotopes in biological science Radioactivity	Types of radiation, properties of radiations, detection and measurement of radioactivity. Units of radioactivity, application of radioactivity, radiation hazards and radiation protection. Application of radiobiology in treatment of cancer, 3D printing.	**4**
Unit XII	Environmental factors	Noise, noise hazards, vibrations-effect, EMF properties, hazards. Protection measures.	**3**
Unit XIII	Cybernetics	Homeostasis, Control of Mechanisms, feedback mechanisms – types.	**4**

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

1. Biophysics, an introduction. 1st edition. (2002) Cotteril R. John Willey and Sons Ltd., USA
2. Textbook of optics and atomic physics, 8th edition (1989) P.P. Khandelwal, Himlaya Publishing House, India.
3. Nuclear Physics: An Introduction. 2nd edition (2011). S. B. Patel. Anshan Publication, India
4. Biophysics.1st Edition (2004).M.P. Arora. Himalaya publishing House, India.
5. A Text Book of Biophysics.1st Edition (1996).R. N. Roy. New Central Book Agency (P) Ltd, Calcutta, India.
6. Text Book Of Physiology, Vol.1,2..6th Edition (2016). Avichal Publishing Company, India.

CELL BIOLOGY (BU 106)

Course Code	Category	Course Name	L	T	Total Hr
BU 106	Major	Cell Biology	4	0	48

Objective:

The objective of the course is to familiarize the students with basic concepts of cell Biology. This is essential for taking further courses in Biotechnology during the next couple of years.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Cells and Genomes	Universal features of cells Genome diversity and tree of life Genetic information in eukaryotes	6
Unit II	Principles of microscopy	Working principle & uses of: Light Microscopy Phase contrast microscopy Electron microscopy (EM): Scanning EM (SEM) & Transmission EM (TEM)	8
Unit III	Ultra structure and functions of cellular organelles	Nucleus and Chromosomes Biosynthesis of mitochondria, Chloroplast (genomes) Ribosomes; Golgi complex Lysosomes (Vacuoles and micro bodies) Endoplasmic Reticulum and Golgi apparatus	10
Unit VI	Intracellular compartments and Protein Sorting	The compartmentalization of cells The Transport of molecules between the nucleus and the cytosol The Transport of Proteins into Mitochondria and Chloroplasts; Peroxisomes; The Endoplasmic Reticulum	10
Unit V	Intracellular Vesicular Traffic	The Molecular Mechanisms of Membrane Transport Transport from the ER through the Golgi Apparatus Transport from the *trans* Golgi Network to Lysomes Transport into the Cell from the Plasma Membrane: Endocytosis Transport from the trans Golgi Network to the Cell Exterior: Exocytosis	14

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED:

Reference Book:

1. Cell Biology - S.C. Rastogi
2. Cell and Molecular Biology - De Robertis
3. Cell and Molecular Biology - Lodish
4. Cytology, Genetics and mol. Biology - P.K. Gupta
5. Biotechnical cell biology - Veer Bala Rastogi
6. Cell biology, Genetics, Mol. Biology - P.S.Verma & V.K. Agrawal
7. Mol. Biology of cell - Albert et al
8. The Cell - Cooper

BASIC LABORATORY METHODS (BU 107)

Course Code	Category	Course Name	L	T	Total Hr
BU 107	Major	Basic Laboratory Methods	4	0	48

Objective:

This course has been designed to introduce the student to laboratory, Preparations of reagents, measurements and various classical and modern techniques used in biochemical research. The course encompasses the principles, significance, applications, and limitations of these techniques. The basic instrumentation is also included.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to Biotechnology Lab and workplaces	Introduction, Technologies of modern biotechnology, Applications of Biotechnology; Organization of a biotechnology company, Biotechnology workplaces and safety in Laboratory.	9
Unit II	Math's in Biotechnology Laboratory	Exponents and Scientific notations; use of Logarithms; Units of measurements; Proportional relationships- Percent solution preparations, units of conversions; concentration and dilutions	10
Unit III	Laboratory measurements	Measurement of weight, measurement of volume, measurement of temperature, measurement of pH and measurement of light	8
Unit VI	Laboratory solutions	Preparation of molar solution, buffers. Cleaning glassware's	6
Unit V	Basic Laboratory Techniques	Spectrophotometry, Quantification of Protein and Nucleic acid Concentration, Chromatography, Gel Electrophoresis of Proteins and Nucleic acids, Overview of Protein Purification-Isolation and Characterization of the Enzyme Alkaline Phosphatase From *Escherichia Coli*., Enzymatic Methods of Analysis, Polymerase Chain Reaction (PCR).	15

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED:

Basic Laboratory methods for Biotechnology – by Lisa Seidman

COMPUTATIONAL METHODS IN BIOTECHNOLOGY (BU 108)

Course Code	Category	Course Name	L	T	Total Hr
BU 108	Major	Computational Methods in Biotechnology	4	0	48

Objective:

The objective of the course is to enlighten the student with knowledge of biotechnology with techniques involved in Biotechnology and its use in the field of Medical and health care.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Knowing Computers	Basic Applications of Computer, Components of Computer System- Input devices; Output devices; Computer Memory; Concept of Hardware and Software; Antivirus	08
Unit II	Operating System	Basics of Operating System; Basics of popular operating system (LINUX, WINDOWS); the User Interface; Task Bar; Icons; Menu; Running an Application; Changing Mouse Properties	10
Unit III	Power point & Spreadsheet	Basics of PowerPoint presentation; Entering and Editing Text; Preparation of Slides and slideshow; Inserting Word Table or An Excel Worksheet; Adding Clip Art Pictures; Inserting Other Objects; Resizing and Scaling an Object Presentation of Slides; Choosing a Set Up for Presentation; Rehearse timing: Short cut keys Introduction – Basics of Spreadsheets; Manipulation of Cells; Entering Text, Numbers and Dates; Creating Text, Number and Date Series; Editing Worksheet Data; Formatting spread sheet; Formulas and Function; Short cut keys	12
Unit IV	Programming Languages	Flowcharts – Algorithms - Pseudocodes – Programming languages: data types, variables, constants, operators, input output, expressions, control flow constructs (conditional and loop statements) - functions, arrays, structures and unions - Pointers - Data structures - File handling. Programming languages for Bioinformatics.	08
Unit V	Communication Using The Internet	Basic of Computer Networks; Local Area Network (LAN); Wide Area Network (WAN); Internet; Concept of Internet; Applications of Internet; Connecting to the Internet; Troubleshooting; World Wide Web (WWW). E-mail Account & Its Functions. Role of computer in Biological field.	10

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

REFERENCE BOOKS

1. The complete reference Microsoft Reference access 2007 by Virginia Anderesen.
2. Microsoft Office 2003: The Complete Reference (Osborne Complete Reference Series) by Jennifer Kettell, Guy Hart-Davis, Curt Simmons and Jennifer Kettell
3. E-Book: Microsoft Office 2010 Ultimate Tips & Tricks
4. Computer Fundamentals , 4th edition (2004) P.K. Sinha, BPB publication, India
5. Computer Networks. 4th edition (2008). Tanenbaum. Pearson Education, India
6. Introduction To Database Management Systems, 1st edition, (2004), Atul Kahate, Pearson education, India

PRACTICALS:

1. Use of internet – Downloading & Installing software/plug-ins on
2. Windows 98/XP and later versions (Acrobat Reader, Post Scripts Viewer, etc.)
3. Searching/Surfing on the WWW
4. Spreadsheet Applications (Microsoft Excel): Worksheet Basics: Entering information in a Worksheet, Saving & Opening a Worksheet, Editing, Copying & Moving data, Inserting, Deleting & Moving Columns & Rows, Clearing
5. PowerPoint Presentation- Creating a Presentation Using a Template, Entering and Editing Text, Inserting Word Table or an Excel Worksheet; Adding Clip Art Pictures and Other Objects, Resizing and Scaling an Object Presentation of Slides, Transition and Slide Timings

Semester III

GENETIC - A (BU 201)

Course Code	Category	Course Name	L	T	Total Hr
BU 201	Major	Genetic – A	4	0	48

Objective:

- **The objective of the course is to familiarize the students with the importance & universality of Genetics.**
- **To provide knowledge of basic law of inheritance.**
- **To understand the concept of linkage map, sex linked genes & crossing over.**

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Mendelian Genetics	Introduction to Genetics Mendelian principle Concept of law inheritance Multiple allele, epistasis, incomplete Dominance, co dominance, pleiotrophy	6
Unit II	Linkage & crossing over	Definition of linkage, coupling & repulsion hypothesis Linkage in Drosophila Linkage group, factors affecting linkage Definition of crossing over, mechanism, crossing over in Drosophila, factors affecting crossing over	6
Unit III	Chromosome mapping & sex determination	Chromosomal map in Drosophila Male haploidy & haplodiploidy mechanism Non disjunction as a proof for chromosomal theory of sex determination Sex linkages, types of sex linked genes, Inheritance of sex linked characters (Colourblindness , hemophilia) Inheritance of eye colour in Drosophila	8
Unit VI	Genetic Material	Properties, structure and replication of chromosome Mechanism of replication of prokaryotic & eukaryotic chromosomes	8
Unit V	Mutation	Types & molecular mechanism of mutations, mutagens & DNA repair	6
Unit VI	Transposable elements	Mechanism of transposition Role of transposons in mutation	6
Unit VII	Recombination's in bacteria	Transformation Conjugation Transduction Constructions of genetic maps in bacteria	8

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED:

Text Book:

Cell Biology, Genetics, Molecular Biology by Verma P. K.

Reference Book:

1. Principles of Genetics: Gadener Eldon J., Snustard D. Peter, John Wiley
2. Principles of Genetics: Snustard D. Peter & Simmons M. J. Pub. John Wiley
3. Genetics: A molecular approach: T. A. Brown, Pub. BIOS Scientific
4. Fundamental of Genetics: Single B. D. Pub: Kalyani
5. Genetics: Rastogi V. B. Pub: Kedar Nath Ram Nath
6. Genetics: Verma P. S. & Agrawal V. K. Pub: S. Chand
7. Principle of Gene manipulations: Old & Primose Pub: Black Well Scientific
8. Genes: Lewin B. Pub: Oxford Univ. Press, London
9. Genetics: Strickberger M. W. – Prentice Hall India
10. Genetics: Analysis of genes & genomes – Harti DL, Jones EW – Jones & Bartlett, Massachusetts

MICROBIOLOGY (BU 202)

Course Code	Category	Course Name	L	T	P	Total Hr
BU 202	Major	Microbiology	4	0	4	48

Objective:

The objective of the course is to familiarize the students with microorganisms, their structures, metabolism, diseases caused by microorganisms and their control.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to Microbiology	Scope and history of Microbiology. Classification and identification of microorganism.	8
Unit II	Characteristics	Cultivation of bacteria. Culture media, preservation methods of bacterial cultures and maintenance	8
Unit III	Microorganism-Bacteria	Morphology and fine structure of bacteria. Cell wall structure in details – Gram positive and gram negative bacteria. Reproduction and growth. Growth kinetics. Bacterial genetics- extra chromosomal elements, gene transfer mechanisms	8
Unit IV	Control of Microorganisms	Control of by physical and chemical agents. sterilization and disinfection Role of antibiotics and chemotherapeutic agents antiviral agents, viral agents, and antiviral drugs	8
Unit V	Microbes as parasites	The host-parasite relationship Symbiotic associations, Characteristics of parasitism Entry, exit and transmission. Normal flora, various sites of normal flora, list of normal flora and its beneficial and adverse effects.	8
Unit VI	Microbial Pathogenesis	Types of infections - primary, secondary, nosocomial, iatrogenic, zoonotic etc Mechanisms of Bacterial pathogenesis – bacterial toxins, capsules, enzymes, intracellular parasitism, antigenic variations etc. leading to establishment of infections. Principles of lab diagnosis of infectious diseases	8

METHODOLOGY

The course would be taught through lectures, demonstrations and practical classes.

BOOKS RECOMMENDED:

1. General Microbiology: Vol. I & 2 by Powar & Daginawala
2. Microbiology by Pelzer
3. Microbiology by Prescott
4. General Microbiology by Stanier
5. Instant notes in Microbiology by Nicklin

PRACTICAL IN MICROBIOLOGY (4 hrs per week)

LIST OF EXPERIMENTS

1. To study different types of Microscope.
2. Sterilization and disinfections
3. Preparation of culture media
4. Staining procedures
5. Monochrome staining
6. Negative staining
7. Gram Staining
8. Capsule staining
9. Motility of microorganisms
10. Fungal mounting
11. Aseptic transfer techniques
12. Streak plate method
13. Spread plate method
14. Pour plate method
15. Biochemical tests
16. IMViC test
17. Urease test
18. Triple Sugar Iron test
19. Catbohydrate fermentation test
20. Catalase test
21. Oxidase test

HUMAN BIOCHEMISTRY - A (BU 203)

Course Code	Category	Course Name	L	T	Total Hr
BU 203	Major	Human Biochemistry – A	4	0	48

Objective:

The objective of the course is to familiarize the students with basic principles of Biochemistry by study micro molecules, metabolism and their regulations.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Biochemistry & Medicine	Introduction to biochemistry, Relationship between biochemical processes and health	3
Unit II	Water & pH	Biomedical importance of water, Interaction of water with biomolecules, Importance of pH and buffers	2
Unit III	Biomolecules	Introduction to biomolecules and their physiological significance Amino Acids & Peptides Proteins: Myoglobin & Hemoglobin	6
Unit VI	Bioenergetics	Biologic Oxidation The Role of ATP The Respiratory Chain & Oxidative Phosphorylation	4
Unit V	Overview of Metabolism	Metabolism of Carbohydrate: The Citric Acid Cycle: The Catabolism of Acetyl-CoA, Glycolysis & the Oxidation of Pyruvate Metabolism of Glycogen: Gluconeogenesis & Control of the Blood Glucose by hormone, The Pentose Phosphate Pathway & fate of G-6-P	8
Unit VI	Metabolism of Fatty acids	Biosynthesis of Fatty Acids B-Oxidation of Fatty Acids: Ketogenesis Metabolism of Essential fatty acids & Eicosanoids Metabolism of Acylglycerols & Sphingolipids	10
Unit VII	Metabolism of Lipid	Lipid Transport & Storage Cholesterol Synthesis, Transport, & Excretion and clinical significance	9
Unit VIII	Vitamins And Minerals	Classification, structure and function of fat soluble and water soluble vitamins (including antioxidant properties). Minerals of biological significance: Na, K, Ca, Mg, Mn, P, Fe, Cu, I, Zn, Se, Co.	6

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED:

Reference Book:

1. Harper's Illustrated Biochemistry – Robert Murray, Peter A., Mayes, Victor W. Rodwell, Daryl K. Granner
2. Leninger: Principles of Biochemistry
3. Biochemistry with clinical correlations by Delvil T. M.

ENZYME TECHNOLOGY (BU 204)

Course Code	Category	Course Name	L	T	Total Hr
BU 204	Major	Enzyme Technology	4	0	48

Objective:

The objective of the course is to familiarize the students with basic properties, enzyme kinetics, enzyme inhibition and applications of enzyme in various fields.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Properties of enzymes	Catalytic power, specificity, holoenzymes, apoenzyme, coenzyme and cofactor. Nomenclature and classification of enzymes, active site-Fischer and Koshland models. Collision theory, activation energy and transition state energy, the law of mass action and order reaction.	8
Unit II	Enzyme kinetics	Kinetics of single substrate enzyme catalyzed reaction, equilibrium steady state assumption (Michaelis-Menten), transformation of Michaelis Menten equation, Lineweaver Burk, Eadie-Hofstee, Hanes plots. Determination of Vmax, Km, Kcat and their significance. Effect of pH, temperature, enzyme and substrate concentration on enzyme activity. Single displacement and Double displacement reaction.	12
Unit III	Enzyme Inhibition and Catalysis	Reversible inhibition- competitive, uncompetitive and non competitive inhibition, allosteric and irreversible inhibitions. Assay of enzymes: Coupled kinetic assay, units of enzyme activity (IU), Turnover number, purification of enzymes and criteria of purity. Covalent catalysis, acid-base catalysis, metal ion catalysis. Mechanisms of enzymes action-lysozyme, chymotrypsin and ribonuclease.	12
Unit IV	Production of enzymes	Enzymes from animal and plant sources, Enzymes from microbial sources, Large scale production, Biochemical fundamentals, Genetic engineering, Recovery of enzymes, Isolation of soluble enzymes, Enzyme purification, Immobilized enzymes, Legislative and safety aspects.	10
Unit V	Synthesis of chemicals using enzymes	Hydrolytic enzymes, Chiral building blocks for synthesis, Reduction and oxidation, Use of enzymes, in sugar chemistry, Use of enzymes to make amino acids and peptides.	6

METHODOLOGY:

BOOKS RECOMMENDED:

Reference Books:

1. Principles of Biochemistry general aspects 1983- Smith et al McGraw Hill.
2. Principles of Biochemistry, 2001, nelson & Cox, CBS India.
3. Biochemistry, Leninger, A.H.
4. Text book of Biochemistry, West,E.S., Todd, Manson & Vanbruggen. Macmillon.
5. Organic chemistry, I.L.Finar, ELBS, 1985.
6. Biochemistry, Zubay,C.Addison. Wesley 1986.
7. Biochemistry of Nucleic acides, Adams.e.T.Al. Chapmann and Hall, 1986

PRACTICALS:

1. Assay of chymotrypsin and trypsin.
2. Isolation and partial purification of enzymes, amylases and cellulases.
3. Localization of enzymes – mitochondrial (SDH) and cytosolic (GSH)
4. Determination of characteristics of enzyme-catalyzed reaction (Vmax and Km).
5. Effect of temperature and pH on the rate of enzyme catalysed reaction.
6. Effect of inhibitors/activators on enzyme catalyzed reactions.
7. Immobilization of enzymes.
8. Characterisation of immobilised enzymes.

Semester IV

GENETIC - B (BU 205)

Course Code	Category	Course Name	L	T	Total Hr
BU 205	Major	Genetic – B	4	0	48

Objective:

- The provide knowledge of population genetics & evolutionary genetics.
- To familiarize the students with basic concepts of nucleic acid in prokaryotic & eukaryotic organism.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Population Genetics	Gene pool Allele frequencies Random genetic Drift & Hardy- Weinberg Law of equilibrium & applications of Hardy Weinberg Law	6
Unit II	Molecular Genetics	DNA as a genetic material: experimental evidence Watson & Crick Model, Alternative forms of DNA Genomic organization of prokaryotic & eukaryotic cells. Concept of central Dogma Replication – Experimental evidence of DNA replication & mechanism of DNA replication in prokaryotes & eukaryotes	8
Unit III	Gene Expression	Transcription – overview & types of RNA molecule. Process of transcription, RNA processing & post transcriptional modification Machinery of protein synthesis: Genetic Code, Ribosome's & role of t-RNA Translation: Overview, post translational modification Regulation of Gene expression Lac – operon & Trp operon	8
Unit VI	Gene Cloning	Steps in Gene cloning Cloning vectors: Plasmid, Phages, Cosmid, YACs, BACs Cloning strategies: shot gun method, Homo polymer tailing, linkers & adaptors Screening of Recombinants (Genetic Analysis method, Immuno chemical Method, Nucleic Acid Hybridization method) Applications of Genetic engineering	10
Unit V	Evolutionary Genetics	The emergence of Evolutionary theory Genetic variation in natural populations Molecular evolution – Molecules, Molecular phylogeny	8

Sr. No.	Topic	Detail of syllabus	Hrs.
		Speciation : Species and modes of speciation Human evolution – Humans & Apes, Human Evolution in fossils record, DNA sequencing variation & human origin.	
Unit VI	The genetic basis of cancer	Cancer: A genetic disease Oncogenes Tumor suppressor genes Cancer & genetic counseling Genetic pathways to cancer	8

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED:

Text Book:

Cell Biology, Genetics, Molecular Biology by Verma P. K.

Reference Book:

1. Principles of Genetics: Gadener Eldon J., Snustard D. Peter, John Wiley
2. Principles of Genetics: Snustard D. Peter & Simmons M. J. Pub. John Wiley
3. Genetics: A molecular approach: T. A. Brown, Pub. BIOS Scientific
4. Fundamental of Genetics: Single B. D. Pub: Kalyani
5. Genetics: Rastogi V. B. Pub: Kedar Nath Ram Nath
6. Genetics: Verma P. S. & Agrawal V. K. Pub: S. Chand
7. Principle of Gene manipulations: Old & Primose Pub: Black Well Scientific
8. Genes: Lewin B. Pub: Oxford Univ. Press, London
9. Genetics: Strickberger M. W. – Prentice Hall India
10. Genetics: Analysis of genes & genomes – Harti DL, Jones EW – Jones & Bartlett, Massachusetts

MEDICAL MICROBIOLOGY (BU 206)

Course Code	Category	Course Name	L	T	P	Total Hr
BU 206	Major	Medical Microbiology	4	0	4	48

Objective:

The objective of the course is to familiarize the students with infectious microbial agents and clinical aspects.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Bacteriology	Bacteria of medical importance Gram Positive Cocci-*Staphylococcus, Streptococcus,Pneumococcus* Gram Negative Cocci- *Neissaria* Gram Positive Bacilli- *Bacillus anthraxis, C. diphtheria, Clostridium* Gram Negative Bacilli- members of *Enterobacteriacae , Pseudomonadaceae, Vibrio cholerae* Other: *Mycoplasma, Ricketasia, Chyamadia, Mycobacteria*	16
Unit II	Virology	General properties of viruses, viral replication, viral genetics, Classification of viruses, pathogenesis of viral infections and Bacteriophages. Laboratory diagnosis of viral infections,collection, storage and transport of specimen, viral cultivation, serological methods of viral diagnosis.	8
Unit III	Mycology	Structure and characteristics of fungi, differences between Bacteria and fungi, common terminologies, sporulation morphological classification, method of identification, culture and laboratory diagnosis, infections produced (Mycoses). Medical importance of fungi.	8
Unit VI	Epidemiological aspects	control of infection and disease Hospital acquired infection, prevention and control	4
Unit V	The clinical manifestations of infection	Respiratory tract infections Urinary tract infections Sexually transmitted diseases Gastrointestinal tract infections Meningitis Vector-borne infections Pyrexia of unknown origin Zoonotic infections	12

METHODOLOGY

The course would be taught through lectures, demonstrations and practical classes.

BOOKS RECOMMENDED:

1. Medical Microbiology by Mims
2. Medical microbiology by C.P. Baweja
3. Medical microbiology by Ananthnarayanan

4. Parasitology by Chatterjee
5. Mycology by Jagdish chander
6. Diagnostic microbiology by Bailey & Scott

PRACTICAL

LIST OF EXPERIMENTS

1. **Isolation and identification of bacterial pathogen from clinical specimen**
    a. Urine sample
    b. Pus sample
    c. Blood sample/any other
2. **Antibiotic sensitivity test (Disk diffusion method and well diffusion method)**
3. **Widal test**
4. **Techniques for diagnosis of viral infections**
    a. HIV
    b. HBsAg
    c. Dengue
5. **Techniques for diagnosis of parasitic infections**
    a. Malaria
    b. Intestinal parasitic infection
6. **Techniques for identification of pathogenic fungi**
    a. Germ tube test
    b. LPCB preparation for molds
    c. Slide culture technique

HUMAN BIOCHEMISTRY - B (BU 207)

Course Code	Category	Course Name	L	T	Total Hr
BU 207	Major	Human Biochemistry – B	4	0	48

Objective:

The objective of the course is to familiarize the students with biochemical pathways involved in intermediatary metabolism, Biosynthesis of amino acids nucleic acid along with metabolic disorders.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Integration of Metabolism	The Provision of Metabolic Fuels	6
Unit II	Biosynthesis of Amino Acids	Biosynthesis of the Nutritionally Nonessential Amino Acids, peptides Catabolism of Proteins & of Amino Acid Nitrogen; structural organization of Hemoglobin and myoglobin Catabolism of the Carbon Skeletons of Amino Acids and Nitrogen- Urea cycle	14
Unit III	Disorders of amino acid metabolism	-Phenylketonuria, tyrosinemia, alkaptonuria, albinism, MSUD Conversion of Amino Acids to Specialized Products Porphyrins & Bile Pigments Nucleotides	12
Unit VI	Metabolism of Nucleic acid and disorders	Metabolism of Purine & Pyrimidine Nucleotides Disorders in Purine/Pyrimidine metabolism	10
Unit V	Endocrine system	The Diversity of the Endocrine System Hormone Action and its clinical significance	6

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED:

1. Harper's Illustrated Biochemistry – Robert Murray, Peter A., Mayes, Victor W. Rodwell, Daryl K. Granner
2. Leninger: Principles of Biochemistry
3. Biochemistry by Voet & Voet
4. Biochemistry by Satyanarayna
5. Biochemistry by Stryer

BIOMEMBRANE (BU 208)

Course Code	Category	Course Name	L	T	Total Hr
BU 208	Major	Biomembrane	4	0	48

Objective**:**

The objective of the course is to enlighten the student with knowledge of membrane structure and transport of small and macromolecules across the cell membrane.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	The lipid bilayer	Membrane lipids are amphiphathic molecules that spontaneously form bilayers. The lipid bilayer is a two-dimensional fluid. The fluidity of a lipid bilayer depends on its composition. The lipid bilayer serves as a solvent for membrane proteins. The lipid bilayer of the plasma membrane is asymmetrical. Glycolipids are found on the surface of all plasma membranes, but their function is unknown.	**8**
Unit II	Membrane proteins	Membrane proteins can be associated with the lipid bilayer in various ways. In most transmembrane proteins the polypeptide chain crosses the lipid bilayer in an α-helical confirmation. Some β Barrels form large transmembrane channels. Membrane protein can be solubilized and purified in detergents. The cytoplasmic side of membrane proteins can be studied in red blood cell ghosts. Spectrin is a cytoskeletal protein noncovalently associated with the cytosolic side of the red blood cell membrane. Glycophorin extends through the red cell lipid bilayer as single ∝- helix. Band III of the human red blood cell membrane is a transport protein. Bacteriorhodopsin is a proton pump that traverses the bilayer as seven ∝- helices.	**14**
Unit III	Membrane carbohydrate	The carbohydrate in biological membranes is confined to the noncytoplasmic surface. Cell-surface carbohydrate is suspected to be important in cell-cell interactions.	**8**
Unit IV	Membrane transport of small molecules	Protein free lipid bilayers are permeable to water but impermeable to ions. Role of membrane proteins in transport across cell	**12**

Sr. No.	Topic	Detail of syllabus	Hrs.
		membrane. Transport form a continuous protein pathway across the lipid bilayer. Carrier proteins behave like membrane-bound enzymes. Role of Na^+ -K^+ pump, Role of Ca^+ pump. Membrane bound enzymes that synthesize ATP are transport ATPases working in reverse. Active transport can be driven by ion gradients.	
Unit V	Membrane Receptors	Structure and functions. Methods to study membrane receptors. Purification and characterization of adrenergic and cholinergic receptors.	**6**

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

Reference Book:

1. Leninger: Principles of Biochemistry, 3nd Ed. – Nelson D. et al (Worth Publishers)
2. Cell Biology – Roy S.C. and De Kalyan Kumar (New Central Book Agency
3. Cell Biology – Fundamantal and Application, - Gupta M.L. and Jangir M.L. (Agrobios)
4. Cell and Molecular biology, 8th Ed. – De Robertis E.D.P. and De Robertis, Jr. E.M.F. (Lippincott Williams & Wilkins).
5. Molecular Biology of the Cell, 2nd Ed. – Alberts B. et al (Garland Publishing)
6. Molecular Cell Biology, 2nd Ed. – Lodish et.al

Semester V

MOLECULAR BIOLOGY (BU 301)

Course Code	Category	Course Name	L	T	Total Hr
BU 301	Major	Molecular Biology	4	0	48

Objective:

- The course gives an in-depth insight into the molecular aspects of life - the central dogma.
- It explains molecular aspects of genes and its regulation- genome- gene expressions.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction	History of significant discoveries in Molecular Biology, Experiments demonstrating DNA as the genetic material, RNA as genetic material, Structure of DNA and RNA, Physico - chemical properties of DNA, Organization of DNA in viral, prokaryotes and eukaryotic chromosome	8
Unit II	Genes	Concept of gene, Gene structure, split genes, Structure of prokaryotic genes, eukaryotic genes –structure.	8
Unit III	DNA replication and Repair	Meselson and Stahl experiment, Replication in prokaryotes and eukaryotes, Structure and function of enzymes involved in DNA replication. DNA repair: Mismatch repair, excision repair.	10
Unit IV	Transcription and Translation in prokaryotes and eukaryotes	Initiation, elongation and termination, Transcription products, Types of RNA - mRNA, rRNA, tRNA and sn RNA. Genetic code- properties of genetic code, start codon and termination codon. Wobble Hypothesis. Translation - translation of prokaryotic and eukaryotic mRNA - initiation, elongation and termination.	12
Unit V	Regulation of Gene expression	Regulatory protein, promoters, activators, repressors, operon concept, positive and negative regulation, Molecular details of *Lac* and *Trp* operon, Transposable elements	10

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED:

Reference Book:

1. Introduction to Molecular Biology - P. Paolella; Mc. Graw Hill, New York
2. Fundamentals of Biochemistry, - J.L. Jain, Sanjay Jain, Nitin Jain, S. Chand Publishers
3. Genetics. A Molecular approach.2ndEdn. - Peter J. Russel.
4. Principles of genetics - Snustad and E J . Gardner, John Wiley publishers.
5. Molecular Biology of the gene - Watson, Baker, Ganu, Bell, Levene, Losiek (Pearson Publication)
6. Cell and Molecular Biology by Gerald Karp, Academic Press
7. World of the Cell , Becker, Reece, Poenie, The Benjamin/Cumming's Pub.
8. Cell Biology ,Lodish et al, W H Freeman and Co.,NewYork. 9. Cell Biology , Thomas D Pollard and W.C.Earnshaw, Saunder's Publishers

FERMENTATION TECHNOLOGY (BU 302)

Course Code	Category	Course Name	L	T	Total Hr
BU 302	Major	Fermentation Technology	4	0	48

Objective:

To acquaint students with technical and biological aspect of microbial utilization for production of metabolites.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to Fermentation technology	History, Scope and Development of Fermentation technology; Isolation and screening of industrially important microorganisms − primary and secondary screening; Maintenance of Strains; Strain improvement: Mutant selection and Recombinant DNA technology.	12
Unit II	Fermentation media	Natural and Synthetic media; Basic components of an media (Carbon sources; Nitrogen sources; Vitamins; Minerals; Anti-foaming agents); Role of buffers in media; Process of aeration, and agitation.	10
Unit III	Fermentor design	Basic designs of Fermentor; Type of fermentors: Waldhof, Tower, Deepjet, Cyclone column, Packed tower and airlift fermenter; Scale up study and Product development; Down-stream processing and Product recovery; Regulation and safety.	14
Unit IV	Production of Microbial Products	Production of alcohol; Organic acid − Citric acid; Antibiotic − Penicillin, Amino acid − Glutamic acid; Vitamin − B1; Single Cell Protein (SCP).	12

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED:

1. Emt.el-Mansi & CFA. Bryce Fermentation Microbiology & Biotechnology, Taylor & Francis Ltd. (2004).
2. Stanbury, P.F., A. Whitaker & S.J. Hall. Principles of fermentation technology Oxford Press. (1997).
3. H. J. Peppler, D. Perlman. Microbial Technology: Fermentation Technology. (2014). Academic Press.
4. Hongzhang Chen. Modern Solid State Fermentation: Theory and Practice. (2013). Springer Press, Germany.
5. G. Lancini, R. Lorenzetti. Biotechnology of Antibiotics and other Bioactive Microbial Metabolites. (2014). Springer publications, Germany.

RESEARCH METHODOLOGY (BU 303)

Course Code	Category	Course Name	L	T	Total Hr
BU 303	Major	Research Methodology	4	0	48

Objective**:**
The objective of this course is to develop Research Aptitude, Logical Thinking and Reasoning

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to Research Methodology and Research Problem	Meaning of Research; Objectives of Research; Motivation in Research; Types of Research; Research Approaches; Significance of Research; Research Methods versus Methodology; Research Process; Criteria of Good Research; Problems Encountered by Researchers in India; What is a Research Problem? Selecting the Problem; Necessity of Defining the Problem; Technique Involved in Defining a Problem	8
Unit II	Research Design	Meaning of Research Design; Need for Research Design; Features of a Good Design; Important Concepts Relating to Research Design; Different Research Designs; Basic Principles of Experimental Designs; Developing a Research	8
Unit III	Data Collection & Analysis	Plan Collection of Primary Data; Observation Method; Interview Method; Collection of Data through Questionnaires; Collection of Data through Schedules; Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method Meaning of correlation and regression. Tests of significance – F & t tests, chi-square tests, ANOVA. Cluster analysis: phylogenetic clustering by simple matching coefficients. Presentation of statistical data: tabulation (simple tables, frequency distribution table); charts and diagrams (bar charts, histograms, pie charts, dendrogram).	16
Unit IV	Interpretation and Report Writing	Meaning of Interpretation, Why Interpretation?, Technique of Interpretation, Precautions in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.	16

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

Reference Book:

1. Research Methodology- Methods & Techniques by C. R. Kothari
2. Principles & Techniques of Biochemistry & Molecular Biology by Wilson & Walker
3. Methods in Biostatistics by B. K. Mahajan
4. Fundamentals of Biostatistics by Khan & Khanum
5. Fundamentals of Biostatistics by U.B.Rastog

Semester VI

ETHICAL ISSUES AND BIOSAFETY (BU 304)

Course Code	Category	Course Name	L	T	Total Hr
BU 304	Major	Ethical Issues and Biosafety	4	0	48

Objective**:**

This part of the syllabus helps the students to understand the ethical, social, legal aspects in biology and biocontainment.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Bioethics	Bioethics - legal and socioeconomic impacts of biotechnology- ethical concerns of biotechnology research and innovation, Bioethics committees	10
Unit II	Intellectual Property Rights	Intellectual property rights-patent, copyright, trade mark, TRIP- GATT and PBR, WTO	12
Unit III	Patents and Patent Laws	Patent system – patenting laws-Legal development-Patentable subjects and protection in biotechnology-The patenting living organisms.	14
Unit IV	Biosafety	GLP - Containment facilities – Biosafety levels - Genetically modified organisms and its release - Genetically modified foods, Biosafety guidelines in India - International guidelines	12

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

Text Books:

1. Sasson A, Biotechnologies and Development, UNESCO Publications, 1988.
2. Sasson A. Biotechnologies in developing countries present and future, UNESCO publishers, 1993.

Reference Book:

1. Singh K, *Intellectual Property rights on Biotechnology*, BCIL, New Delhi, 2010
2. Shaleesha A. Stanley, Bioethics, Wisdom educational service, 2008, Wisdom Educational Service.
3. Beier, F.K., Crespi, R.S. and Straus, T. *Biotechnology and Patent protection*-Oxford and IBH Publishing Co. New Delhi, 1985.
4. Biotechnology by U.Sathyanarayana, 2009 , Books and allied (p) Ltd
5. Biotechnology by B.D.Singh, kalyani publishers,2009

BASIC IMMUNOLOGY (BU 305)

Course Code	Category	Course Name	L	T	P	Total Hr
BU 305	Major	Basic Immunology	4	0	2	48

Objective**:**

To acquire basic and broad overview of immunology and its applications in the challenging fields of medicine and in basic and applied research in immunology.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to the Immune System	General properties of immune response, Components (Hematopoiesis, Cells, organs and molecules) of the Immune System, Innate Immunity; The Early Defense against Infections (Anatomic barriers).	9
Unit II	Antigen Capture and Presentation to Lymphocytes	Antigen Recognition in the Adaptive Immune System: Cell-Mediated Immunity Humoral Immunity	9
Unit III	Immunologic Tolerance and Autoimmunity	Self-Nonself Discrimination in the Immune System and Its Failure Mechanism of tolerance: Central tolerance, Peripheral tolerance Autoimmune diseases in human	9
Unit IV	Immune Responses against Tumors	Cancer: origin and malignant transformation Tumors of the immune system, tumor antigens Tumor evasion of the immune system, Cancer immunotherapy Immunity to Noninfectious Transformed and Foreign Cells	9
Unit V	Hypersensitivity Diseases	Types of hypersensitive responses: Type I, II, III, IV an overview Disorders Caused by Immune Responses	6
Unit VI	Congenital and Acquired Immunodeficiencies	Diseases Caused by Defective Immune Responses	6

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

Reference Book:

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition Wiley- Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.
7. Cellular Immunology – Biotol

PRACTICAL

1. Differential leucocytes count
2. Total leucocytes count
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Separation of serum from blood
7. Double immunodiffusion test using specific antibody and antigen.
8. ELISA.

BU 306

B.Sc. Dissertation / Project**:**

Candidates need to complete a short dissertation / project. Prior to proposing a project, the students must have identified a research topic and a mentor who is familiar with their prospective inquiry and who is willing to provide guidance and oversee the project.

Semester VII

ADVANCE CELL BIOLOGY (BP 101)

Course Code	Category	Course Name	L	T	P	Total Hr
BP 101	Major	Advance Cell Biology	4	0	2	48

Objective**:**

The objective of the course is to familiarize the students with the advances in cell biology.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Cytoskeleton	Muscle contraction & ciliary movements General features of microtubles and actin filaments Microtubule organizing centers and microtubule-associated proteins Actin filaments and actin-binding proteins Intermediate filaments Organization of the cytoskeleton	8
Unit II	Cell Differentiation and the maintenance of tissues	Maintenance of the differentiated state Tissues with permanent cells: Renewal by simple duplication, Renewal by stem cells- epidermis, Renewal by pluripotent stem cells- blood cell formation Quiescent stem cells – skeletal muscle, Soft cells and tough matrix – growth turnover and repair in skeletal connective tissue	8
Unit III	Cell Growth and Division	Cell division The control of cell division Tumor viruses as tools for studying the control of the cell cycle Events in the S phase	4
Unit IV	Cell adhesion and extra cellular matrix	Cell adhesion & cell junctions Cell –cell interaction & cell matrix interaction Extracellular matrix	4
Unit V	Chemical signaling	Three different strategies of chemical signaling – local chemical mediators, hormones and Neurotransmitters Signaling mediated by intracellular receptors – mechanisms of steroid hormone action Signaling mediated by cell surface receptors – cAMP and Ca+ ions as second Messengers Target cell adaptation Signal Transduction, Secondary messengers	8

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit VI	Cancer	Tumor cells and the onset of cancer Proto-oncogenes and tumor-suppressor genes Oncogenic mutations affecting cell proliferation Mutations causing loss of cell-cycle control	8

METHODOLOGY

The course would be taught through lectures, demonstrations and practical classes.

BOOKS RECOMMENDED:

1. Cell and Molecular Biology by De Robertis.
2. Molecular Biology of Cell by Bruce Alberts 2002.
3. The cell by Cooper 2000
4. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by P. S Verma and VK Agarwaal. Publisher S. Chand and Comp. 2005
5. Cell Biology by Powar
6. Cell Biology by Lodish

PRACTICAL

LIST OF EXPERIMENTS

1. Microscopes- Compound microscopes
2. Observations of permanent slide
   Different types of Animal Cell
3. Mitosis cell division in Onion Root-Tip Cells
4. Meiotic cell division in grasshopper testis
5. Buccal smear – Identification of Barr Body
6. Isolation of Mitochondria/chloroplast
7. Counting of cells using Haemocytometer
8. Permanent slide preparation

ADVANCE MOLECULAR BIOLOGY TECHNIQUES (BP 102)

Course Code	Category	Course Name	L	T	P	Total Hr
BP 102	Major	Advance Molecular Biology Techniques	4	0	2	48

Objective**:**

The objective of the course is to familiarize the student with the fundamentals concepts and technique in molecular biology and its use in the medical research.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	DNA damage, repair and mutation	a. Different types of DNA damages b. Mutation, types of mutation, spontaneous and induced mutation, Detecting mutation c. Nucleotide excision repair, Base excision repair, mismatch repair, recombination repair, SOS operon, Double strand break repair, transcription coupled repair	6
Unit II	Recombination	Homologous and site specific recombination, Models for homologous recombination Proteins involved in recombination: RecA, B, C, D, Ruv A, B, C Gene conversion	6
Unit III	*RegulatedExpression of Eukaryotic Genes*	Comparative features of prokaryotic and eukaryotic genes Structure and expression of class I genes Structure and function of class II genes Structure and expression of class III genes Dealing with introns Novel structural motifs in transcription factors Global influences on gene expression	10
Unit IV	*The Molecular Anatomy of Eukaryotic genomes*	Architectural elements Genes encoding RNA Genes encoding polypeptides Tandem repetition of DNA sequence: A common characteristic of eukaryotic genomes Repeated sequences dispersed in genomes Sequences at centromeres and telomeres Genomes of eukaryotic organelles Human genome project DNA microarrays and functional genomics	10
Unit V	Techniques in molecular biology	Plasmid isolation Preparation and analysis of eukaryotic genomic DNA DNA sequencing Isolation and purification of mRNA from cell Blotting methods PCR	6

Sr. No.	Topic	Detail of syllabus	Hrs.
		Gene isolation Site directed mutagenesis Labeling of nucleic acids Protein interaction technology Molecular pharming	
Unit VI	Transgenic animals	Methods of gene transfer Analysis of expressed gene	5
Unit VII	Molecular markers	RFLP RAPD AFLP Microsatellites	5

METHODOLOGY

The course would be taught through lectures, demonstrations and practical classes.

BOOKS RECOMMENDED:

1. Benjamin Lewin. (2008) Genes IX, Jones and Bartelett Publishers Inc.
2. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James D. Watson (2004), Molecular Biology of the Cell, 4th Edition, Garland Publishing
3. Raff, Keith Roberts, Peter Walter, (2003) Essential Cell Biology, 2nd Edition, Garland Publishing.
4. Watson James D., Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick (2004) Molecular Biology of the Gene, 5th Edition, Pearson. Education, Inc. and Dorling Kindersley Publishing, Inc.
5. Weaver R., (2007) Molecular Biology, 4th Edition, McGrew Hill Science.
6. Molecular cloning: A laboratory Manual by Sambrook et all
7. From Genes to Clones by Winnacker

PRACTICAL

LIST OF EXPERIMENTS

1. Isolation of Genomic DNA from *E.coli* DH5α
2. Purification of isolated genomic DNA
3. Quantification of DNA by UV Spectrophotometer
4. To perform Agarose Gel Electrophoresis
5. Replica Plate Techniques
6. Polymerase Chain Reactions
7. Isolation of genomic DNA from blood sample/tissues/any bio material

ANIMAL TISSUE CULTURE (BP 103)

Course Code	Category	Course Name	L	T	P	Total Hr
BP 103	Major	Animal Tissue Culture	4	0	2	48

Objective**:**

The objective of the course is to familiarize the students with the basics of Animal Tissue Culture Techniques and use in various fields of research and human welfare.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to animal tissue culture	Historical background, The application of tissue culture, Terminology, Stages in cell culture	4
Unit II	Outline of the key techniques of animal cell culture	Setting up the laboratory, Culturing cells, Maintaining the culture, Quantification of cells in cell culture, Cloning and selecting cell lines, Physical methods of cell separation, Hazards and safety in the cell culture laboratory	8
Unit III	Animal cell culture media	General cell culture media design, Natural media, Synthetic media, Further considerations in media formulation, Nutritional components of media, The role of serum in cell culture, Choosing a medium for different cell type	8
Unit IV	Characterization of cell lines	Species verification, Intra-species contamination, Characterization of cell type and stage of differentiation, Microbial contamination	8
Unit V	Preservation of animal cell lines	Variation and instability in cell lines, Preservation of cell lines, Freezing of cells, Thawing of cells, Quantification of cell viability, Cell banks	6
Unit VI	Hybridoma Technology	The limitation of traditional antibody preparation, The basis of hybridoma technology, The details of hybridoma technology, Long term storage of hybridoma cell lines, Contamination, Hybridomas from different species, Human hybridomas, Commercial scale production of monoclonal antibodies	8
Unit VII	Large scale animal cell culture	Culture parameters, Scale up of anchorage-dependant cells, Culture vessels, Suspension culture	6

METHODOLOGY

The course would be taught through lectures, demonstrations and practical classes.

BOOKS RECOMMENDED:

1. Cell and Tissue Culture: Lab Procedures in Biotechnology by Alan Doyle (ed) J. Bryan Griffith (ed)
2. Culture of Animal Cell by Freshney

PRACTICAL

LIST OF EXPERIMENT

1. Layout of Animal Tissue Culture laboratory
2. Washing of glasswares
3. Sterilization of glasswares
4. Preparation of culture media
5. Thawing of cell lines
6. Passaging of cell lines
7. Cell quantification and Cell viability
8. Cryopreservation of cell cultures

Semester VIII

HUMAN PHYSIOLOGY (BP 104)

Course Code	Category	Course Name	L	T	P	Total Hr
BP 104	Major	Human Physiology	4	0	2	48

Objective:

The objective of the course is to study the physiological aspects of the human systems and its role in functioning of all the major organs of the body.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Basic concepts and principles	Introduction and background (homeostasis, control systems), Biophysics of blood flow Regulation of respiration., Auto regulation of renal blood flow and the concept of clearance	6
Unit II	Sensory Organs	Eye, Ear, Nose, Tongue and Skin: Functions & Disorders	4
Unit III	Digestive system	Functions & Disorders, Pharynx, oesophagus, Stomach and Intestines, Liver & Pancreas, Peritoneum	4
Unit IV	Circulation system	Heart rate and the significance, Cardiac cycle, HR factors ECG- Machine, Recording, Abnormalities types Causative Factors Reporting & Interpretation	6
Unit V	Respiration system	Respiration, Mechanism Inspiration, Expiration Gas exchange mechanism Lung surfactant, compliance Lung volume and capacity Respiratory Exercises Artificial Respiration Basis & Techniques	6
Unit VI	Genito-Urinary System	Kidney, Urethra, bladder, Urethra, Female Reproductive System, Male Reproductive System	6
Unit VII	Skeletal system	Mechanism of contraction, Difference between 3 types of muscles, Electro myography & mechanical recording of muscle contraction, Locomotion, Diseases of muscles Dystrophies,	6
Unit VIII	Nervous System	Nerve fibres, types ,functions, injuries, impulses & velocity	4
Unit IX	Endocrine system	Hormones, Functions & Disorders	4
Unit X	Genetic testing	Genetic testing, Eugenics and Aging	2

METHODOLOGY

The course would be taught through lectures, demonstrations and practical classes.

BOOKS RECOMMENDED:

1. Textbook of Medical Physiology by C. Guyton
2. Physiology by C. Chatterjee
3. Human Anatomy & Physiolgy by Tortora
4. Medical physiology by Chaudhary
5. Anatomy and histology by Ross and Wilson
6. Human Anatomy and Physiology by Creager

PRACTICAL

LIST OF EXPERIMENTS

1. Blood grouping
2. Haemoglobin estimation
3. Total WBC and RBC count
4. Erythrocyte sedimentation rate
5. Differential Counting of Blood
6. PVC count

BIOINFORMATICS (BP 105)

Course Code	Category	Course Name	L	T	P	Total Hr
BP 105	Major	Bioinformatics	4	0	2	48

Objective:

The objective of the course is to enlighten the student with basic concepts and technique in Bioinformatics and its use in the field of Medical and health care.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Biology in the computer age: An Introduction to Bioinformatics	How Is Computing Changing Biology? Isn't Bioinformatics Just About Building Databases? What Does Informatics Mean to Biologists?? How Do I Understand Sequence Alignment Data? What Challenges Does Biology Offer Computer Scientists? What Skills Should a Bioinformatician Have? Why Should Biologists Use Computers? How Can I Configure a PC to Do Bioinformatics Research? What Information and Software Are Available? Can I Learn a Programming Language Without Classes? How Can I Use Web Information How Do I Understand Sequence Alignment Data? How Do I Write a Program to Align Two Biological Sequences? How Do I Predict Protein Structure from Sequence? What Questions Can Bioinformatics Answer?	8
Unit II	Computational approaches to biological questions.	Introduction Computational Methods in Bioinformatics What Biologists Model Accessing 3D Molecules through a 1D Representation Abstractions for Modeling Protein Structure. Mathematical Modeling of Biochemical Systems. Why Biologists Model	8
Unit III	Biological research on the web	Introduction Using Search Engines Boolean Searching Search Engine Algorithms Finding Scientific Articles Using PubMed Effectively The Public Biological Databases Data Annotation and Data Formats 3D Molecular Structure Data DNA, RNA, and Protein Sequence Data Genomic Data Biochemical Pathway Data	8
Unit IV	Sequence analysis, pairwise alignment, and database searching	Introduction Genefinders and Feature Detection in DNA Predicting Gene Locations Feature Detection	8

Sr. No.	Topic	Detail of syllabus	Hrs.
		Pairwise Sequence Comparison Scoring Matrices Gap Penalties Global Alignment Local Alignment Tools for local alignment Sequence Queries against Biological Databases Local Alignment-Based Searching Using BLAST The BLAST algorithm	
Unit V	Multiple sequence alignments, trees and profile	Introduction Taxonomy and Evolution Concept of molecular evolution Terms: Orthologs, paralogs and xenologs. Multiple sequence alignment: MSA by Dynamic Programming MSA by progressive strategies MSA by Clustal-W Application of MSA Phylogenetic inferences Phylogenetic trees based on neighbor joining Software for phylogenetic analysis Profiles and motifs: General concepts	8
Unit VI	Tools for genomics and proteomics	Introduction From Sequencing Genes to Sequencing Genomes Analysis of Raw Sequence Data: Basecalling Sequencing an Entire Genome The shotgun approach The clone contig approach LIMS: Tracking all those minisequences Sequence Assembly Accessing Genome Informationon the Web NCBI Genome Resources TIGR Genome Resources EnsEMBL Other Sequencing Centers Organism-Specific Resources Annotating and Analyzing Whole Genome Sequences Genome Annotation MAGPIE Functional Genomics: New Data Analysis Challenges Sequence-Based Approaches for Analyzing Gene Expression DNA Microarrays: Emerging Technologies in Functional Genomics Bioinformatics Challenges in Microarray Design and Analysis Planning array experiments, Proteomics Tools for Proteomics Analysis	8

METHODOLOGY

The course would be taught through lectures, demonstrations and practical classes.

BOOKS RECOMMENDED:

1. Developing Bioinformatics computer skills – Gibas C and Jambeck P
2. Introduction to bioinformatics – T.K. Attwood and Parry-Smith D.J.
3. Introduction to Bioinformatics: Lesk, A.M. Oxford University press.
4. Developing Bioinformatics Computer Skill: Cynthia Gibbs and Per Jambeck. O'Reilly & Associates.

PRACTICAL

LIST OF EXPERIMENTS

1. Introduction to SPDBV (deep view).
2. Basic exercise in protein structure visualization.
3. Basic exercise in protein structure visualization coloring.
4. To study the PubMed using internet.
5. To study the NCBI website using internet
6. BLAST
7. FASTA

PHARMACEUTICAL BIOTECHNOLOGY (BP 106)

Course Code	Category	Course Name	L	T	P	Total Hr
BP 106	Major	Pharmaceutical Biotechnology	4	0	2	48

Objective:

The objective of the course is to give strong base and advanced information on biopharmaceutical aspects in relation to drug development.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Bio-processing system	Expression system Cultivation systems Cultivation medium Contaminants	8
Unit II	Formulation of biotech products, including biopharmaceutical Considerations	Microbiological consideration Excipients used in Parental formulations of Biotech products Shelf life of protein based pharmaceuticals Delivery of proteins: Routes of administration and adsorption enhancement Approaches for rate controlled and target site specific Delivery by the parental route	12
Unit III	Pharmacokinetics and Pharmacodynamics of peptide and protein drugs	ADME of protein therapeutics Bioavailability and Bioequivalency Pharmacodynamics of protein therapeutics Interspecies scaling Heterogeneity of protein therapeutics Chemical modification of protein therapeutics Immunogenicity	10
Unit IV	Genomics, Proteomics and additional biotechnology-related techniques	Genomics, proteomics and pharmacogenetics/genomics Genetically engineered animals Protein engineering Peptide chemistry and peptidomimetics Nucleic acid technologies Catalytic antibodies Glycobiology Biotechnology and drug discovery	10
Unit V	Nanobiotechnology	Nanotechnology: An overview Characteristics of Nanoparticles Method's for Nanoparticles preparation Wet Chemical Processes, Mechanical Processes, Form-in-Place Processes, Gas Phase Synthesis Bioinspried Approaches to Building Nanoscale Devices Biology as Model system for Building Nanoscale Devices Nanotechnology food and biomedical applications	8

METHODOLOGY

The course would be taught through lectures, demonstrations and tutorials classes

BOOKS RECOMMENDED:

1. Proteins: Biochemistry and Biotechnology - Gary Walsh
2. Foye's Principles of Medicinal Chemistry –William David A. and Lemke Thomas L.
3. Pharmaceutical Biotechnology, 2nd ed. by Crommelin D.J.A. & Sindelar R. D.
4. C. M. Niemeyer and C. A. Mirkin- (Editor), Nanobiotechnology: Concepts, Applications and Perspectives, Wiley Press
5. Nanobiotechnology by Subbiah Balaji

PRACTICAL

LIST OF EXPERIMENTS

1. Antibiotic production from biological sources.
2. To perform antibiotic assay.
3. Determination of Minimum Inhibitory Concentration (*MIC)* of given antibiotics.
4. Sterility testing of pharma products.
5. Toxicity testing.
6. Industrial visit.

Semester IX

GENETIC ENGINEERING (BP 201)

Course Code	Category	Course Name	L	T	P	Total Hr
BP 201	Major	Genetic Engineering	4	0	2	48

Objective:

To familiarize the student with emerging field of biotechnology i.e. Recombinant DNA Technology as well as to create understanding and expertise in wet lab techniques related to genetic engineering.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Recombinant DNA technology	The recombinant DNA concept, Milestones in genetic engineering, Tools of Genetic Engineering; Enzymes, Nuclease, The Restriction Endonucleases, Phosphodiesterase, Polynucleotide kinase, DNA ligase, DNA polymerase I, Reverse transcriptase, Terminal deoxynucleotidyl transferase, Poly A polymerase	8
Unit II	*Vector System*	Salient features of cloning vector, types of cloning vectors- plasmids, cosmids, phages (lambda and M13 phages), animal (SV40, Baculo) and plant (CMV) viruses, Artificial chromosomes- YACs and MACs	8
Unit III	*The Means: Constructing, Cloning, and Selecting*	Ligation of foreign DNA to vectors - cohesive and blunt end methods - homopolymer tailing and adaptors, Techniques of gene transfer - transformation, transfection, micro injection, electroporation, lipofection and biolistics, Screening Cloned Populations of Recombinants, Preparation of gene libraries and c-DNA libraries	12
Unit IV	Molecular Mapping of genome	Chemical synthesis of DNA, DNS sequencing techniques, PCR, Mapping of genome- genetic & physical map, physical mapping and map based cloning, molecular markers in genome analysis- RFLP, RAPD & AFLP analysis, molecular markers PCR based, FISH , Microarray, Northern Blotting, Southern blotting, MicroRNAs and RNA Interference,.	12
Unit V	*Applications of Genetic Engineering*	*Transgenic & Gene knock out technologies, Targeted gene replacements, Applications of GE in medicine & industry*	8

METHODOLOGY

The course would be taught through lectures, demonstrations and practical classes.

BOOKS RECOMMENDED:

1. Molecular Biology of the gene - J. Watson
2. Genes VI, VII and VIII - Benjamin Lewin
3. Molecular Biotechnology Principles and application of recombinant DNA
4. Molecular Biology - Robert F. Weaver
5. Plant Molecular Biology: A practical approach. - C.H. Shaw (2006), Panima Pub. Corp.
6. Molecular cloning Vol. 1-3. Sambrook and Russel. 2001. CSH press.
7. Principles of gene manipulation. 1994. Old and Primrose, Blackwell Scientific Publ.
8. Principles and techniques of biochemistry and molecular biology, 6th Ed. Wilson Keith and Walker John
9. (2005) Cambridge University Press, New York.
10. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, R.L. Press,Oxford, 1995

PRACTICAL

LIST OF EXPERIMENTS

1. Competent Cell Preparation
2. Transformation
3. Isolation of plasmid DNA by alkaline lysis mini preparation
4. Restriction digestion of vector DNA
5. Restriction digestion of lambda DNA
6. Gel Elusion
7. Random Fragment Length Polymorphism
8. Random Amplified Polymorphic DNA

ADVANCE IMMUNOLOGY (BP 202)

Course Code	Category	Course Name	L	T	P	Total Hr
BP 202	Major	Advance Immunology	4	0	2	48

Objective:

The objective of the course is to familiarize the student with the basics of immune system and its role in disease outcome

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Antigens, Immunoglobulins Structure and Function	Overview of Antigens Basic and fine structure of immuneglobulin: light chains, heavy chains and sequences Antigen determinants on Immunoglobulin: Isotopic, allotypic, Idiotypic Immunoglobulin super family	10
Unit II	Generation of B cell and T cell responses	Brief introduction of Antibodies Organization and expression of immunoglobulin genes Antigen-Antibody interactions: Principles and Applications Major Histocompatibility Complex Antigen Processing and Presentation T cell receptor T cell maturation, activation, and differentiation B cell generation, activation, and differentiation	12
Unit III	Immune Effector Mechanisms	Cytokines The Complement system Cell mediated effector responses Leukocyte migration and inflammation Hypersensitive reaction	10
Unit IV	Immuno techniques	Strength of antigen and antibody interactions: Antibody affinity, antibody avidity Cross reactivity Precipitation reactions, agglutination reactions (immunodiffusion and immunoelectrophoretic technique) Radioimmunoassay, Enzyme linked Immunosorbant./Assay(ELISA) Western Blotting Immuno precipitation Immunofluorenscence Flow cytometry and Fluorescence	08
Unit V	The Immune System in Health and Disease	Immune response to infectious diseases Vaccines AIDS and other immunodeficiencies Autoimmunity Transplantation immunology Cancer and the immune system	8

METHODOLOGY

The course would be taught through lectures, demonstrations and practical classes.

BOOKS RECOMMENDED:

1. Immunology – Kuby et.al
2. Cellular Interactions and immunobiology – BIOTOL series
3. Immunology – Roitt et. al.
4. Immunobiology – Janeway Travers et. al
5. Cellular and molecular Immunology - Abbas A.K., Lichtman A.H. and Pober, J.S.
6. Fundamental Immunology – Paul
7. Immunobiology 3rd ed. – Janeway Travers

PRACTICAL

LIST OF EXPERIMENTS

1. Animal handling
2. Blood collection
3. Routes of drug administration
4. Dissection of mice lymphoid organ (spleen)
5. Latex agglutination method
6. Determination of Phagocytic index
7. Clinical diagnostic immunoblotting/ SDS PAGE
8. ELISA
9. Immunoassay – immuno diffusion method, rocket electrophoresis
10. ICT for malaria and HIV detection

CLINICAL RESEARCH (BP 203)

Course Code	Category	Course Name	L	T	P	Total Hr
BP 203	Major	Clinical Research	4	0	2	48

Objective:

The objective of the course is to impart the knowledge of clinical research which can be used for drug discovery and development.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to Clinical Research	Introduction to Clinical Research Terminologies and definition in Clinical Research Origin and History of Clinical Research Difference between Clinical Research and Clinical Practice Types of Clinical Research Phases of clinical research Clinical Trials in India –The National Perspective Post marketing surveillance Pharmaceutical Industry – Global and Indian Perspective	5
Unit II	Pharmacology & Drug development	Introduction to Pharmacology Concept of Essential Drugs Routes of Drug Administration Introduction to Drug Discovery and Development- Hurdles in Drug Development Sources of Drugs Approaches to Drug Discovery Pharmacovigilance Factors affecting drug response	8
Unit III	Preclinical Studies	Guidelines For Care And Use Of Laboratory Animals Introduction To Preclinical Pharmacology Introductory Talk on Animal studies : present status Pre – Clinical Toxicity Lab Animals in Pharmacology Preclinical drug testing Calculation of first human dose Investigational New Drug Application Clinical trials New Drug Application and Approval	8
Unit IV	Guidelines and Regulations in Clinical Research	1.International Conference on Harmonization (ICH)-Brief history of ICH, Structure of ICH, ICH Harmonization Process 2.Good Clinical Practice: ICH guidelines 3.Indian GCP guidelines (CDCSO guidelines) 4.ICMR Guidelines - Ethical Guidelines for Biomedical Research on Human Subjects 5.Schedule Y	8

Sr. No.	Topic	Detail of syllabus	Hrs.
		6.Institutional Review Board / Independent Ethics Committee Stakeholders in clinical research (Investigators, sponsors, CRO,SMO) 7.Clinical Trial Protocol and Protocol Amendment(S) 8.Investigator's Brochure 9. Essential Documents for the conduct of a Clinical Trial • Introduction of Clinical Trial Regulation • European Medicine Agency • Food and Drug Administration (US FDA) • Drug and cosmetic act • GMP	
Unit V	Clinical Development	Research question Case report form Informed Consent Preparing data collection forms Protocol writing New drug discovery process- purpose, main steps involved in new drug discovery process, timelines of each steps, advantages and purposes of each steps, ethics in clinical research, unethical trials, Phase-I, II, III, IV trials. -Introduction and designing -Principles of sampling -Inclusion and exclusion criteria -Methods of allocation and randomization -Informed consent process in brief -Termination of trial -Safety monitoring in clinical trials	8
Unit VI	Clinical Regulatory requirements	Audit/ Inspection Fraud and Misconduct in Clinical Trials Conflict of interest in Clinical research Vaccine trails in children Bioavailability and Bioequivalence How to fill an ADR reporting form and methods for causality assessment Risk to benefit ratio bias and confounding factor Uses of placebo	6
Unit VII	Marketing	Promotional inputs & development of Medico-Marketing, Prescribing Information (PI) Or Package Insert (PI), Publication issues	3
Unit VIII	Data management	Clinical data management (CDM): Introduction, CRF Design, Electronic Data Capture, Data Validation, Discrepancy Management, Clinical Data Coding, SAE Reconciliation, Archiving clinical data	2

METHODOLOGY

The course would be taught through lectures, demonstrations and practical classes.

BOOKS RECOMMENDED:

1. Basic and Clinical Pharmacology, Prentice hall, International, Katzung, B.G.
2. Remington Pharmaceutical Sciences, Lippincott, Williams and Wilkins
3. Drug interaction, Basic Bussiness Publ, Bombay, J.K. Mehra
4. Central Drugs Standard Control Organization. Good Clinical Practices-Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health; 2001.
5. International Conference on Harmonization of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonized Tripartite Guideline. Guideline for Good Clinical Practice.E6; May 1996
6. Ethical Guidelines for Biomedical Research on Human Subjects 2000. Indian Council of Medical Research, New Delhi

PRACTICAL

LIST OF EXPERIMENTS

1. Introduction to animal house
2. Handling of lab animals
3. Various routes of drug administration (lab animals)
4. Assessment of adverse drug reaction
5. Documentation for clinical research

Semester X

BP 511

M.Sc. Dissertation Project:

Each candidate needs to complete a short dissertation project. Prior to proposing a project, the students must have identified a research topic and a mentor who is familiar with their prospective inquiry and who is willing to provide guidance and oversee the project.

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