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DR. D. Y. PATIL BIOTECHNOLOGY & BIOINFORMATICS INSTITUTE

TATHAWADE, PUNE

SYLLABUS FOR

B.TECH (MEDICAL)BIOTECHNOLOGY

(BATCH 2017-18)

SEMESTER I

Course Code	Course Name	L	T	P	Hr	Cr
BS 101	Physics	3	0	2	5	4
MB 101	Human Anatomy	3	0	4	7	5
BS 102	Organic Chemistry	3	0	4	7	5
BS 103	Mathematics and Biostatistics	3	1	0	4	4
BI 101	Introduction to Computers & Computer Organization	3	0	4	7	5
HU 101	Communication Skills	1	2	0	3	3
Total		**16**	**3**	**14**	**33**	**26**
SEMESTER II						
MB 201	Medical Biochemistry	3	0	4	7	5
MB 202	Human Physiology	3	0	4	7	5
MB 203	Microbiology and Virology	3	0	4	7	5
MB 204	Cell biology	3	0	4	7	5
BS 204	Environmental Sciences	3	1	0	4	4
MB 206	Electronics and Instrumentation Engineering	3	1	0	4	4
Total		**18**	**2**	**16**	**36**	**28**
SEMESTER III						
MB 301	Bioprocess Engineering	3	0	4	7	5
MB 302	Animal Cell Culture	3	0	4	7	5
BI 303	Bioinformatics	3	0	4	7	5
MB 304	Molecular Biology	3	0	4	7	5
MB 305	Human Genetics	3	1	2	6	5
MB 306	Analytical Techniques	3	0	4	7	5
Total		**18**	**1**	**22**	**41**	**30**
SEMESTER IV						
MB 401	Biopharmaceuticals	3	0	4	7	5
MB 402	Developmental Biology	3	0	4	7	5
MB 403	Pharmacology & Toxicology	3	1	0	4	4
MB 404	Genetic engineering	3	0	4	7	5
MB 405	Immunology	3	0	4	7	5
HU 602	Bio safety, Bioethics & IPR	3	1	0	4	4
Total		**18**	**2**	**16**	**36**	**28**
SEMESTER V						

MB 501	Cancer Biology	3	1	2	6	5
MB 502	Tissue Engineering and Transplantation	3	0	4	7	5
MB 503	Molecular modelling and drug designing	3	0	4	7	5
MB 504	Disease Biology	3	0	4	7	5
MB 505	Molecular Cell Signalling	3	1	0	4	4
MB 506	Genomics, Transcriptomics & Proteomics	3	1	2	6	5
Total		**18**	**3**	**16**	**37**	**29**
SEMESTER VI						
MB 601	Biomedical Devices and Instruments	3	0	4	7	5
MB 602	Biosensor and Artificial Organs.	3	1	0	4	4
MB 603	Health Care Law Management	3	1	0	4	4
MB 604	Molecular Diagnostics	3	0	4	7	5
MB 605	Metabolic Engineering and Systems Biology	3	0	4	7	5
MB 606	Nanomedicine	3	0	4	7	5
Total		**18**	**2**	**16**	**36**	**28**
SEMESTER VII						
MB 701	Clinical Trials	3	1	0	4	4
MB 702	Forensic Biotechnology	3	0	4	7	5
MB 703	Molecular Basis of Drugs	3	1	0	4	4
MB 705 / MB 706	Elective 1	3	1	0	4	4
MB 707 / MB 708	Elective 2	3	1	0	4	4
MB 704	Seminars in Medical Biotechnology	3	1	0	4	4
Total		**18**	**5**	**4**	**27**	**25**
Elective 1 : (MB 705 : Vaccine Technology), (MB 706 : Personalized Medicine)						
Elective 2 : (MB 707 : Biomimetics), (MB 706 : Biomechatronics)						
SEMESTER VIII						
	Research Project	-	-	-	-	25

SEMESTER I						
Course Code	**Course Name**	**L**	**T**	**P**	**Hr**	**Cr**
BS 101	Physics	3	0	2	5	4
MB 101	Human Anatomy	3	0	4	7	5
BS 102	Organic Chemistry	3	0	4	7	5
BS 103	Mathematics and Biostatistics	3	1	0	4	4
BI 101	Introduction to Computers & Computer Organization	3	0	4	7	5
HU 101	Communication Skills	1	2	0	3	3
Total		**16**	**3**	**12**	**31**	**26**

TITLE OF THE COURSE: PHYSICS
COURSE CODE: BS 101 **L T P Hr C**
MARKS: 150 **3 0 2 5 4**

OBJECTIVE

The objective of this course is:

To create general understanding regarding basic physical principles involved in living systems.

To familiarize the student with basic concepts in physics as: classical optics used in microscopes and telescopes, thermometry and heat, mechanical, fluid and solid state properties.

To familiarize students with concepts in digital electronics, lasers, sound waves, electricity.

To introduce them to concepts in modern physics such as: production of X-ray, X-ray crystallography, quantum mechanics etc.

LEARNING OUTCOME

At the end of the course, the students will have sufficient scientific understanding of the basic concepts in classical and modern physics, laser sources, concepts and laws applicable to quantum-mechanical particles. This would enable him to understand use of physical methods in understanding Biomolecular structure and interactions

PREREQUISITES

This is an introductory course. School level knowledge of physics is sufficient. There are no prerequisites.

COURSE DESCRIPTION

Sr. No.	Topics	Detail syllabus	No. of Lectures
1	Optics: Interference Diffraction & Polarization	Introduction to optics, Principles of superposition, Constructive & destructive Interference, Types of Interference, Newton‟s rings. Diffraction- Types of diffraction, Diffraction grating, Rayleigh‟s criterion, Resolving power of Microscope and Telescope. Polarization of light waves, Polaroid, Optical activity.	08
2	Thermometry and Heat	Principles of Thermometry, Temperature and it‟s measurements, Platinum resistance Thermometer, Thermocouple and Thermistors, Modes of Heat Transfer.	05
3	Properties of Fluid: Surface Tension & Viscosity	Surface Tension, Surface Energy, Angle of Contact, Capillarity action, Determination of Surface tension by capillary rise method, Jaeger‟s method, Temperature dependence of surface tension and its applications. Viscosity, Coefficient of viscosity, streamline and turbulent flow, Reynolds‟s number, Stoke‟s law, Terminal velocity, Determination of „η‟ by falling sphere method.	07
4	Elasticity	Stress and Strain, Hook‟s law, Stress-strain curve, Young‟s modulus, Determination of Young‟s	03

		modulus.	
5	Solids and Semiconductor Devices	Classification of Solids (Conductor, Semiconductor and Insulators), intrinsic and extrinsic semiconductors, PN Junction Diode, Zener Diode, Junction Transistors (CE,CB mode)	05
6	Introduction to	Introduction to Binary mathematics, BCD numbers,	02
	Digital Electronics	Basic logic gates, De-Morgan‟s Theorem	
7	Lasers	Properties of Lasers, Production mechanism, Ruby Laser, Helium Neon Laser, applications of Lasers.	03
8	Sound waves	Types of sound waves (Longitudinal and Transverse), Audible, Ultrasonic and Infrasonic waves, Beats, Doppler effect, Applications of Ultrasonic waves.	03
9	Electricity	Heating effect of electric current, Joule‟s law, Transformers, Types of Transformers.	02
10	Magnetism	properties of magnets, Magnetic forces and fields Moving charges and induced magnetism, Induction Electromagnets, Induced current and magnetism Induced magnetism in a cooled superconducting dis	03
11	Modern Physics: X-rays, Crystallography, Introduction to Quantum Mechanics	Introduction to X-Rays : Introduction, Production of X-rays, X-Ray diffraction and its Applications. Introduction to crystal structure, Unit cell, seven crystal systems. Plank‟s Quantum Theory, Properties of Photon, Photoelectric effect, wave particle duality of radiation, de Broglie‟s hypothesis, Heisenberg‟s Uncertainty principle.	05
Total Lectures			46

METHODOLOGY

The course will be covered through lectures supported by tutorials and practicals. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given. Normally a students is expected to complete the assignment by himself, however if needed, difficulties will be discussed in the tutorial classes. There will be two class tests/ and surprise test conducted during the tutorial classes.

EXAMINATION SCHEME

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

Physics-David Haliday and Robert Resnik (Vol I and Vol II) [Wiley Eastern

Pub] Perspectives of Modern Physics-Arthur Beiser [Mc Graw Hill]

Fundaments of optics-Jenkins [Mc Graw Hill]
Optics –Ajoy Ghatak [Tata Mc Graw Hill]

Digital Principles and Applications-Malvina and Leach [Mc Graw Hill]

PRACTICAL TRAINING (TWO HOURS PER WEEK) MARKS 50

The course will also have a practical component. The practical training would be in the area of optics, electronics, thermometry, calorimetry, conductivity, measurement of physical properties as: viscosity and surface tension.

List of experiments

1. Diffraction Grating: Use of diffraction grafting for determination of wavelength of spectral lining.
2. Resolving Power: To determine the resolving power of Microscope or telescope.
3. Diode Characteristics: Study of forward and reverse characteristics of Diode.
4. Transistor Characteristics: Study of characteristics of Photocell.
5. Band gap of semiconductor: Study of input and output characteristics of a transistor and determination of band gap of a semiconductor.
6. Ultrasonic Interferometer: Determination of velocity of ultrasonic waves by ultrasonic
7. Study of logic gates (OR, AND, NOT).
8. Thermocouple: Study of variation of thermo emf (electromotive force) with temperature.
9. Surface Tension: Determination of the surface tension of a given solution.
10. Viscosity: Determination the coefficient of viscosity by Stoke‟s method and its practical application.
11. Joule‟s Law: Determine of Joule‟s constant.
12. Determination of wavelength of monochromatic light by Newton‟s rings experiments.
13. Thermal Conductivity: Determination of coefficient of thermal conductivity of given specimen.

Evaluation scheme Practical training

Examination	**Duration**	**Marks**
Minor test 1	1 hour	15
Continuous Assessment		10
Major test at the end of semester	3 hours	25
Total		50

TITLE OF THE COURSE: HUMAN ANATOMY

COURSE CODE: MB 101 **L T P Hr C**

MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

The objective of the course is to develop insight of physiological aspects of the human systems with respect to various interactions occurring with all the major organs of the body.

The course is well equipped to deal with branches of biophysics, biochemistry and clinical applications as well.

LEARNING OUTCOME:

The course would enables the student to understand the integral mechanism operating in the human system along with the regulation of each system

PREREQUISITES:

Since the course is very basic in nature school level knowledge in physics, chemistry & Biology is enough to take the course and there are no prerequisites.

COURSE DESCRIPTION:

Sr. No.	Topic	Description	Hrs
1	Basic concepts and introduction:	Basic concepts and introduction:	2
2	Sensory Organs	Anatomy of Eye, Ear, Nose, Skin & Tongue	6
3	Digestive system	Digestive Organs Pharynx, oesophagus Stomach and Intestines Liver & Pancreas Peritoneum	6
4	Circulation system	Blood composition, The Heart Chambers Blood vessels – Arteries and Veins Lymphatic, Pulmonary & systematic circulation Lymphoid System - nodes and its importance	6
5	Respiration system:	Respiratory Organs Larynx & Trachea Thoracic cage Lungs	6
6	Genito-Urinary	Kidney, Urethra, bladder,	6

	System	Urethra, Female Reproductive System Male Reproductive System	
7	Skeletal system	Human Skeleton -	5
		Identification, Classification and Functions of 1. Bones 2. Joints 3.Muscle	
8	Nervous System	Brain & Spinal cord Spinal nerves – segments Meninges ,Blood supply to Brain Division of nervous system	6
9	Endocrine system	Glands, their location and anatomy.	3
Total number of lectures			**46**

METHODOLOGY :

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

REFERENCE BOOKS

1) Textbook of Medical Physiology by C. Guyton.

2) Physiology by C. Chatterjee.

3) Human Anatomy & Physiology by Tortora.

4) Medical Biochemistry – Anant Narayan

5) Text Book of Biochemistry by Harper Ed. 1988

6) Medical physiology by Chaudhary.

7) Anatomy and histology by Ross and Wilson

8) Human Anatomy and Physiology by Creager

PRACTICALS IN HUMAN ANATOMY (4 Hrs.)
MARKS: 100

List of Experiments:

1. Demonstration of human cell from slides/charts.
2. Demonstration of various tissues from permanent slides. Epithelial tissue
   Connective tissue.
   Muscular tissue
   Nervous tissue
3. Demonstration of individual bone.
4. Demonstration of respiratory system from chart.
5. Pear expiratory flow rate(PEFR)
6. Demonstration of cardiovascular system form chart.
7. Electro cardio gram (ECG)
8. Demonstration of eye, nose, ear and tongue from model and charts.
9. To study and count spleenocytes from mammalian spleen
10. To study circulatory system from charts and TS of artery and vein from permanent slides.
11. To study digestive system from charts and TS of liver, spleen and pancreas from permanent slides.
12. Study of Urinary system (charts)
13. Study of Genital system (male & female) from charts and TS of testis and ovary from permanent slides.
14. To study nervous system (From models / charts)

Evaluation Scheme Practical training

Examination	**Duration**	**Marks**
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

TITLE OF THE COURSE: ORGANIC CHEMISTRY
COURSE CODE: MB 101 **L T P Hr C**
MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

• To familiarize the students with basic concepts of organic chemistry.

• To familiarize the students with structures of organic molecules as: alkanes, alkenes, alkynes, aliphatic and aromatic molecules

• To introduce them to interactions amongst organic compounds

LEARNING OUTCOME:

At the end of this course student should be able to understand basic principles of organic chemistry and develop skills in handling organic molecules. This is essential for undertaking practical training in Biochemistry and genetic engineering at the later stage.

PREREQUISITES:

This is an introductory course. There are no prerequisites for the course.

COURSE DESCRIPTION

Sr. No.	Topic	Details	lectures
1	Introduction to organic chemistry	Functional groups	2
2	Organic compounds	Chemistry of alkanes, alkenes, alkynes (Comparative study)	5
3	Stereochemistry	Stereo isomers, Enantiomers, Chiral centers/ Optical activity, Geometric isomers Meso- isomers, Conformational isomers	8
4	Chemistry of cyclic aliphatic carbons	Nomenclature and preparation, Reactions of small ring compounds, (cyclopropane and cyclobutane), Baeyers Strength Theory, Stereochemistry of Cyclic Aliphatic compounds	8
5	Chemistry of heterocyclic compounds	Furan, Pyrrole, Thiophene, Purines, Pyrmidines (Nucleic acids), Quinoline, Isoquinoline	8
6	Chemistry of aromatic compounds	Structure of Aromatic compounds (Benzene and its derivatives), Aromatic Characters: The Huckel rule (4N+2)	8
7	Reaction mechanisms	Nucleophilic SN^1 , SN^2, Electrophilic	5
Total Number of lectures			44

METHODOLOGY

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

EXAMINATION SCHEME

Examination	Duration	Marks
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

REFERENCE BOOKS

1) Organic Chemistry (6 th Edition, 1992)- Robert Thornton Morrison and Robert Neilson Boyd (Prentice Hall)
2) Organic Chemistry vol I and II and III by I. L Finnar. 5th Edition Pearson Publications

PRACTICAL IN ORGANIC CHEMISTRY (4 Hrs per week)
MARKS : 100

List of experiments:

Quantitative analysis, 5 organic and inorganic mixtures

Quantitative analysis: Estimation of aniline, acetone, and aspirin & Molecular weight of monobasic/dibasic acids.

Preparation of orange dyestuff (Sagand III)

Preparation of p-nitroacetanilide from actanilide

Preparation of acetnilide from aniline

Preparation 2,4 DNP derivatives

Estimation of Cu2+ from brass

Estimation of %q of NH4Cl+BaSO4 grarimetric analysis

Preparation of Std. $K_2Cr_2O_7$ solution and estimation of Fe (II) and Fe(III) from a given mixture of Fe(II) and Fe(III) using external indicators.

Evaluation Scheme Practical training

Examination	**Duration**	**Marks**
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		100

TITLE OF THE COURSE: MATHEMATICS AND BIOSTATISTICS

COURSE CODE: BS 103 **L T P Hr C**

MARKS: 100 **3 1 0 4 4**

OBJECTIVES:

The objective of the course is to familiarize the students with advancement in applied mathematics and biostatistics.

LEARNING OUTCOME:

At the end of the course, the students will have advance knowledge and understanding of principles of applied mathematics and statistical tools used in biotechnology**.**

PREREQUISITE:

Students should be familiar with basic concepts in mathematics, statistics and computer applications

COURSE DESCRIPTION:

Sr. No.	Topic	Detail	lectures
1.	Introduction	Scope, application and use of statistics, Collection and classification of data, Census and sampling graphs and diagrams, Arithmetic mean, median standard deviation Partial Differential equations, First order and second order to biology. Lagrangee‟s method and charpits method.	6
2.	Probability and Statistics	Scientific notation: significant digits, rounding off, scientific notation, Error analysis Probability: addition theorem, multiplication theorem and conditional probability-Bayes theorem, Binomial distribution, Poisson‟s distribution and Normal distribution. Convergence of sequences and series; Power series; Partial Derivatives.	9
3.	Curve fitting	Curve fitting, fitting a straight line and second degree curve. Correlation and regression .Fitting a non linear curve. Bivariate correlation application to biological sciences. Analysis of enzyme kinetic data; Michaelis-Menten; Lineweaver-Burk and the direct linear plot;	8
4.	Sampling distribution	Large samples and small samples. Testing of null hypothesis, Chi square test, Z test,t2 test type I and type II errors. Fisher‟s F test. Goodness of fit. Analysis of variance: One-way ANOVA, Parametric and Non parametric tests,	6
5.	Design of experiments	One way, two way classifications, Randomized block designs, Latin square designs,	6
6.	Computer intensive statistical analysis	Electronic data processing, operating system common software system available, Internet applications, Database and bioinformatics.	6

		Use of statistical software packages-SPSS, CyLab, Systat, GLIM, Arc etc.	
		Total	**45**

EXAMINATION SCHEME

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

REFERENCE BOOKS

1. Statistical methods by George W. Snedecor& William G. Cochran,VIII edit,Ames: Iowa State University Press, 2003
2. Biostatistics :A Foundation for Analysis in the Health Sciences by Wayne W. Daniel, Wiley Publication, IX edi. 2008
3. Biostatistical Analysis by Zerold H Zar, IV edi. Pearson Education,2008
4. Fundamentals of Biostatistics by Bernard Rosner, VI Edi.2006
5. Biostatistics; Bare Essentials by Norman and Streiner,III edi.2008.

List of Practicals

Sr. No.	**Name of practical**	**Hr.**
1.	Finding maxima and minima	2
2.	Fitting of bionomial/poisson distribution	2
3.	Curve fitting	2
4.	Regression equation fitting and correlation computation	2
5.	Multiple regression, partial and multiple correlation	2
6.	Z test	2
7.	T test	2
8.	Chi square tests	2
9.	Non parametric test	2
10.	Randomized block design (RBD)	2
11.	Latin square design (LSD)	2

TITLE OF THE COURSE: INTRODUCTION TO COMPUTERS & COMPUTER ORGANISATION

COURSE CODE: BI 101 **L T P Hr C**

MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

To familiarize the students with computers and programming concepts.

To introduce basic concepts in: hardware, software and its implementation.

To introduce concepts of Networking, World Wide Web (Internet), Telnet, FTP, Etc.

Programming module is intended to familiarize them with computer logic and solution of real world problems using computers.

LEARNING OUTCOME:

At the end of this course student would be able to understand basic principles of Computing, Networking and Programming.

PREREQUISITES:

The course is of introductory nature and there are no prerequisites for the course.

COURSE DESCRIPTION :

Sr. No.	Topic	Description	Hrs
1	Basic Organization of Computers	Introduction to Computer, historical background, Block diagram of a Computer, parts of Computer, their integration and function .	1
2	Hardware	Computer hardware, different types of I/O devices, motherboard, BIOS, Primary and Secondary Memory, different types of Printers, Storage Media, their sizes and use. Computer booting, loading operating system (OS) and execution. execution cycle (fetch and execute)	3
3	Software	Introduction to software, Application software (Packaged & Customized) and System Software (OS & Utilities). Complier & Interpreter, software loading and execution, Task management by OS for Application Software.	2
4	Types of Computer	Difference between Super Computer, Mini Computer and a Micro Computer and their applications.	1
5	Data representation in Computers	Introduction to Binary, Octal and Hexadecimal Number System	1
6	Binary Arithmetic	Basic Binary Arithmetic i.e. Addition, Subtraction, Multiplication, Division, Compliments, Subtraction by means of 2"s Compliment, Logical operations on Binary (AND, OR, NOT)	2
7	Transforming Data into Information	Distinction between data and information their represented in computers.	1

8	Operating System & Interface	OS, tasks performed by OS , Introduction to DOS, Windows and Linux/UNIX	2
9	Networking Fundamentals	Computer networks (n/w), various terms associated with networks, topologies for n/w, different mediums, hardware and technologies associated with n/w, n/w protocols, introduction, OSI layers, TCP/IP stack, services provided by TCP, IP, Addressing	5
10	Client Server Architecture	Introduction to client, server, client-server architecture	1
11	LAN/WAN/MAN/CAN	Introduction to LAN/WAN/MAN and CAN, and their use. Different technologies used to implement them.	2
12	Telnet, FTP	History and use of Telnet based on UNIX terminals. FTP and its use. TFTP. Case study how to setup Telnet and FTP servers on LINUX	2
13	Internet, WWW, HTML	Internet, DNS and name resolution. History of Internet. IP Addressing scheme and its relation to the Internet. Basic HTML tags	3
14	Introduction to C and Programming in high level language	Data types, Decision control, Loop control, Case control, Functions, Arrays and Strings	20
Total Number of Lectures			46

METHODOLOGY

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

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

1) Introduction to Computers by Norton
2) Fundamentals of Computers by Raja Raman
3) Computers Fundamentals by Sinha
4) Introduction to Computers by Subramanian.

PRACTICAL IN INTRODUCTION TO COMPUTERS & COMPUTER ORGANISATION (4 Hrs per week) Marks : 100

LIST OF EXPERIMENTS

1) Introduction to computer system
2) Hardware parts, Different Software
3) Concepts of files and directories, File Handling.
4) Introduction to MS Word, MS Excel, MS Office, MS Access
5) Micro Soft Presentation
6) Graphics Software
7) Operating System (Basics)
8) DOS, Unix, Windows
9) Commonly used Commands
10) Use of DOS and Unix Commands
11) Networking, FTP, Telnet
12) Internet, WWW, HTML Web Browsers
13) Programs in basic programming in C
14) Programs using Decision Controls in C
15) Programs using Loop and Case Control structure
16) Programs illustrating use of function
17) Programs illustrating use of arrays and Structure
18) Programs using Pointers
19) Programs for Biological application
20) Finding complement of DNA
21) ORF finding
22) Inverted Repeats
23) Motif finding
24) Translation

EVALUATION SCHEME (PRACTICAL)

Examination	Duration	Marks
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

TITLE OF THE COURSE: COMMUNICATION SKILLS

COURSE CODE: HU 101	**L**	**T**	**P**	**Hr**	**C**
MARKS: 100	**1**	**2**	**0**	**3**	**3**

OBJECTIVE:

To develop communication skills amongst students,

To familiarize students with communication elements,

To acquaint them with the Scientific reading , Writing & Presentation skills. To familiarize students with concepts in plagiarism.

LEARNING OUTCOME:

At the end of the course, the students will be able to use different forms of communication, produce good document in science and avoid plagiarism of any form.

PREREQUISITES:

This is an introductory course and there are no prerequisites.

COURSE DESCRIPTION:

Sr. No.	**Topics**	**Detail syllabus**	**No. of Lectures**
1	Introduction to communication	Elements, definitions, scope of communication and communication as part of science	02
2	Communication elements	Verbal and nonverbal communications. Principles of effective communication, Oral presentations, Barriers to communications, Use of good English: Introduction to English Grammar: parts of speech, use of articles & prepositions, use of correct tense, spellings etc.	02
3	Scientific reading, writing & presentation	Introduction to scientific reports and writings? Compilation of experimental data, Communication methods in science, Use of good English in science, Examples of Scientific and Unscientific writing. Process of Scientific writing: thinking, planning, rough drafts and revising context. Different styles of scientific writing APA, MLA or Chicago. Writing papers, reviews and Bibliography	08
4	Plagiarism	Introduction to Plagiarism Examples of Plagiarism	04
Total Lectures			16

METHODOLOGY

The course will be covered through lectures supported by tutorials. During tutorials, students would be made to present scientific and nonscientific data/information using different communication skills.

They would be corrected as and when needed and taught how to improve their skills in reading, writing and data presentation.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

Technical Writing and Professional Communication- Thomas Huckin and Lesle Oleson London William Collins and Sons.

Business English and Communication- By Lyn Clark and Zimmer. New York Mcgraw Hill.
Developing Communications-Mohan K

SEMESTER II						
MB 201	Medical Biochemistry	3	0	4	7	5
MB 202	Human Physiology	3	0	4	7	5
MB 203	Microbiology and Virology	3	0	4	7	5
MB 204	Cell biology	3	0	4	7	5
BS 204	Environmental Sciences	3	1	0	4	4
MB 206	Electronics and Instrumentation Engineering	3	1	0	4	4
Total		**18**	**2**	**16**	**36**	**28**

TITLE OF THE COURSE: MEDICAL BIOCHEMISTRY

COURSE CODE: MB 201	**L T P Hr C**
MARKS: 200	**3 0 4 7 5**

OBJECTIVE

To familiarize the student with basic biochemistry involved in human metabolism.

LEARNING OUTCOME

At the end of the course, the students will have sufficient scientific understanding of the subject and have good knowledge of various biomolecules their functions and metabolism.

PREREQUISITES

Basic knowledge of organic chemistry is required.

COURSE DESCRIPTION

Sr. No.	Topics	Detail syllabus	No. of Lectures
1	Carbohydrates Properties and Metabolism	Classification and biochemical importance, chemistry and functions of Monosaccharides, disaccharides and polysaccharides including Glycosaminoglycans (Mucopolysaccharides). Synthesis and break down of glycogen, glycolysis, Rapport Leubering cycle, glucoeogensis HMP shunt pathway and its biological significance, Uronic acid pathway (significance only). Metabolism of Galactose and Galactosemia. Blood sugar level and its regulation, oral GTT and glycosuria, Biochemistry of diabetes mellitus.	**8**
2	Lipids	Classification and biological importance of Triacyl glycerol, phospholipids, glycolipids, fatty acids (PUFA), prostaglandin, steroids and lipoproteins. Biochemical aspects of digestion and absorption of Lipids. Beta oxidation, biosynthesis of saturated fatty acids only, cholesterol biosynthesis, transport (role of HDL, & LDL) Excretion, ketogenesis, ketolysis and ketosis. Adipose tissue metabolism, Lipolysis and re-esterification, fatty liver and atherosclerosis.	**6**
3	Proteins	General nature of amino acids, various ways of classification of amino acids, biologically important peptides, classification, properties and biological importance of proteins. Structural organization of proteins, plasma proteins –functions, clinical significance of various fractions, methods of separation (Only principle.) Biochemical aspects of digestions and absorption of proteins. Fate of amino acid in the body (Deamination, Transmination, Transdeamination, Dacarboxylation), fates of ammonia (Urea	**8**

		cycle, glutamine formation), Metabolism of aromatic and sulphur containing amino acids and their inborn errors. Metabolism of Glycine.	
4	Enzymes	General nature, classification of enzymes, specificity and mode of action of enzymes, factors affecting enzyme activity. Clinical importance (Diagnostic, therapeutic and as a Laboratory reagent) of enzymes and isozymes. Enzyme kinetics and inhibition	**8**
5	Vitamins	General nature, classification, sources, active forms.	**02**
6	Hormones	General characteristics and Mechanism of hormone action. CAMP-the second messenger, phosphotidyl inositol/ calcium system as second messenger. Steroid hormone & Thyroid hormone mechanism of actions.	**05**
7	Nucleic acid	Structure of purines, pyrimidine, structure of DNA and RNA,	03
		Total	**46**

METHODOLOGY :

The course will be covered through lectures supported by tutorials, PowerPoint presentations, research articles and practical. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given. Normally a students is expected to complete the assignment by himself, however if needed, difficulties will be discussed in the tutorial classes. There will be two class tests/ and surprise test conducted during the tutorial classes.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

100

TEXT BOOKS :

1. Medical Biochemistry – U. Satyanarayan.
2. Biochemistry for Medical students by D.M. Vasudevan & Shree Kumari.
3. Medical Biochemistry by M.N. Chatterjee and Rana Shinde.
4. Text Book of Medical Biochemistry by Ramakrishnan, Prasannan & Rajan.
5. Medical Biochemistry by Debajyoti Das.
6. Biochemistry by A.C.Deb. S. Dandekar. Dinesh Puri.
7. Harper‟s Biochemistry
8. Medical Biochemistry by N.V.Bhagwan
9. Biochemistry by L. Stryer.
10. Biochemistry by Orten & Neuhans.

PRACTICALS IN MEDICAL BIOCHEMISTRY (4 Hrs.)
MARKS: 100

LIST OF EXPERIMENTS:

1. Prepare buffers.
2. Create a BSA standard curve and protein quantification
3. Protein Purification spectrophotometry and purification method
4. Protein Purification : ion exchange chromatography− Ion exchange Chromatography for the Purification of IgG
5. Protein Purification : Affinity Chromatography for the Purification of Fibronectin.
6. Dialysis of purified fibronectin
7. Enzyme Immunoassay (EIA) : Fibronectin EIA.
8. Alkaline Phosphatase enzyme activity, specific activity, assay methods, effect of enzyme concentration and time.
9. Enzyme Kinetics: Michaelis -Menten Kinetics and Inhibitors. Using Alkaline Phosphatase
10. Blood Clotting Experiments
11. Serum Protein Analysis: Electrophoresis and Total Protein Determination

EVALUATION SCHEME (PRACTICAL)

Examination	**Duration**	**Marks**
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

TITLE OF THE COURSE: HUMAN PHYSIOLOGY
COURSE CODE: MB 202 **L T P Hr C**
MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

The objective of the course is to develop insight of physiological aspects of the human systems with respect to various interactions occurring with all the major organs of the body.

The course is well equipped to deal with branches of biophysics, biochemistry and clinical applications as well.

LEARNING OUTCOME

The course would enables the student to understand the integral mechanism operating in the human system along with the regulation of each system

PREREQUISITES

Since the course is very basic in nature school level knowledge in physics, chemistry & Biology is enough to take the course and there are no prerequisites.

COURSE DESCRIPTION

Sr. No	Topic	Description	Hrs
1.	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	7
2.	Sensory Organs	Eye, Ear, Nose, Tongue and Skin: Functions & Disorders	4
3.	Digestive system	Functions & Disorders, Pharynx, oesophagus, Stomach and Intestines, Liver & Pancreas, Peritoneum	4
4.	Circulation system	Heart rate and the significance, Cardiac cycle, HR factors ECG- Machine, Recording, Abnormalities types Causative Factors Reporting & Interpretation	7
5.	Respiration system:	Respiration, Mechanism Inspiration, Expiration Gas exchange mechanism Lung surfactant, compliance Lung volume and capacity Respiratory Exercises Artificial Respiration Basis & Techniques	6
6.	Genito-Urinary System	Kidney, Urethra, bladder, Urethra, Female Reproductive System, Male Reproductive System	5
7.	Skeletal system	Mechanism of contraction, Difference between 3 types of muscles, Electro myography & mechanical recording of muscle contraction, Locomotion, Diseases of muscles Dystrophies,	5
8.	Nervous System	Nerve fibres, types ,functions, injuries, impulses & velocity	4

9.	Endocrine system	Hormones, Functions & Disorders	4
Total No. of Lecture			**46**

METHODOLOGY

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

REFERENCE BOOKS

1) Textbook of Medical Physiology by C. Guyton.
2) Physiology by C. Chatterjee.
3) Human Anatomy & Physiology by Tortora.
4) Medical Biochemistry – Anant Narayan
5) Text Book of Biochemistry by Harper Ed. 1988
6) Medical physiology by Chaudhary.
7) Anatomy and histology by Ross and Wilson
8) Human Anatomy and Physiology by Creager

PRACTICALS IN HUMAN PHYSIOLOGY **(4 Hrs. per Week)**

MARKS: 100

LIST OF EXPERIMENTS

1. Demonstration of cell division i.e. mitosis and Meiosis from permanent mounted slides.
2. To study various body fluids.
3. Phenol Red Clearance or intestinal Absorption of Glucose
4. Renal Function, Phenol Red Clearance
5. measurements of membrane potentials,
6. Responses of skeletal muscle to electrical stimulation,
7. Electromyography, pulmonary and cardiovascular measurements in humans,
8. Contractility and regulation of the frog heart,
9. Human electrocardiography and renal control of body fluids.

EVALUATION SCHEME (PRACTICAL)

Examination	**Duration**	**Marks**
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

TITLE OF THE COURSE: MICROBIOLOGY AND VIROLOGY

COURSE CODE: MB 203 **L T P Hr C**

MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

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

LEARNING OUTCOME

At the end of the course, the students will have sufficient scientific understanding of bacteria and viruses and diseases caused by them.

PREREQUISITES

Since the course is very basic in nature, school level knowledge in biology is sufficient to take the course and there are no prerequisites.

COURSE DESCRIPTION

Seq. No	Topic	Description	Hrs
1.	Introduction to Microscopy	Principle and applications of various microscopic techniques– TEM, SEM, AFM, Confocal-Microscopy, Scanning tunneling microscope and photonic force microscope, Flow cytometry	6
2.	Introduction to Microbiology	Scope and history of Microbiology. Characterization, classification and identification of microorganism. Microscopic examination (Staining and microscopic techniques)	6
3.	Microorganism-Bacteria	Morphology and fine structure of bacteria. Cell wall structure in details. Cultivation of bacteria. Reproduction and growth. Growth kinetics. Isolation and preservation.	8
4.	Control of Microorganisms	Control of By physical and chemical agents. Role of antibiotics and chemotherapeutic agents	4
5.	Microbial Physiology/ Metabolism	Microbial metabolism: Utilization of energy in Non-synthetic pathways (bacterial motility and transport of nutrients), Biosynthetic processes. Novel bacterial pathways. Energy production	4
6.	Microbial organisms and diseases	Definitions and types of hosts, reservoir, parasites, carriers, vectors, source of infections Mechanisms of Bacterial pathogenesis – bacterial toxins, capsules, enzymes,intracellular parasitism, antigenic, variations etc. leading to establishment of infections Types of infections - primary, secondary, nosocomial, iatrogenic, zoonotic etc. Nrmal flora, various sites of normal flora, list of normal flora and its beneficial and adverse effects. Principles of lab	6

		diagnosis of infectious diseases.	
7.	Mycology	Structure and characteristics of fungi, differences between Bacteria and fungi, common terminologies, sporulation morphological classification, method of identification, culture	8

		and laboratory diagnosis, infections produced (Mycoses). Medical importance of fungi.	
8.	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, antiviral agents, viral-agents, and antiviral drugs	6
Total number of Lectures			**48**

METHODOLOGY

The course would be taught through lectures, demonstrations and practicals.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

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.
6) Principle of Fermentation technology by Stanbury & Witter

PRACTICALS IN MICROBIOLOGY AND VIROLOGY (4 Hrs. PER WEEK)
MARKS: 100

LIST OF EXPERIMENT

1) Introduction to lab apparatus (instruments and glassware).
2) Washing, plugging & sterilization of test tubes.
3) Study of microscope & observation of permanent slides (mitosis, meiosis, prokaryotic and ukaryotic cells.
4) Prepaation of media-NA (nutrient agar), NB (nutrient Broth), PDA, (Potato dextrose agar) and LB media
5) Isolatin of microbes from soil sample on nutrient agar slants.
6) Isolation of microbes from soil & bacterial suspension by streak plate method. Observation of microbial growth & study of colony characteristics
7) Staining Of Microbes:
8) Monochromal
9) Negative Staining,
10) Grams Staining.
11) Endospores staining by Schaeffer and Fulton‟s method).
12) Effect of Environmental parameters on growth of microorganisms.
13) Effect of pH.
14) Effect of temperature.
15) Effect of Buffered & unbuffered media.
16) Effect of Osmotic pressure.
17) Growth curve of E.coli.
18) Testing of antiseptics & dyes in the control of microorganisms.
19) Metachromatic granules staining.
20) Counting of cells (of micro organisms by pour plate and spread plate technique/by Hemo cytometer)
21) Identification of disease causing bacteria. Analysis of blood for infections.

EVALUATION SCHEME (PRACTICAL)

Examination	**Duration**	**Marks**
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60

Total	**100**

TITLE OF THE COURSE: CELL BIOLOGY

COURSE CODE: MB 204 **L T P Hr C**

MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

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

LEARNING OUTCOME:

At the end of this course, student should be able to comprehend essentials of cell Biology useful for their understanding at the later stage and will have sufficient scientific understanding of the Animal Tissue Culture techniques, knowledge of aseptic handling of cell lines. Use of these techniques in various fields of research and medicine and human welfare.

PREREQUISITES:

This is an introductory course. There are no prerequisites for the course.

COURSE DESCRIPTION

Sr. No	Topic	Description	Hr
1	Cell as basic unit of living systems (Prokaryotes, Eukaryotes)	Pre-cellular evolution: artificial evolution of cells, Broad classification of cell types, how cells are studied	5
2	Ultra-structure of the cell	Cell membrane and special functions of membrane	4
3	Structure and function of cell organelles	Cytosol, Golgi bodies, ER (smooth and rough), Cytoskeleton structures (action, microtubules etc.), Mitochondria, Chloroplasts, Lysosomes, Nucleus	7
4	Cell-cell Interaction	Germ cells and Fertilization, Cellular mechanisms of development	5
5	Cellular Physiology	Cell division and cell cycle, Cellular differentiation, Cell senescence and death, apoptosis	3
Total Number of lectures			**44**

METHODOLOGY

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

EXAMINATION SCHEME (THEORY)

Examination	Duration	Marks
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10

End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

1) Cell and Molecular Biology by De Robertis.
2) Molecular Biology of Cell by Bruce Alberts 2002. The cell by Cooper 2000
3) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by P. S Verma nd VK Agarwaal. Publisher S. Chand and Comp. 2005
4) Cell Biology by Powar
5) Cell and Tissue Culture by John Paul.
6) Basic Cell Culture Vol. 290 Protocols by Cheryl D Helgason, Cindy L Miller. Humanan Press Basic Cell Culture 2nd Edition by JM Davis Oxford Press
7) Tissue Culture in Biological Research by G. Penso and D. Balduki. Biotechnology by B. D. Singh.
8) Principle of Fermentation Technology by Wittakar.

PRACTICAL IN CELL BIOLOGY **(4 Hrs. per week)**
MARKS: 100

LIST OF EXPERIMENTS

1) Microscopes- Different types of microscopes
2) Compound microscopes
3) Stereoscopic microscope
4) Observations of permanent slide
5) Stem Transverse Section – Dicot
6) Stem Transverse Section – Monocot
7) Different types of Animal Cell
8) Mitosis – Slide preparation and cell division
9) Meiosis - Slide preparation and cell division.
10) Preparation of slides and staining – Leaf Transverse Section and Stem Transverse Section

EVALUATION SCHEME (PRACTICAL)

Examination	**Duration**	**Marks**
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

TITLE OF THE COURSE: ENVIRONMENTAL SCIENCE

COURSE CODE: BS 204 **L T P Hr C**

MARKS: 100 **3 1 0 4 4**

OBJECTIVE OF THE COURSE:

The objective of the course is to familiarize the students with the problems related to environmental pollution, loss of natural resources, climate change, solid waste disposal, biodiversity and social issues due to environmental degradation. It is also important for them to develop clear understanding of biodiversity and its conservation.

LEARNING OUTCOME

At the end of this course student should be able to understand importance and need of sustainable development.

PREREQUISITES

Since the course is very basic in nature there are no prerequisites.

COURSE DESCRIPTION

Sr. No	Topic	Description	Hrs
1	Natural Resources and associated problems	Land, water, food, forest, mineral and energy resources, their use, over-exploitation and conservation.	8
2	Ecosystems	Concept, structure and function of ecosystem. Producers, Consumers and decomposers, Energy flow in ecosystem. Ecological succession and pyramids, Food chains, food webs and ecological pyramids. Characteristic features of Forest, Grassland, Desert and Aquatic Ecosystems.	6
3	Environmental Pollution	Definition, Causes, Effects and control measures of Air, Water, Soil, Noise, thermal and Marine Pollution. Nuclear hazards and Solid waste management. Role of an individual in prevention of Pollution and Pollution case studies	8
4	Biodiversity and its Conservation	Genetic, species and ecosystem diversity. Value of Biodiversity: social, ethical, aesthetic and option values. India as a mega diversity nation. Hotspots of Biodiversity. Threats to Biodiversity: Habitat loss, poaching of wildlife, man wild life conflicts. Endangered and Endemic species of India. Conservation of Biodiversity: in situ and ex situ conservation of biodiversity	8
5	Social Issues and the Environment	Urban problems related to energy. Water conservation, Rain water harvesting, and watershed management. Resettlement and rehabilitation of people. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation: Case studies. Environment	7

		protection Acts: Air (Prevention and control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Environmental	

		ethics: Issues and possible solutions. Public awareness	
6	Human Population and Environment	Population growth. Population explosion- family welfare programs. Environment and Human Health. Human Rights. HIV/ AIDS and Women and Child welfare. Role of Information and Technology in environment & human health.	6
7	Field work	Visit to a local area to document environmental assets River/forest/grassland/hill/mountain Visit to local polluted site- Urban/Rural/Industrial/Agricultural Study of Common plants, insects, birds. Study of simple ecosystems- pond, river, hill slopes, etc	5
Total number of lectures			48

METHODOLOGY

The course would be taught through lectures, demonstrations and field work. The students will undertake field trip to sensitive hot spots in Western Ghats to observe and collect samples of Flora and Fauna for on the spot studies, collection and identification of specimens. These would be evaluated on the basis of report presented by the students.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

1) Agarwal, K.. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2) Bharucha Erach, The Biodiverstiy of India, Mapin Publishing Pvt. Ltd. Ahmedabad- 380013, India, mail: mapin@icenet.net (R)
3) Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.480p Cark R.S., Marine pollution, Clanderson press Oxford (TB)
4) Cunnigham, W.P.Cooper, T.H. Gorhani, E & Hepworth M.T. 2001

TITLE OF THE COURSE: ELECTRONICS AND INSTRUMENTATION ENGINEERING

COURSE CODE: MB 206 **L T P Hr C**

MARKS: 100 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

Objective of the course is to familiarize students with the basic concepts of electronic engineering and electronics engineering. This knowledge would help them in applying them in various biological techniques. Also the Knowledge of this subject will form a profound base for the instrumentation used in various advanced courses of Biotechnology and Bioinformatics.

LEARNING OUTCOME

At the end of this course student should be able to understand the engineering electronics and instruments.

PREREQUISITES

Since the course is very basic in nature, knowledge of physics and mathematics is required

COURSE DESCRIPTION

Sr. No	Topic	Description	Hrs
	Electronics		
1.	Introduction to Electronics	History and Scope of Electronics	1
2.	Electronic Signals	Characteristics of electrical Signals	2
3.	Electronic devices	Input & output relations, Simple electronics devices: Resistors, Capacitors, Inductors, Bias voltage.	6
4.	Electronic circuits	Simple circuits for amplification, power supplies and for wave shaping .Amplification: Concept of amplification, type of amplifiers, OP-Amp and its characteristics, simple applications (Adder, substracter, integrator, differentiator), and filters.	8
5.	Digital electronics	Number systems, binary codes, Boolean algebra, arithmetic operations, logic functions, combinational and sequential logic, different OR, AND, NOR, NAND, EXOR gates, flip flops, registers and counters.	8
6.	Microprocessor	Introduction to Microcomputer and Microprocessor and block diagram, CPU and ALU, Timing and control unit and Block diagrams instruction and data formats.	7
7.	Interfacing peripherals and applications	A to D converters, DAC, Resolution, speed, types	3
	Instrumentation		
8.	Introduction	Introduction to instrumentation and definitions	1
9.	Sensing elements	Types of sensors, electrodes and transducers	1
10.	Electrodes:	Electrolyte interface, Sensing element, Detectors, Signal	5

	conducting circuits, circuit models, suitability of electrode potentials, circuit models, external and internal electrodes, pH, pO2 and pcO2 electrodes, connectivity.	
11. Transducers	Definitions, types, displacement pres	4

		sure, temperature, vibration, ultrasound etc, calibration, sensitivity and resolution, Flow transducers & Rota meter, venture, orifice Plate	
		TOTAL NO. OF LECTURE	46

METHODOLOGY

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

1. Digital Electronics by R. K. Jain Jain, Tata Mc Graw Hill, 3rd Edition, 2003.
2. Grob‟s Basic Electronics – Mitchel E. Schultz.., Tata McGraw Hill, 10thEdition 2006. 3. Principals of electronics By V. K. Mehta, S. Chand Publisher , 1stEdition , 2010.
3. Op Amps and linear integrated circuits By Ramakant Gaikwad, McGraw –Hill publishing company limited, 4thEdition, 2002.
4. Integrated Electronics By Millman and Halkias. Mcgraw-Hill, 3rdEdition 1972 .
5. The Z 80 Microprocessor By Ramesh Gaonkar,. Penram Publisher , 3rdEdition, 1988.
6. A course in electrical and electronic measurements and instrumentation by A. K. Sawhney, Puneet Sawhney, Rai publisher, 1996

METHODOLOGY

The entire course is covered through lectures, group discussions and with the help of teaching aids.

PRACTICALS IN BASIC CONCEPTS IN ELECTRONICS AND INSTRUMENTATION ENGINEERING (4 Hrs. Per Week) MARKS : 100

Sr. No.	Name of the Practical	Time (Hrs)
1.	Study of diode characteristics	4
2.	Study of operational Amplification 741 i) Inverting Amplifier ii) Non inverting amplifier	4
3.	Study of operational Amplification 741 i) Inverting Amplifier ii) Non inverting amplifier	4
4.	Study of Ph meter circuits & working	4
5.	Study of Ph electrodes & role of electrolytes	4
6.	Study of Conductivity meter, circuits & working	4
7.	Study of Conductivity meter electrodes & functions	4
8.	Pressure development & vibration DVPT	4

EVALUATION SCHEME (PRACTICAL)

Examination	Duration	Marks
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

SEMESTER III						
MB 301	Bioprocess Engineering	3	0	4	7	5
MB 302	Animal Cell Culture	3	0	4	7	5
BI 303	Bioinformatics	3	0	4	7	5
MB 304	Molecular Biology	3	0	4	7	5
MB 305	Human Genetics	3	1	2	6	5
MB 306	Analytical Techniques	3	0	4	7	5
Total		**18**	**1**	**22**	**41**	**30**

TITLE OF THE COURSE: BIOPROCESS ENGINEERING

COURSE CODE: MB 301	**L T P Hr C**
MARKS: 200	**3 0 4 7 5**

Teaching hours per week and credits: 3 hours, 3 credits

Objective:

The objective of the course is to create an understanding about basic industrial processes for the production of medically important compounds.

Pre-requisites:

Students are expected to have a basic understanding in Biology.

Course Description:

Sr. No.	Topics	Detail syllabus	No. of lectures
1	Fermentation Basics	• Design of a bioprocess facility • Components of fermentation process • Types of bioreactors with special emphasis on reactors for animal cell culture including single use bioreactors • Kinetics of cell growth, productivity and yield	8
2	Measurement and control of bioprocess parameters	• PID systems • Measurement and control of process variables- pH, temperature, pressure, flow, dissolved oxygen and carbondioxide	8
3	Process Optimization	• Design of experiments for fermentation process optimization • Removal of adventitious agents in production of medically important products	4
4	Downstream processing	• Centrifugation, Filtration, Precipitation • Chromatography: basic and high-throughput bioseparations including affinity monolith chromatography	8
5	Large scale mammalian cell culture	• Case studies- production and downstream processing of a) Viral products (viral vaccines) b) Monoclonal antibodies c) Immunological regulators (interferons/ interleukins) d) Hormones (Follice stimulating hormone, erythropoietin) e) Enzymes (Hyaluronidase, tissue plasminogen activator) f) Other biosimilars/recombinant products (e.g., insulin)	10
6	Bioprocess engineering applications in medicine	• Tissue engineered skin replacements • Chondrocyte culture for cartilage replacement • Production of viral vectors for gene therapy • Stem cell expansion and controlled differentiation	8
7	Economics	• Scale up • Challenges and cost economics	2
	Total		48

Methodology:

The course will be covered through lectures supported by tutorials and laboratory practicals. Students will be evaluated based on two class tests, lecture and laboratory attendance, class participation.

Books Recommended:

1. Michael L. Shuler and Fikret Kargi (2002) Bioprocess Engineering: Basic Concepts, 2nd Edition, Prentice Hall PTR, pp 553.
2. Stanbury Peter F., Allan Whitaker and Stephen J. Hall (2016) Principles of Fermentation Technology, 3rd Edition, Elsevier, pp 824.

Other reading material:

For case studies and specific topics, handouts/ reviews/research papers will be given.

METHODOLOGY:

The course will be covered through lectures supported by tutorials and laboratory practicals. Students will be evaluated based on two class tests, lecture and laboratory attendance, class participation.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED

- Principles of fermentation technology-Stanbury and Whitaker
- Industrial microbiology-Casida
- Industrial microbiology-Patel.

Teaching hours per week and credits for practicals only: 4 hours/week, credits 2

Sr. No.	**Name of the experiment**	**Learning objective**	**Literature/ Weblinks for reference and videos ***
1.	Study of design of lab scale Stirred Tank Bioreactor (Lab scale fermenter) and calibration of different probes	To know basic of bioreactors with their parts and various dimensions. To understand the importance of calibration.	**3**
2	Measurement of control parameters during a fermentation- pH, temperature, dissolved oxygen	To know the importance of process parameters in bioreactors operations.	**1,3**
3	Removal of adventitious agents during fermentation of medically important products		
4	Production of streptomycin/penicillin antibiotic by fed batch fermentation and determination of antibiotic activity.	To learn upstream and downstream processing in antibiotic fermentation.	**2,4**

5	Recovery of medical compound/antibiotic from fermentation broth- precipitation, dialysis, concentration, chromatography	To understand different methods of DSP and their role.	**4**
6	Production of therapeutic recombinant products using fermentation	To learn culturing of recombinant cell.	**1**
7	Immobilization of yeast cells using different substrates and determination of biological activity	To know the basics of immobilization and its methods and significance.	**3,4**
8	Study of rheology of fermentation broth. Determination of viscosity, cell counts/ml, dry cell wt/ml broth and packed cell volume.	To know basic of fermentation process parameters and their significance.	**1,3**
9	Visit to Industry	To learn different units in industry such as production. Quality control, Quality assurance, R & D, and Lab. To study unit operations in industry.	

*** References:**

1. Manual of Industrial Microbiology and Biotechnology
   (2nd Edition by Arnold L. Demain and Julian E. Davies, Ronald M. Atlas, Gerald Cohen, Charles L. Hershberger, Wei-Shou Hu, David H. Sherman, Richard C. Willson and J. H. David Wu)
2. Industrial Microbiology-An introduction
   (By Michael J. Waites, Neil L. Morgan, John S. Rockey and Gary Higton)
3. Principles of Fermentation Technology
   (2nd edition, by Peter F. Stanbury, Allan Whitaker and Stephen J. Hall, Butterworth-Heinemann, An imprint of Elsevier Science
4. Fermentation and Enzyme Technology By D.I.C. Wang, C.L. Cooney, A.L. Demain, P. Dunnill, A.E. Humphrey & M.D. Lilly John Wiley and sons, New York

TITLE OF THE COURSE: ANIMAL CELL CULTURE

COURSE CODE: MB 302 **L T P Hr C**

MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

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

LEARNING OUTCOME:

At the end of the course, the students will have sufficient scientific understanding of the Animal Tissue Culture techniques, knowledge of aseptic handling of cell lines. Use of these techniques in various fields of research and medicine and human welfare.

PREREQUISITES

Student should have background of cell biology, cell division, basic of aseptic laboratory techniques. They should know basic concept of various laboratory media.

COURSE DESCRIPTION

Seq. No	Topic	Description	Hrs
1	Introduction:	History, Cell culture techniques, Equipment, and sterilization methodology.	4
2	Introduction to animal cell cultures:	Nutritional and physiological: Growth factors and growth parameters General metabolism	6
3	Primary cell cultures	Establishment and maintenance of primary cell cultures of adherent and non-adherent cell lines, fibroblasts, endothelial cells, embryonic cell lines and stem cells.	4
4	Secondary cell cultures	Establishment and maintenance of secondary mammalian and insect cell lines	2
5	Characterization of cell lines	Karyotyping, biochemical and genetic characterization of cell lines	2
6	Production of vaccine in animal cells:	use of Hybridoma for production of monoclonal antibodies.	2
7	Bioreactors in animal cells	Bioreactors for large-scale culture of animal cells	2
8	Transplantation, tissue culturing.	Transplantation techniques.	2

		Tissue Culturing	
9	Cryopreservation and tissue culture applications	Cryopreservation Tissue culture applications	2

The course would be taught through lectures, demonstrations and LCD PowerPoint presentation

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

1) Cell and Tissue Culture by John Paul.
2) Basic Cell Culture Vol. 290 Protocols by Cheryl D Helgason, Cindy L Miller. Humanan Press
   Basic Cell Culture 2nd Edition by JM Davis Oxford Press
3) Tissue Culture in Biological Research by G. Penso and D. Balduki. Biotechnology by B. D. Singh.
4) Principle of Fermentation Technology by Wittakar.

PRACTICALS IN ANIMAL TISSUE CULTURE (4 Hrs. Per Week)
MARKS : 100

1. A. Preparation of stock solution of MS media
B. Preparation of stock solution of iron salts of MS media
C. Preparation of stock solution of vitamins and amino acids of MS media
2. To prepare Ca-Mg free PBS
3. To culture Monolayer of chick embryo fibroblast
4. To study the permanent Histological slides of Chick embryo

PRACTICAL EVALUATIONS

Practical work is evaluated while it is being carried out. The evaluation done for each practical session will be consolidated into a final evaluation. Equal weight age will be given to each session in the final evaluation. In case of a deviation from this guideline, the course coordinator will make an appropriate note in the Course Description.

EVALUATION SCHEME (PRACTICAL)

Examination	**Duration**	**Marks**
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

TITLE OF THE COURSE: BIOINFORMATICS

COURSE CODE: BI 303 **L T P Hr C**

MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

The objective of the course is to familiarize the student with basic concepts in Bioinformatics and its use in the field of medicine.

LEARNING OUTCOME:

At the end of the course, students will have sufficient understanding of Biological databases, warehousing of Biological data etc. This knowledge would be applicable in subsequent courses in Bioinformatics in the coming years.

PREREQUISITES:

Students should be familiar with school level mathematics and Biology to take up this course. In case they do not have mathematics at the twelfth level they should have cleared the core mathematics in the first semester.

COURSE DESCRIPTION:

Sr. No.	Topics	Detail syllabus	No. of Lectures
1.	Overview of Bioinformatics and its analogy	Scope and fields of Bioinformatics. Contribution to different problems in biology. Homology, Analogy, Orthology, Paralogy and Xenology	04
2.	Biological sequence databases	NCBI, GenBank, EMBL, DDBJ EBI, NBRF-PIR, SWISSPROT	07
3.	Structural data bases	PDB, CATH, SCOP	06
4.	Sequence alignment and data base search	Pairwise sequence alignment, Multiple sequence alignment: Clustering algorithm MSA	08
5.	Sequence Polymorphism	SNP database and its application	02
5.	Introduction to phylogenesis	Phylogenetic, cladistics and ontology Building phylogenetics trees Evolution of macromolecular sequences	06
6.	Introduction to structural Bioinformatics	Amino acids, Polypeptide Composition Secondary Composition Backbone flexibility & ψ Angles, Ramchandran Plot Tertiary & Quaternary Structure Hydrophobicity, Disulphide bonds, Active Sites	05
7.	Bioinformatics in Clinical research	Data-mining and Clustering, Analysis of 2D gels, mass spectrometry, Biomarkers, Metabolomics, Pharmacogenomics,	10

		Correlation of experimental results with experimental database	
Total no. of Lectures			**48**

METHODOLOGY

The course will be covered through lectures, demonstration and practicals.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

1) Introduction to Bioinformatics By T. K.Attawood & D .J. Parry-smith
2) Fundamental Concepts of Bioinformatics by Dan E Karne and Michael L Raymer.
3) Bioinformatics by D.Srinivasan Rao

PRACTICALS IN BIOINFORMATICS (4 Hrs. Per Week)
MARKS : 100

List of Practicals

1) Introduction to Nucleic Acid and Protein Sequence Data Banks
2) NCBI
3) EMBL
4) DDBJ
5) EBI
6) NBRF-PIR
7) SWISSPROT
8) SNP
9) PDB etc.
10) Tools on Expasy database
11) Metabolic Pathway Database
12) Database Similarity Searches:
13) BLAST
14) FASTA
15) PSI-BLAST algorithms
16) Multiple sequence alignments –
17) Clustering algorithm
18) PRAS
19) Other MS
20) Patterns, motifs and Profiles in sequences:

21) PROSITE

22) BLOCKS
23) Prints
24) Pfam etc.

PRACTICAL EVALUATIONS:

Practical work is evaluated while it is being carried out. The evaluation done for each practical session will be consolidated into a final evaluation. Equal weightage will be given to each session in the final evaluation. In case of a deviation from this guideline, the course coordinator will make an appropriate note in the Course Description.

EVALUATION SCHEME (PRACTICAL)

Examination	**Duration**	**Marks**
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

TITLE OF THE COURSE: MOLECULAR BIOLOGY **(4 Hrs. Per Week)**
COURSE CODE: MB 304 **L T P Hr C**
MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

The objective of the course is to familiarize the students with advanced research area and basic concept in molecular biology

LEARNING OUTCOME:

At the end of the course, the students will have sufficient scientific understanding of DNA structure, Replication, Transcription, Translation, Mutation, Recombination and Gene Expression .

PREREQUISITES:

Since the course is very advance in nature, student must know about Gene structure and gene regulation. Student must have background with Genetics.

COURSE DESCRIPTION:

Sr. No	Topic	Description	Hrs
1	Introduction:	What is gene? Molecular basis of genes, DNA as genetic material, Meselson and Stahl experiment for semi conservative mode of DNA replication, what is genetic code.	4
2	Structure and Maintenance of Genome:	Structure of DNA (Structure of purines, pyrimidines, De-oxy ribose sugar, Phosphoric acid, Nuceosides and Nucleotides), Structure of RNA What is Chromosome? Structure of chromosome, what is chromatin? Chromosome and chromatin diversity Chromosomal duplication and segregation Nucleosome structure, Higher order chromatin structure, Regulation of chromatin structure, Mitochondrial genome.	6
3	Replication of DNA in Prokaryotes and Eukaryotes:	Chemistry of DNA synthesis Mechanism of DNA polymerase, replication fork (Okazaki fragments), Termination and control of DNA replication.	6
4	Mutation and DNA repair	Types of mutations. Replication errors and their repairs. DNA damage and repair.	4
5	Recombination:	Homologous recombination at molecular level: models of homologous recombination, proteins in homologous machines, homologous recombination in prokaryotes and Eukaryotes, mate typing, Genetic consequences of mechanism of recombination. Site specific recombination and transposition of DNA: conservative site specific recombination, biological roles of sites recombination, transposable elements, and their	8

		regulations, V9DJ recombinants, Gene conversion.	
6	Transcription & Translation in	Transcription in Prokaryotes and Eukaryotes (role of proteins and factors etc.)	4

		Translation in Prokaryotes and Eukaryotes, Genetic Code, RNA Splicing and RNA editing	
7	Control of Gene Expression:	Gene regulation in prokaryotes, operon models, Gene regulation in eukaryotes, gene activators, enhancers and silencers.	4
8	Genetic Engineering and Recombinant DNA technology.	Genetic engineering in *E. coli* and other prokaryotes, yeast, fungi and mammalian cells,	3
9	Gene Cloning	Enzyme and Vector in cloning; DNA and RNA isolation, Ligation, Transformation techniques, Recombinant selection and screening methods, DNA sequencing and PCR,	5
Total			44

METHODOLOGY

The course would be taught through lectures and assignments.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

1) Instant notes in Molecular Biology by Turne.
2) Molecular Biology of Gene Watson, Baker et al. 5th Edition
3) Molecular Biology of the Cell by Alberts.
4) Gene X by Lewin and Benjamin.

PRACTICALS IN MOLECULAR BIOLOGY (4 Hrs. Per Week)
MARKS: 100

OBJECTIVE:

The objective of the course is to create general understanding amongst the students in the subject of molecular biology through in-depth laboratory practical. The objective of the course is to understand them a general overview, concepts and basic principles in the molecular biology with emphasis to familiarize the students with molecular lab techniques.

LEARNING OUTCOME:

At the end of the semester, it is expected that students understood the basic molecular biology such as DNA, replication, DNA repair and recombination, gene expression and regulation, and how to apply molecular knowledge to solve a critical problem. It is expected that they will be more confident to use the knowledge in pursuing their higher education or for industrial applications.

PRE-REQUISITES:

This is an introductory level course. Students are expected to have an understanding of introductory knowledge in Physics, Chemistry and Biology.

LABORATORY DESCRIPTION

Sr. No.	Laboratory exercise	Hrs
1	DNA extraction from Plant materials	4
2	Agarose gel electrophoresis of DNA	4
3	Bacterial DNA extraction & Gel electrophoresis	4
4	Plasmid DNA extraction & Gel electrophoresis	4
5	Quantification of DNA by UV spectrophotometer	4
6	Demonstration of SDS-PAGE	4
7	Restriction digestion analysis	4
8	Preparation of competent cells & transformation	4
9	Replica Plate Techniques	4

EVALUATION SCHEME (PRACTICAL)

Examination	Duration	Marks
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

TITLE OF THE COURSE: HUMAN GENETICS

COURSE CODE: MB 305	**L**	**T**	**P**	**Hr**	**C**
MARKS: 150	**3**	**1**	**2**	**6**	**5**

OBJECTIVE OF THE COURSE:

The objective of the course is to familiarize the students with the importance & universality of Human Genetics.

The students would understand Mendelian Genetics & its extensions in relation to human races.

Students will be acquainted with Non-Mendelian Genetics, Sex Determination, Genetic diseases, Syndromes, Chromosomal Aberrations, and Population Genetics.

The students will be familiar with sub-disciplines in Genetics and their importance in applied medical sciences.

LEARNING OUTCOME

At the end of this course students should have sound knowledge of Genetics and its importance in applied sciences with respect to its use in Medical Biotechnology.

PREREQUISITES

Since the course comes under Basic sciences, school level knowledge of molecular biology and chemistry is required by the students to take up this course.

COURSE DESCRIPTION

Sr. No	Topic	Description	Hrs
1.	History of Human Genetics	Historical views of heredity	2
2.	Mendelian	Mendelian, Laws of Segregation Law of Independent assortment Trihybrid crosses	3
3.	Extensions of Mendelism	Gene-environment interactions, intralocus & Interlocus Interactions	3
4.	Sex determination	Sex determination mechanisms & numerical; Genotypic Sex determination mechanisms; Environmental Sex determination mechanisms; Sex linked inheritance. Linkage and crossing over Inactivation of the Sex chromosome	5
5.	Non Mendelian Genetics	Extra chromosomal inheritance; organelle heredity; Plasmid inheritance, Infectious heredity & Maternal effect	4
6.	Chromosomal Aberrations & genetic disorders	Structural & numerical Chromosomal Aberrations and various genetic syndromes & disorders	4
7.	Cyto-Genetics	Chromosome structure and organization Chromosomal analysis, Karyotyping & chromosomal mapping techniques	3
8.	Population Genetics	Genetic variability, Genotypic & allelic frequency	5

		Hardy Weinberg‟s law & numerical; Factors affecting changes in allelic & genotypic frequency- Mutation; migration; selection & random genetic drift	
9.	Current Topics in Genetics	New Therapies for Genetic Disease, Positional Cloning of	4

		Disease Genes, Epigenetics, MicroRNAs and RNA Interference,	
1	Genetics Counselling	Introduction to genetics counselling, methods prenatal diagnosis of genetic disorders- invasive and non-invasive, ethical issue of genetic counselling, eugenics Online Mendelian Inheritance in Man (OMIM) NCBI Genes and Disease	4
1	Pedigree Analysis	In humans with single gene disease gathering family history, pedigree symbols, construction of pedigrees, presentation of molecular genetic data in pedigrees	7
1	Human Genome Project and	Introduction and Background, Major outcome, hurdles and solution	2
		Total	**46**

METHODOLOGY

The course would be taught through lectures, demonstrations & tutorials with the help of logical questions and numerical etc**.**

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS
RECOMMENDED

Text books

A text book of genetics by Sambhamurthy

The Human Genome: A user Guide, by R. Scott Hawley and Catherine A Mori, Academic Press.

Human Genetics: The Basics, By Ricki Lewise, Taylor and Francis

Reference Books

1) Genetics by Russell
2) Genetics by Klug
3) Genetics by Tamarind
4) Genetics by Snustad & Simmons
5) Genetics by B.D Singh
6) Genetics by Pierce

PRACTICALS IN HUMAN GENETICS **(2 Hrs. Per Week)**
MARKS : 100

LIST OF EXPERIMENT

1. Model Organisms and their significance in Genetic studies: 05 Prs. Virus – TMV (Tobacco leaves),

   Bacteria – E coil (slide)
   Neurospora and Yeast (slides)
   Paramecium (slides)
   Coenorhabites elegans.

   Drosophila melanogaster – Life Cycle
   Mosquito (Anopheles and Culex) – Life cycle
   Dssected reproductive system of Rat - Maize,
   Pea, Arabiodopsis – Life Cycle
2. Induction of polyploidy in Onion root tips.
3. Methyl Green-Pyronin Staining of DNA
4. Dermatoglyphs of human fingers
5. Human Karyotype.
6. ABO Blood Gr
7. Genetic traits in population
8. Founder Effect
9. Isolation of Mitochondrial DNA
10. Plasmid DNA isolation
11. β Thalassemia
12. VNTR marker
13. Replica Plate Techniques
14. Growth curve analysis

EVALUATION SCHEME (PRACTICAL)

Examination	**Duration**	**Marks**
Minor test 1	1 hour	15
Continuous Assessment		05
Major test at the end of semester	2.5 hours	30
Total		**50**

TITLE OF THE COURSE: ANALYTICAL TECHNIQUES

COURSE CODE: MB 306	**L T P Hr C**
MARKS: 200	**3 0 4 7 5**

OBJECTIVE OF THE COURSE:

The objective of the course is to introduce the M. Tech. students to the concept of Bioanalytical Techniques in more details. The student would be learning spectroscopic techniques, advance separation techniques and DNA & Protein sequencing. They would also understand the importance of analytical tools in biotechnology & its applications in various industries. The topics like Nuclear magnetic resonance spectroscopy, Infra-red spectroscopy, Mass spectroscopy, Ultra-violet spectroscopy, ORD-CD, X-ray crystallography and their comparative study are also included in the theory course.

LEARNING OUTCOME

At the end of this course student should be able to understand advanced level concepts of analytical tools, their theory and interpretation of their data for Biotechnological use.

PREREQUISITES

Since this course is detailing with more details of bioanalytical techniques the Graduate level knowledge of analytical techniques is essential for this course.

COURSE DESCRIPTION

The course will include three lectures. The contents to be studied in this course are given below

Sr. No	Topic	Description	Hrs
1	Spectroscopy	Origin of UV spectra, Absorption and emission spectra, types of transition, chromophore & related terms, Fluorescence quenching, effect of conjugation, Applications, Characterizing Protein and DNA by UV Spectroscopy, Origin of infra-red spectra, modes of vibrations, instrumentation, sampling technique and applications	08
2	ORD and CD	Principles of light polarization, Theory of ORD & CD, the octant rule, Applications of ORD & applications of CD.	05
3	Separation Techniques	Principle and applications of− Column Chromatography, HPLC, FPLC, Gas Chromatography. IEF, 2D electrophoresis, Pulse-field electrophoresis. Sedimentation, Use and Principle of Ultracentrifugation.	07
4	Techniques for Intermolecular Interactions	Principle and Applications of− Surface Plasmon Resonance, Thermophoresis, RT-PCR, Fluorescence resonance energy transfer (FRET), Isothermal Titration Calorimetry (ITC),	07
5	Structure Determination	Principle and applications of NMR, X-ray crystallography, SAXS, CryoEM	08
6	Mass spectroscopy	Origin, Instrumentation, types of ions produced, interpretation and applications of mass spectra GCMS, LCMS & MSMS	07
7	Macromolecular sequencer	Maxum-Gillbert‟s method and Sanger‟s method for DNA sequencing, Third Generation automated sequencer, Protein Sequencers	04
Total			**44**

METHODOLOGY :

The course would be taught through lectures and actual spectra interpretation. The instrumentation of the available techniques will be demonstrated at the time of teaching.

RECOMMENDED BOOKS

1. Principles and Techniques of Biochemistry and Molecular Biology, by Keith Wilson (Editor), John Walker (Editor) Edition 7th (2010), Cambridge University Press. ISBN-10: 0521731674
2. Introductory Practical Biochemistry by S. K. Sawhney (Editor), Randhir Singh, Edition 2nd, (2005) Alpha Science,
3. Instrumental methods of chemical analysis by Gurdeep Chatwal and Sham Anand.
4. Biophysical chemistry by Nath and Upadhyay. (2010) Himalaya Publications
5. Spectrometric analysis by P.N. Kalsi.
6. Principles of instrumentation by Skoog.

PRACTICALS IN ANALYTICAL TECHNIQUES (4 Hrs. Per Week)
MARKS: 100

COURSE DESCRIPTION

Sr. No.	Experiment	Hrs
1.	Effect of quencher on fluorescence of protein.	4
2.	Assaying protein-carbohydrate interaction using Spectrofluorimeter.	4
3.	Following DNA denaturation via UV-spectroscopy.	4
4.	Analyzing protein crystal data to generate 3D structure of protein.	4
5.	Isolation of cell organelles via ultracentrifuge	4
6.	Amino acid content determination of BSA using HPLC.	4
7.	Separation of plant alkaloids using HPLC	
8.	2D electrophoresis of single cell protein	4
9.	IEF of proteins	4
10.	Purification of any protein	4

METHODOLOGY

The course will be covered through practical work supported by field study.

EVALUATION SCHEME (PRACTICAL)

Examination	Duration	Marks
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

SEMESTER IV						
MB 401	Biopharmaceuticals	3	0	4	7	5
MB 402	Developmental Biology	3	0	4	7	5
MB 403	Pharmacology & Toxicology	3	1	0	4	4
MB 404	Genetic engineering	3	0	4	7	5
MB 405	Immunology	3	0	4	7	5
HU 602	Bio safety, Bioethics & IPR	3	1	0	4	4
Total		**18**	**2**	**16**	**36**	**28**

TITLE OF THE COURSE: BIOPHARMACEUTICALS

COURSE CODE: MB 401 **L T P Hr C**

MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

The objective of the course is to familiarize the students with manufacturing of various biopharmaceutical products.

LEARNING OUTCOME:

At the end of the course, the students will have sufficient understanding of different biopharmaceuticals products and their manufacturing process.

PREREQUISITES:

Since the course is very advance in science, student must know about the new biotechnological and molecular genetics method which to apply in food. Student must have background with Biotechnological aspects and molecular genetics.

COURSE DESCRIPTION:

Sr. No.	Topic	Description	Hrs
1	Introduction to pharmaceutical products	Understanding Biopharmaceutical product.	**2**
2	The drug manufacturing process	Good manufacturing practices, sources of biopharmaceuticals materials, Production of final product, Analysis of final product, immunological approaches for detection of contaminants.	**7**
3	Blood products and therapeutically enzymes	Disease transmission. blood cells substitutes, serum protein isolation, haemostasis- coagulation pathway blood factor isolation for transfusion ,anticoagulants. thrombolytic agents. Enzymes of therapeutic value.	**7**
4	Hormones of therapeutic interests	insulin-diabetes, insulin receptors, production of human insulin by rDNA technology, formulation insulin administration. Glucagon, human growth hormones, (hGH) GH receptor :biological effect, recombinant hHG, use of GH, gonadotropin, FSH; LH; hCG; inhibins and activins	**7**
5	Growth Factors	i) growth factors and wound healing, insulin like growth factors (IGFS)− biochemistry, receptors, binding proteins, biological effects. IGF II and effect on foetus deve1opment, affect on reproduction, EGF-epidermal growth factor, PDGF - Platelet derived growth factor	**7**
6	Haemopoietic growth factor	Erythropoietin (EPO) receptor, transduction regulation, therapeutic applications.	**6**

7.	Antibodies, vaccine and adjuvant	polyclonal and monoclonal antibodies via hybridism technology, immunoglobulin, normal, hepatitis B and tetanus, therapeutic application of monoclonal antibodies, vaccine technology, traditional vaccine preparation, the Impact of genetic engineering on vaccine technology; recombinant	**5**

		veterinary vaccine adjuvant.	
8.	Nucleic acid therapeutics	Basic approach to gene therapy; vectors used In gene therapy, manufacturing plasmid DNA, antisense technology, ribozyme	**3**
9.	Cytokines	Interleukins and interferon	**2**
Total number of Lectures			**48**

METHODOLOGY

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

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

Books: Biopharmaceuticals -biochemistry and biotechnology second edition by Gary Walsh, John wiley and sons Its. 2003 edition.

PRACTICALS IN BIOPHARMACEUTICALS (4 Hrs. per Week)
MARKS: 100

LIST OF EXPERIMENT

1. To determine the presence of glucose by GOD or POD method.
2. To determine the SGPT activity in serum or plasma by DNPH method.
3. To learn the technique of Ouchterlony double diffusion.
4. Estimation of tetracycline by chemical assay method.
5. To perform the sterility test on injectables.
6. To perform the antifungal assay using antifungal drug (Flucanozole).
7. Estimation of penicillin by chemical assay method.
8. To perform ELISA test.
9. To isolate the antimicrobial compounds from the plants.
10. To perform LAL test for determination of bacterial endotoxines.
11. Estimation of streptomycin by chemical assay method.

EVALUATION SCHEME (PRACTICAL)

Examination	**Duration**	**Marks**
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

TITLE OF THE COURSE: DEVELOPMENTAL BIOLOGY

COURSE CODE: MB 402 **L T P Hr C**

MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

The objective of the course is to develop insight of embryonic development of various organisms, with emphasis on human embryonic development. The course is designed include development at various levels.

LEARNING OUTCOME

The course would enable the student to understand the human embryonic development.

PREREQUISITES

Since the course is very basic in nature however require knowledge of anatomy.

COURSE STRUCTURE

Sr. No.	Topic	Description	Hrs
1.	Introduction	Introduction to Developmental Biology Origins and History, Early Beliefs Gametogenesis, Fertilization, Mechanisms of Preventing Polyspermy, Fertilized-Egg, Activation	6
2.	Genes and Development	Early Evidence for Genes, Differential Gene Expression, Genetic Knockouts, Antisense RNA	5
3.	Cleavage	Mechanisms of Cleavage, Cleavage Patterns, Holoblastic, Cleavage: Isolecithal and Mesolecithal; Meroblastic Cleavage: Telolecithal and Centrolecithal; Cleavage Patterns in Major Groups of Organisms; Cell Specification	8
4.	Gastrulation	Cell Movements, Germ Layers, Gastrulation in Major Groups of Organisms	4
5.	Axis Formation	Types of Axes, Axis Formation in Drosophila, Amphibians, Birds Mammals	4
6.	Later Embryonic Development	The Central Nervous System (CNS) and Epidermis, Mesoderm, Endoderm differentiation, Cell Death, Front Limb vs. Hind Limb Formation	6
7.	Post Embryonic Development	Sex Determination, Dosage Compensation, Unusual Sex Determination, Environmental Sex Determination, Metamorphosis, Regeneration	6
8.	Environmental Influences on Development	Environmental Influences: Normal Effects, Environmental Disruptions: Abnormal Effects, Teratogens, Endocrine Disruptors	7
		Total	46

METHODOLOGY

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME (THEORY)

Examination	Duration	Marks

I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

RECOMMENDED BOOKS

1) Developmental Biology, Eighth Edition, Scott F. Gilbert, Susan Singer, **Publisher:** Sinauer Associates Inc.; **ISBN-13:** 978-0878932504
2) Developmental Biology: A Very Short Introduction, Lewis Wolpert, **Publisher:** Oxford University, **ISBN-13:** 978-0199601196
3) Essential Developmental Biology, Jonathan M. W. Slack **Publisher:** Wiley-Blackwell; 3 edition, **ISBN-13:** 978-0470923511

PRACTICALS IN DEVELOPMENTAL BIOLOGY MARKS: 100

(4 Hrs. per Week)

LABORATORY EXPERIMENTS

1) Study of different stages of development using slides.
2) Analyzing GloFish genetics with Punnett squares-worksheet
3) Staging Experiment
4) Cartilage staining of zebrafish embryos
5) Oxygen consumption and metabolic rate Activation of Wnt signaling using lithium chloride: Lithium Treatment to Disrupt Wnt Signaling Microinjection of Zebrafish Embryos

EVALUATION SCHEME (PRACTICAL)

Examination	**Duration**	**Marks**
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

TITLE OF THE COURSE: PHARMACOLOGY & TOXICOLOGY

COURSE CODE: MB 403 **L T P Hr C**

MARKS: 100 **3 1 0 4 4**

OBJECTIVE:

The objective of the course is to familiarize the students with aspects of Pharmacology, principles of Drug Action and toxicology.

LEARNING OUTCOME

At the end of the course, the students will have sufficient scientific understanding of drug action and effect of toxic substances.

PREREQUISITES

Since the course is very basic in scientific world, student must know about relationship between drugs with biological cell.

COURSE DESCRIPTION

Seq. No	Topic	Description	Hrs
1.	Pharmacology Introduction	Organized drug discovery and development. Pharmacological, microbial, recombinant, biochemical and molecular level	02
2.	Clinical Developments	Screening systems and their construction strategies Alternative strategies in lead identification, lead optimization, pre-clinical development: Clinical trials, patenting and clearance for application	04
3.	Mechanism of action	Receptor versus enzyme mediated drug action, SAR and its quantitative description Molecular principles in agonist and antagonist action. Peptide and protein mimicry Morphines verses enkephalins	06
4.	Chemical Kinetics	Principles and practice of transition state mimicry Illustrative examples, collected substrate analogue inhibitors ,and design strategies	06
5.	Aspects of Pharmacology	Combinatorial approach to compound libraries, current status and future Prospects, synthetic peptide libraries, peptide libraries through phage display.	05
6.	Toxicology Introduction	Definition and derivation of toxicology Sister sciences, endocrinology and pharmacology Definition of toxins and toxicants Key features of toxicology and study of toxicants Modes of exposure, elimination, bioavailability, partition	5

7.	Dose Response	Toxicant targets Physiologic dose-response The role of intercellular chemical communication: hormone, receptor, transducer, effectors Agonist, antagonist	5

		Interconnections of transduction mechanisms	
8.	Metabolism	Biochemistry of toxicant metabolism Enter hepatic circulation Toxic dynamics and toxic kinetics	3
9.	Dosage	Stress and dose interactions Diet as modulator or mode of exposure Developmental status/age and toxicity Predispositions to toxic risk Moderators of toxic risk Carcinogenesis	5
10.	Models	Adequacy of models for developmental toxicity; Steroid disruptors: oestrogen, androgen, progestin, corticoid; Thyroid, retinoid and other disruptors.	4
		Total	**45**

METHODOLOGY

The course would be taught through lectures, demonstrations.

Evaluation Methodology theory

Minor Test 1	**1 Hour**	**15**
Minor test 2	**1 Hour**	**15**
Seminars		**10**
End Semester Examination	**3 hours**	**60**
Total		**100**

BOOKS RECOMMENDED:

1 Comprehensive medicinal chemistry-VolI & VolVI by C. Hansch.
2 Design of enzyme inhibitors as drug by M.sandle & H. J. Smith
3 Computer aided drug design by T.J.Pexin & C.L. Propst Dekk14e.
4 Klaassen. McGraw-Hill:New York, NY. 2001. 1236 pp.
5 Casarett & Doull's Toxicology: The Basic Science of Poisons, 6th Ed.

TITLE OF THE COURSE: GENETIC ENGINEERING
COURSE CODE: MB 404 **L T P Hr C**
MARKS: 200 **3 0 4 7 5**

OBJECTIVE

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

LEARNING OUTCOME

At the end of the course, the students will have sufficient scientific understanding of the subject and have good knowledge of application of Recombinant DNA techniques in Life Sciences Research.

PREREQUISITES

Knowledge of molecular biology is sufficient.

COURSE DESCRIPTION

Sr. No.	Topics	Detail syllabus	No. of Lectures
1	Introduction	Landmarks in Molecular biology and biotechnology, Advantages of using microorganisms, What is genetic engineering and recombinant DNA technology, Control of gene expression and gene complexity in prokaryotes and eukaryotes., Genetic engineering in *E. coli* and other prokaryotes, yeast, fungi and mammalian cells,	10
2	Tools in genetic engineering	Enzymes- DNA polymerases, restriction endonucleases, ligases, reverse transcriptases, nucleases, terminal transferases, phosphatases etc. Cloning vectors-plasmids, bacteriophage vectors, cosmids, phagemids, vectors for plant and animal cells, shuttle vectors, YAC vectors, expression vectors etc.	6
3	Gene cloning	Isolation and purification of DNA (genomic, plasmid) and RNA,, Isolation of gene of interest- restriction digestion, electrophoresis, blotting, Cutting and joining of DNA, Methods of gene transfer in prokaryotic and eukaryotic cells, Recombinant selection and screening methods- genetic, immunochemical, South-western analysis, nucleic acid hybridization, HART, HRT, Expression of cloned DNA molecules and maximization of expression, Cloning strategies- genomic DNA libraries, cDNA libraries, chromosome walking and jumping.	10
4	Recombinant	Blotting Techniques, Autoradiography,	10

	DNA techniques	Hybridization, Molecular Probes and Nucleic acid labelling , DNA sequencing, PCR, Mutagenesis, Analysis of gene expression , DNA fingerprinting, RAPD, RFLP, AFLP.	

5	Applications of Recombinant DNA technology		02
6	Protein interaction technology	Two-hybrid and other two component systems ,Detection using GST fusion protein, co-immunoprecipitation, FRE etc.	04
7	Gene therapy	In vivo approach, ex-vivo approach Antisense therapy, Transgenics.	02
8	Genetic disorders-Diagnosis and screening	Prenatal diagnosis, Single nucleotide polymorphisms, DNA microarrays, Future strategies.	02
Total Lectures			**48**

METHODOLOGY

The course will be covered through lectures supported by tutorials, PowerPoint presentations, research articles and practical. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given. Normally a students is expected to complete the assignment by himself, however if needed, difficulties will be discussed in the tutorial classes. There will be two class tests/ and surprise test conducted during the tutorial classes.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

Biotechnology-Fundamentals and Applications- SS Purohit
Principles of gene manipulation-Old and Primrose
Gene Biotechnology-Jogdand
Molecular Biology-Twyman
Principles of genetics-Klug
Molecular Biology of the gene-Watson
Molecular Cloning (Vol 1,2,3)-Sambrook and Russell

Teaching hours per week and credits for practicals only: 4 Hr 2 Cr
Marks for Practicals: 100

Sr. No.	Name of the experiment	Learning objective	Literature/ Weblinks for reference and videos
1	Requirement of a genetic engineering lab including physical containment facilities and other biosafety procedures	Stringency awareness of genetic engineering procedures safeguarding personnel biosafety and biocontainment	Guidelines for the use and safety of genetic engineering techniques or recombinant DNA technology IICA, 1988, ISSN 0534-5391
2	Culturing *Escherichia coli* K12 and making competent cells for transformation	Preparation of the host for genetic engineering experiments	Sambrook J. Molecular cloning: a laboratory manual. Vol.1 / J.Sambrook, D.W.Russell. – 4th edition - New York: Cold Spring Harbor Laboratory, 2012. III, P.159 - 162
3	Preparation of the vector DNA and target DNA, ligation and transformation	Preparation for transformation of competent cells for gene cloning	Fanglian He, Bio-protocol, standard DNA cloning DOI: https://doi.org/10.21769/BioProtoc.52
4	Elution of DNA from Agarose gel	Isolation of desired DNA fragments	Sambrook J. Molecular cloning: a laboratory manual. Vol.1 / J.Sambrook, D.W.Russell. – 4th edition - New York: Cold Spring Harbor Laboratory, 2012. II, P 125 - 127
5	Selection of transformants by a) Antibiotic resistance b) Blue-white screening c) Restriction analysis	Screening methods for trans formants to check presence of positive and negative clone	Sambrook J. Molecular cloning: a laboratory manual. Vol.1 / J.Sambrook, D.W.Russell. – 4th edition - New York: Cold Spring Harbor Laboratory, 2012. III, P.210
6	Preservation and storage of clones	Different methods of clone preservation: Glycerol stock preservation, Filter paper preservation	Owens CB, Szalanski AL, Filter paper for preservation, storage, and distribution of insect and pathogen DNA samples J Med Entomol. 2005 Jul;42 (4):709-11
7	Cloning in expression vectors for expression of specific genes	Difference between cloning and expression vector	Sambrook J. Molecular cloning: a laboratory manual. Vol.3 / J.Sambrook, D.W.Russell. – 4th edition - New York: Cold Spring Harbor Laboratory, 2012. XIX, P.1481-
8	Target DNA amplification by polymerase chain reaction	Set-up of PCR program in thermocycler	Sambrook J. Molecular cloning: a laboratory manual.

			Vol.1 / J.Sambrook, D.W.Russell. – 4th edition - New York: Cold Spring Harbor Laboratory, 2012. VII, P 470 - 476
9	DNA finger printing technique RFLP/RAPD	Phylogenetic analysis or Differences between individuals at molecular level.	Williams JG, et al. DNA polymorphisms amplified by arbitrary primers are useful as genetic markers. Nucleic Acids Res. 1990 Nov 25;18(22):6531-5.
10	Bioinformatics tools in Genetic engineering	Restriction site identification on gene. Primer designing (Primer blast)	Ye J Coulouris G, Zaretskaya I, Cutcutache I, Rozen S, Madden TL, Primer-BLAST: a tool to design target-specific primers for polymerase chain reaction BMC Bioinformatics. 2012 Jun 18;13:134. doi: 10.1186/1471-2105-13-134. Vincze, T., Posfai, J. and Roberts, R.J. NEBcutter: a program to cleave DNA with restriction enzymes Nucleic Acids Res. 31: 3688-3691 (2003)

Internal evaluation will be based on following criteria

For practicals of 2 credits and 100 marks, internal evaluation will be for 40 marks with following break-up:

Practical: 10 marks

Attendance: 10 marks (above 80% attendance gets full marks)

Laboratory assignment: 10 marks

Journal writing: 10 marks

TITLE OF THE COURSE: IMMUNOLOGY

COURSE CODE: MB 405 **L T P Hr C**

MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

The objective of the course is to familiarize the students with the immune system and it‟s function and the advances in the immunology.

LEARNING OUTCOME

At the end of the course, the students will have sufficient scientific understanding of immune system, molecular biology of antibody formation, various immunological assay and function of immune system in various microbial infections.

PREREQUISITES

Student should have background of cell biology. They should know basic concept of molecular biology also to understand expression off immunoglobulin gene. They should know some basic assays.

COURSE DESCRIPTION

Sr. No	Topic	Description	Hrs
1	Introduction to immunology	Overview of Immune system: History and scope of Immunology, Types of immunity: innate, acquired, Comparative immunity. Immune dysfunction and its consequences. b) Cells and Organs of Immune system: Cells of the immune system lymphoid cells: B, T and null cells, Primary lymphoid organs, secondary lymphoid organs- lymph nodes, spleen mucosal associated lymphoid tissues	6
2	Generation of B-cell and T- cell response:	Antigens: Immunogenicity vs. antigenicity Epitopes (properties of B-cell and T-cell epitopes)	4
3	Immunoglobulins Structure and Function:	Basic and fine structure of immune-globulin: light chains, heavy chains and sequences Antigen determinants on Immunoglobulin: Isotopic, allotypic, Idiotypic Immunoglobulin super family	6
4	Immunoglobulin Classes and Biological Activity:	Immunoglobulin mediated effectors functions optimization Activation of complement Antibody dependent cell mediated cytotoxicity.	6

		Clinical focus: Passive antibody therapy (IgG, IgM, IgA, IgE and IgD), hypersensitivity and immunological disorder	

5	Organization and Expression of Immunoglobulin Genes:	• Genetic model compatible with Ig structure • Multigene organization of Ig genes • Variable region gene rearrangements • Mechanism of variable region DNS rearrangements • Generations of antibody diversity • Class switching among constant regions genes • Expression of Ig genes • Regulation of Ig-gene transcription • Antibody and genes and antibody engineering • Clinical focus	7
6	Antigen Antibody Interactions:	• 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	6
7	MHC-Major Histo-compatibility complexes	• MHC molecules and genes	4
8	Immune System in Health and Disease:	Immune response to infectious disease (viral, bacterial and protozoan) Vaccines (whole organism, purified macromolecules, recombinant vaccine, synthetic polypeptide etc. AIDS, and other acquired or secondary immuno deficiency orders Autoimmunity Transplantation immunology: graft rejections, graft vs. host response Cancer and immune system	7
		Total	46

METHODOLOGY

The course would be taught through lectures, demonstrations and LCD PowerPoint presentation.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

1. Immunology 5th edition by Janis Kuby (W.H Freeman and company)*
2. Essentials of Immunology by Ivan M. Roitt 5th Edition Blackwell Scientific Publ.
3. Cellular and Molecular Immunology, 3rd edition, by Abbas
4. Molecular Biology of the Cell by Bruce Alberts

Teaching hours per week and credits for practicals only: 4 Hr 2 Cr
Marks for Practicals: 100

Sr. No.	Name of the experiment	Learning objective	Literature/ Weblinks for reference and videos
1	To study interaction of antigen and antibody by Ouchterlony double diffusion assay	To learn about precipitin phenomena at equimolar concentrations of antigen and antibody	Rose NR, Hamilton RG, Detrick B. Manual of clinical laboratory Immunology. 6th ed:ASM Press; 2002 Hay FC, Olwyn MR. Practical immunology. 4uu ed:Westwood. Blackwell Publishing Company; 2002. Judith A. Owen JA. Punt J, Sharon A. Kuby Immunology. 7th ed: USA. Susan Winslow; 2013
2	Determination of antibody subunits and their molecular weight by denaturing SDS-PAGE	To know about the components of immunoglobulins and their molecular weights	
3	Detection of typhoid infection by WIDAL test	Immunological detection of specific bacterial infections by direct agglutination	
4	Detection of syphilis using RPR card test	Immunological detection of specific bacterial infections by indirect agglutination	
5	Quantitation of antigen-antibody reactions by rocket immunoelectrophoresis	Semi-quantitative analysis of unknown antigens	
6	Determination of antibody titre by ELISA	To learn about different types of ELISA method and their applications	
7	Determination of protein-protein interaction by immunoadsorption/ immunoprecipitation	To learn about immunopurification and protein-protein interactions	
8	In situ detection of specific cellular antigens (immunodiagnosis) by immunocytochemistry/ immunofluorescence	To understand the location of an antigen in a cell and its functional significance	

9	Detection and analysis of antigen and antibody in biological/pathological samples by immunoblotting	To understand the use of a more confirmatory and quantitative test in disease diagnosis	
10	Use of FACS for diagnostic purposes and purifying specific cell types for further experimentation	To know the principle of fluorescence activated cell sorting and its applications in diagnostics	

Internal evaluation will be based on following criteria

For practicals of 2 credits and 100 marks, internal evaluation will be for 40 marks with following break-up:

Practical: 10 marks

Attendance: 10 marks (above 80% attendance gets full marks)
Laboratory assignment: 10 marks

Journal writing: 10 marks

TITLE OF THE COURSE: BIO SAFETY, BIOETHICS & IPR

COURSE CODE: HU 602 **L T P Hr C**

MARKS: 200 **3 1 0 4 4**

OBJECTIVE:

The objective of the course is to make students learn about the legal, safety and public policy issues raised due to the rapid progress in Biotechnology and development of new products. The biotechnology students suppose to understand and follow the regulatory framework important for the product safety and benefit for the society. The students are given case history to discuss and express their views.

LEARNING OUTCOME

At the end of the course, it is expected that students have understood the basic issues of Biosafety, Bioethics and IPR. IT is expected that they will be more confidant to practice and implement all these policies in their future endeavour.

PREREQUISITES

This is an advance level course. Students must have an understanding of introductory undergraduate level course such as chemistry, biology, microbiology, plant and animal biology and molecular biology.

COURSE DESCRIPTION

Seq. No	Topic	Description	Hrs
1	Biosafety	Introduction and Development of Biosafety Practices Principles	18

		General lab requirements Definitions and Biosafety levels: 1,2,3,4 Summery Biological safety cabinets: centrifuges, Shipment of biological specimens, Biological waste management, Decontamination, Biosafety manuals, Medical surveillance, Emergency response	
2	Bioethics	History and Introduction Ethics and genetic engineering Genetic Privacy Patent of genes Human races Trading Human Life Human Cloning Stem Cells Eugenics Biotechnology and Christian faith Human genome and religious considerations Case Studies Final Considerations	16
3	Intellectual Property Rights	Introduction Types of Intellectual Property Rights Plant and Animal growers rights Patents	14

		Trade secretes, Copyrights, Trademarks IPR and plant genetic recourses GATT and TRIPS and Dunkels Draft Patenting of biological materials International conventions and cooperation Current Issues Patents for higher animal and higher plants Patenting of transgenic organisms and isolated genes Patenting of genes and DNA sequences Indian scenario.	
Total number of Lectures			48

METHODOLOGY

The course will be covered through lectures. The students will be given problems and case histories to discuss and clear their problems. The students will be evaluated based on two class tests, lecture and lab attendance, class participation, write up and quizzes.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

Understanding Biotechnology by Borem
Biotechnology an Introduction: Barnum S.R.
Biosafety and Bioethics : Joshi
Introduction to Bioethics : Bryant
Legal Aspects of Business : Pathak
Intellectual Property Rights : Raju
Patent Law : Narayan
Intellectual Property Management: Jungham

SEMESTER V						
MB 501	Cancer Biology	3	1	2	6	5
MB 502	Tissue Engineering and Transplantation	3	0	4	7	5
MB 503	Molecular modelling and drug designing	3	0	4	7	5
MB 504	Disease Biology	3	0	4	7	5
MB 505	Molecular Cell Signalling	3	1	0	4	4
MB 506	Genomics, Transcriptomics & Proteomics	3	1	2	6	5
Total		**18**	**3**	**16**	**37**	**29**

TITLE OF THE COURSE: CANCER BIOLOGY

COURSE CODE: MB 501 **L T P Hr C**

MARKS: 200 **3 1 2 6 5**

OBJECTIVE OF THE COURSE:

The objective of the course is to develop understanding of the biology of cancer.

The course will elaborate understanding of carcinogens, cancer cells, tumours and treatments.

LEARNING OUTCOME:

The course would enable the student to understand the origin and development of cancer.

PREREQUISITES:

Since the course is advance in nature basic knowledge in cytology, genetics, and molecular biology essential.

COURSE DESCRIPTION:

Sr. No.	Topic	Description	Hrs
1.	Introduction to cancer	Origin of cancer cell, mutation, tumour, epigenetic changes in cancer cells, genetic instability of cancer cell,	5
2.	Cancer progression	Tumour progression, cancer stem cell, their origin, metastasis, tumour induced angiogenesis	6
3.	Causes of cancer	Cancer causing agents, tumour initiator damage, tumour promoters, identification of carcinogens, ways to avoid cancer	6
4.	Cancer critical genes	Understanding ontogenesis, Retrovirus as source of cancer, Ras, tumour suppressor gene, oncogene families, cell transforming ability of oncogene, oncogenes– Ras, myc, src, jun and fos, Controlling factors of oncogene expressions	5
5.	Molecular basis of cancer	Disregulation of cell cycle and cell growth, mutation in apoptosis, p53 mutations, genetic lesions and DNA mismatch repair system in cancer, DNA tumour virus– SV40, polymer, papilloma E6 and E7,	5
6.	Tumour suppressor gene	rb, p53, apc, dcc, hnpcc, nf-1, fn-2, renal cell carcinoma genes, von Hippel - Lindau syndrome	4
7.	Metastasis	The process of metastasis, tools of cell invasion, intravasation, transport, colonisation, angiogenesis. MPIs	4
8.	Cancer diagnoses	Expanded diagnostic technique, Tumour markers, nucleic acid based markers, DNA methylation pattern, mitochondrial DNA mutation,	4
9.	Cancer treatment	Search for cancer cure, traditional therapies, chemotherapy, radiotherapy, inhibitors of oncogenic protein, tumour blood vessesl as target for cancer therapy, types of cancer, immunotherapy	7
		Total	46

METHODOLOGY

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME (THEORY)

Examination	Duration	Marks
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

RECOMMENDED BOOKS

1. Molecular biology of the cell, Bruce Alberts et al. Publisher Taylor and Francis Group
2. Cancer Biology by Raymond W. Ruddon, Oxford University press,
3. Molecular biology of cancer by Lauren Pecorio, Oxford University press,

Teaching hours per week and credits for practical: 2 hours, 1 credit

Sr. No.	Name of the experiment	Learning objective	Literature/ Weblinks for reference and videos
1	To perform MTT assay for the assessment and understanding of anti-proliferative and cytotoxicity effects using suitable drugs.	To observe and learn concepts of cancer growth, proliferation, toxicity	Dai Y, Grant S. 2011. Methods to study cancer therapeutic drugs that target cell cycle checkpoints. Methods Mol Biol. 2011;782:257-304. doi: 10.1007/978-1-61779-273-1_19.
2	To study the effects serum starvation in cancer growth and its secreted microenvironment.	To observe and learn about the growth of growth factors and importance of intra-cellular and inter-cellular microenvironment	Pecorino L. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics. Third Edition. 2012. Oxford University Press.
3	To observe metastasis and angiogenesis (One of hallmarks of cancer) using Boyden chamber assay.	To understand and learn about metastasis and angiogenesis as hallmarks of cancer	Pecorino L. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics. Third Edition. 2012. Oxford University Press.
4	To perform clonogenic assay to understand clonal concept and growth characteristics of cancer cells.	To understand the concept of clonal theory of cancer growth and proliferation	Weinberg, R.A. The Biology of Cancer. Second Edition. 2013. Garland Science. Dai Y, Grant S. 2011. Methods to study cancer

Sr. No.	Name of the experiment	Learning objective	Literature/ Weblinks for reference and videos
			therapeutic drugs that target cell cycle checkpoints. Methods Mol Biol. 2011;782:257-304. doi: 10.1007/978-1-61779-273-1_19.
5	To study angiogenesis using chick embryo model.	To understand angiogenesis using chick embryo model	Pecorino L. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics. Third Edition. 2012. Oxford University Press.
6	To perform wound healing assay.	To develop concept on tissue repair and wound healing	Dai Y, Grant S. 2011. Methods to study cancer therapeutic drugs that target cell cycle checkpoints. Methods Mol Biol. 2011;782:257-304. doi: 10.1007/978-1-61779-273-1_19.
7	To study spheroid culture as a preferred model for angiogenesis study	To understand the concept of angiogenesis	Pecorino L. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics. Third Edition. 2012. Oxford University Press.

TITLE OF THE COURSE: TISSUE ENGINEERING AND TRANSPLANTATION

COURSE CODE: MB 502 **L T P Hr C**

MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

The objective of the course is to develop understanding of the biology of Tissue Engineering and Transplantation.

The course will elaborate understanding of Tissue Engineering and Transplantation.

LEARNING OUTCOME:

The course would enable the student to understand the use of Tissue Engineering, stem cells and Transplantation in therapies.

PREREQUISITES:

Since the course is advance in nature basic knowledge in cell, tissue and molecular biology is essential.

COURSE DESCRIPTION:

Sr. No.	Topic	Description	Hrs
1.	Tissue engineering	Tissue engineering as an alternate to drug therapy, gene therapy and whole organ transplantation,	7
2.	Tissue development	Early transformation of embryo, control of development	8
3.	Stem Cells	Introduction, embryonic stem cells, personalized pluripotent stem cell and uses in therapies, tissue specific stem cells	6
4.	Elements of tissue engineering	Cell cycle, growth and differentiation, trafficking and signal transduction. Kinetics of cell proliferation,	8
5.	Cell and tissue mechanics	Elements of solid and fluid mechanics, mechanical properties of cell and tissues, and biological fluid and gels. Cell adhesion, cell migration, cell aggregation	6
6.	Cell delivery	Cell delivery and recirculation, delivery of molecular agents, cell interaction with polymer surface,	6
7.	Approaches in tissue engineering	Artificial organs, role of synthetic component, control of biological component. Replacement of tissue.	8
8.	Case studies	Tissue engineered cartilage, skin and nerve cells.	6
9.	Transplantations	Transplantation of tissue and organ, types of transplantation, immunotherapy in transplantation	6
		Total no. of Lecture	61

METHODOLOGY

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME (THEORY)

Examination	Duration	Marks
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

RECOMMENDED BOOKS

1. Tissue Engineering: Engineering Principles for the Design of Replacement Organs and Tissues, W. Mark Saltzman Publisher: Oxford University Press, USA; ISBN-13: 978-0195141306
2. Tissue Engineering (Academic Press Series in Biomedical Engineering) Clemens van Blitterswijk Peter Thomsen, Jeffrey Hubbell, Ranieri Cancedda, Joost de Bruijn, Anders Lindahl, Jerome Sohier, David F. Williams (Publisher: Academic Press; ISBN-13: 978-0123708694
3. Stem Cells: A Very Short Introduction, by Jonathan Slack **Publisher:** Oxford University Press, **ISBN-13:** 978-0199603381

Teaching hours per week and credits for practicals: 4 hours; 2 credits

Sr. No.	Name of the experiment	Learning objective	Literature/ Weblinks for reference and videos
1	The Tissue Engineering Triad : Identifying Cells, Matrix, Regulators	Learning the concept of appropriate cells, matrices, regulators for particular tissues	http://ijmds.org/wp-content/uploads/2015/06/932-945-Ju-RevA-T-Eng.pdf
2	Preparation of ear-shaped hydrogel scaffolds.	Use of appropriate biomaterials for a particular tissue shape.	http://cdn.intechweb.org/pdfs/18203.pdf
3	Preparation of decellularized liver scaffolds and histological analysis	The concepts behind use of decellularized organ scaffolds and visualization of ECM “skeleton”	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5295461/
4	Preparation of porous scaffolds by porogen leaching	A method for preparing porous scaffolds and their importance for 3D culture of cells.	https://www.intechopen.com/books/advances-in-biomaterials-science-and-biomedical-applications/biofabrication-of-tissue-scaffolds
5	Culture of cells in porous scaffold and histological analysis	Performing 3D culture of cells and study of the population of the scaffold with cells in 3D configuration.	http://www.material.chula.ac.th/Journal/V16-1/31-36%20RATANAVARAPORN.pdf
6	Preparation of tubular conduits used for blood vessel engineering	Devising method for preparing tubular biomaterial conduits	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3867370/
7	Isolation of stem cells from hair follicles.	Hair follicles as a source of autologous stem cells and method for their isolation	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3742959/
8	Study of Pluripotent	The isolation, culture and	https://www.thermofisher.com/

	stem cells in a virtual laboratory	properties of pluripotent stem cells	in/en/home/global/forms/pluripotent-stem-cell-culture.html
9	Preparation of constructs with vascular-like channels	The importance of vascularization in tissue engineered constructs and a method to introduce channels in a construct	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2817665/
10	*In vitro* differentiation of stem cells into specialized cell type eg. osteoblasts	Use of regulators in medium for differentiation of stem cells into a particular cell type.	http://www.medivetbenelux.com/documents/thescience/Adipose%20Derived%20Stem%20Cell%20-%20General/Multilineage%20Cells%20from%20Human%20Adipose%20Tissue.pdf

TITLE OF THE COURSE: MOLECULAR MODELLING AND DRUG DESIGNING

COURSE CODE: MB 503 **L T P Hr C**

MARKS: 200 **3 0 4 7 5**

OBJECTIVE

To create general understanding regarding basic principles involved in modern medicinal/structural chemistry systems.

To familiarize the student with basic concepts in molecular modelling as: how to build the molecule, how to find out the coordinates of the molecule, how to use the programs that are available in graphics designing.

To familiarize students with concepts in molecular mechanics and dynamics and to study the energy minimization algorithms

To introduce them to concepts in quantum chemistry and methods for calculating the energies, that are required in energy minimization and docking studies

To understand the methodology involved in structure based drug designing, and enzyme inhibition strategies

LEARNING OUTCOME

At the end of the course, the students will have sufficient scientific understanding of the basic concepts in classical and modern molecular modelling and drug designing, concepts and laws applicable to quantum-mechanics particles. This would enable him to understand the entire concepts in computerized drug designing and interaction concepts

PREREQUISITES:

This is an introductory course for the students who want to understand the concepts in molecular modelling and drug designing and should make a compulsory subject.

COURSE DESCRIPTION:

Sr. No.	Topics	Detail syllabus	No. of Lectures
1	Introduction to molecular graphics:	Cartesian, and crystal coordinate system, Reducing molecular coordinates to fit Computer monitor Basic principle of molecular graphics and structure visualization Small molecular structural data bases (Chembridge data base) Protein structural data base (PDB) Different molecular graphics packages, Graphics Programs: HAMOG, RASMOL,MOLMOL	08
2	Building of small molecules	Building of small molecules Internal and cylindrical polar co-ordinate system Methods used in building small molecules using crystal, Cartesian, polar and chemical internal coordinates.	10

		Building of Biopolymers DNA & oligopeptides in different secondary structure	
3	Optimization of geometries of	Energy minimization by systematic search method plotting conformation energy contours (Ramachandran plot), and	10

	small molecules:	finding out minimum energy conformation Gradient based Energy minimization methods Molecular mechanics approach Molecular Dynamics method Monte Carlo method Genetic algorithm	
4	Use of Quantum chemical methods for geometry optimization:	Schrödinger equation Basic Formalism in quantum mechanics Schrödinger equation for a multi- electron atom Schrödinger equation for a molecule Hartree- Fock Method Different MO methods Molecular electrostatic potential Optimization of geometries of small molecules Quantum chemical indices	10
5	Drug designing	Pharmacophore identification and novel drug designing, structure based drug design enzyme inhibition strategies	06
Total Lectures			36

METHODOLOGY:

The course will be covered through lectures supported by tutorials and practicals. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given. Normally a students is expected to complete the assignment by himself, however if needed, difficulties will be discussed in the tutorial classes. There will be two class tests/ and surprise test conducted during the tutorial classes.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

Molecular Modelling, Holtje and Folkers G Weinheim New York

Essentials of Drug designing, V. Kothekar, Dhruv Publications 2005

Molecular modelling: principles and applications, Leach. A. R

Molecular modelling and drug design, Andrew Vinter A.and Gardner, M Boca Raton: CRC Press, 1994

PRACTICALS IN MOLECULAR MODELLING AND DRUG DESIGNING (4 Hrs per week)
MARKS: 100

LIST OF PRACTICALS

The course will also have a practical component. The practical training would be in the area of building molecules drawing molecules visualizing the

phenylalanine
benzene
SPDBV

calculate the electrostatic potential using spdbv software
analysis of Ramchandaran plot using spdbv software

HYPERCHEM

Use of molecular modelling software HYPERCHEM for building small molecules. Computation of quantum chemical parameters using HYPERCHEM

Creating database for small molecular indices using HYPERCHEM

MOE

Use of molecular modelling software MOE for building small molecules

Use of molecular modelling software MOE for building oligopeptides and oligonucleotides Computation of force field parameters using MOE

Computation of conformation map of a small molecule using MOE
Optimization of geometries of small molecules using MOE
Creating database for small molecular indices using MOE

EXAMINATION SCHEME (THEORY)

Examination	Duration	Marks
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

TITLE OF THE COURSE: DISEASE BIOLOGY
COURSE CODE: MB 504 **L T P Hr C**
MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

The objective of the course is to develop an understanding regarding various human diseases. The course covers details of various infectious and non-infectious diseases.

LEARNING OUTCOME:

The course would enable the student to understand various human diseases.

PREREQUISITES :

Since the course is advance in nature knowledge in microbiology, human anatomy and physiology is required.

COURSE DESCRIPTION

Sr. No.	Topic	Description	Hrs
1.	Nature and investigation of disease	Characteristics and features of diseases, classification of disease, investigating disease	6
2.	Pathogens and virulence	Introduction, types of pathogens, virulence factors, course of infection	4
3.	Infectious disease and treatments	Infection of various organs, systemic infection, sepsis, prevention of infection, treatment of infection, controlling spread of pathogens	7
4.	Disorders of immune system	Immunodeficiency diseases, autoimmune disorders, hypersensitivity, rheumatoid arthritis	4
5.	Disorders of endocrine system	Growth hormone disorders, thyroid disorders, Addison‟s disease, Cushing‟s syndrome, disorders of sex hormones.	5
6.	Disorders of endocrine systems	Hormone production, mechanism of hormone action, growth hormone disorder, disorders of adrenal cortex,	4
7.	Disorders of digestive system	Disorders of GIT and accessory organs, Disorders of pancreas, gall bladder, bile duct, stomach and intestine.	4
8.	Disorders of cardiovascular system	Blood pressure, endocarditis, cardiac failure, cardiomyopathies, atherosclerosis and arteriosclerosis	4
9.	Ageing	Introduction, causes of ageing, age related disorders	4
10.	Surveillance Medicine	Introduction, Medical Spaces, Problematisation of the normal, dissemination of intervention, spatialisation of risk factor, reconfiguration of identity	4
Total no. of Lectures			**46**

METHODOLOGY

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME (THEORY)

Examination	Duration	Marks
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

RECOMMENDED BOOKS

1. Gordis, L. (2004). *Epidemiology.* Third edition. Philadelphia: Elsevier Saunders. (The second edition is also acceptable.)
2. Biology of Disease, by Nessar Ahmed, Maureen Dawson, Chris Smith, Ed Wood , **Publisher:** Taylor & Francis; **ISBN-13:** 978-0748772100

Teaching hours per week and credits for practical: 4 hours, 2 credits

Sr. No.	Name of the Experiment	Learning objective*	Literature/ Weblinks for reference and videos
1.	Introduction to pathogens/parasites (e.g., bacteria, protozoans, arthropods etc.) including disease causing stages in their life cycle using permanent slide preparations/images.	Familiarize with various pathogens/parasites and understanding the relationship between pathogen-disease relationships.	https://www.cdc.gov/
2.	Identification of microbes[$] using indicator media (e.g., Blood Agar).	Understand how indicator media are used to broadly predict the presence of a specific microbe.	Microbiology–A Laboratory Manual. 7th ed Cappuccino. J, Sherman. N Pearson Education Publishing, Inc: 2005.
3.	Differentiating a pathogenic bacterium from a non-pathogenic bacterium by detection of their virulence factors a) Detection of a virulence factor (lipo-polysaccharide from cell wall of Gram negative bacterium *E. coli*)/ b) Detection of a virulence factor (siderophores from *Bacillus*/*E. coli*/ *Pseudomonas*)	Familiarize with the virulence factors employed by pathogens.	a) Fomsgaard, A. et al. (1990) Modification of the silver staining technique to detect lipopolysaccharide in polyacrylamide gels. *J Clin Microbiol*.; 28: 2627–2631. b) Al-Hendy, A. (1991) Rapid Method for Isolation and Staining of Bacterial Lipopolysaccharide. *Microbiology and Immunology*; 35: 331–333 c) Brian C. Louden *et al* (2011) Use of Blue Agar CAS Assay for Siderophore Detection. *Journal of Microbiology & Biology Education*; p. 51-53.

Sr. No.	Name of the Experiment	Learning objective*	Literature/ Weblinks for reference and videos
4.	To understand infection/disease progression and its control- a) *In vivo* colonization of pathogenic *E. coli* in *Caenorhabditis elegans* to study establishment of disease and its progression/ *In vitro* study of *E. coli* infection and its progression in suitable cell line (*HeLa*/ *Caco*-2/ *HT*-29). b) To study the control of infection using suitable antibacterial agents and study the recovery.		
5.	Common and rare skin diseases/disorders in a population (based on the cases in the outpatient unit of Department of Dermatology, DPU Medical College and Hospital)[#].	Understand the clinical presentation, pathogenesis, diagnosis and treatment of skin diseases/disorders in a population.	a) https://medlineplus.gov/magazine/issues/fall08/articles/fall08pg22-25.html b) http://www.healthline.com/health/skin-disorders c) Literature procured from the Department of Dermatology, DPU Medical College and Hospital.
6.	Metabolic and immune disorders in a population (based on the cases in the outpatient unit of Departments of Pathology and General Medicine, DPU Medical College and Hospital)[#].	Understand the clinical presentation, pathogenesis, diagnosis and treatment of metabolic/immune disorders	a) https://medlineplus.gov/metabolicdisorders.html b) https://medlineplus.gov/immunesystemanddisorders.html c) Literature procured from the Departments of Pathology and General Medicine, DPU Medical College and Hospital.

Sr. No.	Name of the Experiment	Learning objective*	Literature/ Weblinks for reference and videos
7.	Sexually transmitted diseases in a population (based on the cases in the outpatient unit of Department of Venereology, DPU Medical College and Hospital)#.	Understand the clinical presentation, pathogenesis, diagnosis and treatment of sexually transmitted diseases.	a) https://medlineplus.gov/sexuallytransmitteddiseases.html b) Literature procured from the Department of Venereology, DPU Medical College and Hospital.
8.	Clinical methods (eg: X-ray, CT scan etc.) used in diagnosis of common diseases (at the Departments of Radio-diagnosis, Pathology and Microbiology, DPU Medical College and Hospital)#.	Familiarize with the common clinical diagnostic methods.	a) http://www.who.int/topics/diagnostic_techniques_procedures/en/ b) Literature procured from the Departments of Radio-diagnosis, Pathology and Microbiology, DPU Medical College and Hospital.
9.	Study the implications of viral infections in the context of biomedical research (by visiting a research organization) #.	Familiarize with the biology of viruses, diseases caused and current research landscape.	a) https://medlineplus.gov/viralinfections.html b) Literature procured from the organization.
10.	Diagnosis of rheumatoid arthritis in patient samples by detection of C-reactive protein and its correlation with erythrocyte sedimentation rate (ESR)	Differentiate between sero-positive and negative types of rheumatoid arthritis.	Lars-Olof Hansson et al (1995) Measurement of C-reactive protein and the erythrocyte sedimentation rate in general practice. *Scand J Prim Health Care*; 13:1, 39-45.

Sr. No.	Name of the Experiment	Learning objective*	Literature/ Weblinks for reference and videos
11.	Alternative medicine strategies, e.g., the Ayurvedic system, in combating communicable and non-communicable diseases (at Dr. D. Y. Patil College of Ayurved & Research Centre, Pune)#	Familiarize with alternative systems of medicine like Ayurveda in treating diseases and compare with other alternative and mainstream systems of medicine.	a) Manohar, P.R. (2012) Clinical diagnosis in Ayurveda: Challenges and solutions. *Anc Sci Life*; 31: 149–150. b) Thakar, V.J. (1982) Diagnostic Methods in Ayurveda. *Anc Sci Life*; 1: 139-145. c) Literature procured from the Dr. D. Y. Patil College of Ayurved & Research Centre.
12.	Medical surveillance- a) To consider any one disease and study the symptoms that can help in understanding the disease progression. b) ICMR guidelines for control of hospital infections c) ICMR guidelines for diagnosis and management of any one disease		

*****The practical work in this subject act as a primer to the subject: Molecular Diagnostics in the subsequent semester of this course.
$ Non-pathogenic strains would be used for the experiment.
# Students are expected to take note on the practical carried out and the observations made during visit to the Medical College and Hospital or other research institutes/centres. Practical examination would involve questions based on what has been studied/demonstrated in these visits.

TITLE OF THE COURSE: MOLECULAR CELL SIGNALLING

COURSE CODE: MB 505 **L T P Hr C**

MARKS: 200 **3 1 0 4 4**

OBJECTIVE OF THE COURSE:

The objective of the course is to familiarize the students with the interactions between cells, the pathways and mechanisms of cellular communications.

LEARNING OUTCOME:

At the end of the course, the students will have sufficient scientific understanding of the cellular receptors, their types and their role in cell-cell interactions.

PREREQUISITES:

Since the course is an advanced level course, the student should have sufficient knowledge of enzymes, receptors, cellular transport and its machinery.

COURSE DESCRIPTION:

Sr. No.	Topic	Description	Hrs
1	Principal of cell signalling	Endocrine transmissions, Paracrine transmissions, Autocrine transmissions, Synaptic transmissions, types of signalling molecules,	01
2	Cell-cell recognition	Molecules involved in recognition, their functions and the mechanisms of recognition.	02
3	Cell-adhesion molecules	CAMs, their properties and types.	02
4	Concepts of receptors (extracellular, intracellular):	Receptor ligand interactions (concepts of agonist and antagonist) Receptor characterizations Receptor functions Extra cellular receptors, nuclear receptors, molecular switches, modular domain, types of signalling complexes, feedback loops	04
5	G-proteins coupled receptors	Structure and their function, cAMP, PKA, Inositol phospholiped signalling pathway, Ca^{2+} as intracellular mediator, Ca^{2+} oscillation, Calmodulin and CaM kinase, GPCR desensitization	06
6	Enzyme coupled receptors	RTKs, Ephrines, SH2 domain family, Ras proteins, Ras mediated MAP kinase signalling, Prevention of cross talk in Parallel MAP kinase, Rho family, PI3 kinase, JAK STAT pathway, TGG-β superfamily, chemotaxis in bacteria	06

7	Ion channel couples receptor	Ion channel couples receptor	04
8	Intercellular receptors	Steroid receptors, structure and function	02
9	Second messengers	Phosphoinositides, inositol1,4,5, tris phosphate, diacyl glycerol, camp, cGMP, arachidonic acid, prostaglandins and NO	06
10	Mechanism(s) of signal transduction	Coupling of activation receptors to intracellular signal transducing machinery; protein kinase(s) cascade	06
11	Receptor modifications, adaptation of cells.	Different structural and functional modifications in the receptors. Cellular adaptations.	03
12	Developmental abnormalities due to defective signalling pathways	Abnormalities during growth and development.	02
13	Signal transducing machinery as targets for potential drugs	Different molecules in cell signalling, action of drugs on them.	02
Total number of Lectures			46

METHODOLOGY:

The course would be taught through lectures and demonstrations.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

1) Genes VII by Lewin and Benjamin

2) Molecular cell biology by Lodish, Baltimore

3) Molecular Biology of the cell by Bruce Alberts

TITLE OF THE COURSE: GENOMICS, TRANSCRIPTOMICS & PROTEOMICS
COURSE CODE: MB 506 **L T P Hr C**
MARKS: 150 **3 1 2 6 5**

OBJECTIVE OF THE COURSE:

The objective of the course is to familiarize the students with Bioinformatics basics of sequence analysis and its application to life science research, bacteria and viruses, their structures, metabolism, diseases caused by bacteria and viruses and their control.

LEARNING OUTCOME

At the end of the course, the students will have sufficient scientific understanding of Sequence analysis, Genomics and Proteomics.

PREREQUISITES

Since the course is mid level in nature, so minimum Basics of Bioinformatics and good understanding of Biotechnology

COURSE CONTENT:

Sr. No.	***Topics***	***Detail syllabus***	***No. of Lectures***
1.	Biological basis of sequence analysis	Central Dogma of Bioinformatics. Applications of Sequence analysis	2
2.	Distance and similarity	Evolutionary basis for sequence alignment, Concepts for homology, analogy, Combinatorial problems.	4
3.	Information theory and applications	Introduction: Information theory and applications .Stochastic processes, Markov chains etc.	4
4.	Patterns, motifs, rules	Consensus in sequences, profiles in sequences, Pfam, PRINTS	4
5.	Predictive methods	Pattern searching, Evolutionary basis of sequence analysis, SMART, PRODOM	4
6.	Biodiversity and phylogenetic analysis	Maximum likelihood, Parsimony, Nearest neighbour methods ,Clustering and Clustering strategy etc.	4
7.	DNA and Genome sequencing	Sequence accuracy, Sequence Storage Sequence formats, sequence submission to sequence Database. Human genome project, Micro array analysis Sequencing entire genome	4
8.	Genome databases	The Institute of Genome Research (TIGR), GOLD etc. EnsEMBL	3
9.	Objective and overview of Genome Comparisons	Genome alignments, BLAST 2, MUMmer, PIPMAKER, VISTA,	2

10	Single Nucleotide Polymorphism	SNPs and its Applications , dbSNP and other SNP related databases	2
11	Comparative	Comparison of Gene Order, Comparative Genomics	2

	Genomics	and Comparative Genomics Databases	
12	Motif Databases	Types of motif databases, Programs used for motif Analysis, PSI-BLAST,	2
13	Overview of Proteomics	Experimental Techniques, 2D electrophoresis, Bioinformatics Approaches	2
14	Protein-Protein Interaction Networks databases and software	DIP (Database of Interacting Proteins), PPI Server, BIND- Bimolecular Interaction Network Database, PIM- Hybrigenics, PathCalling Yeast Interaction Database, MINT- a Molecular Interactions Database, GRID- The General Repository for Interaction Datasets , InterPreTS-protein interaction prediction through tertiary structure	2
15	Protein Structure Prediction	Methods to determine secondary and tertiary structure of protein	3
16	Computational resources and database for proteins	SCOP, NCBI, EMBL, PDB, Ensemble	2
		Total	46

METHODOLOGY

The course would be taught through lectures, demonstrations and practicals.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED

1) Introduction to Bioinformatics By T.K. Attwood & D.L. Parry-Smith
2) Bioinformatics By Arthur Lesk.
3) Instant notes in Bioinformatics
4) Fundamental Concepts of Bioinformatics By Krane & Raymer
5) Introduction to Bioinformatics By S. Sundara Rajan & R. Balaji.
6) Bioinformatics By Baxevanis
7) Discovering Genomics, Proteomics, and Bioinformatics by A. Malcolm
8) Applying Genomic and Proteomic Microarray Technology in Drug Discovery by Robert S.

Matson

9) Genomics, Proteomics and Vaccines by Guido Grandi , Guide to human genome computing by Bishop, MJ.

10) Computational methods in genome research by Suhai,S. Theoretical and computational methods in genome research by Suhai, S

Teaching hours per week and credits for practical : 2&1 respectively

Sr. No.	Name of the experiment	Learning objective	Literature/ Weblinks for reference and videos
1.	To determine genome size and genome complexity by Cot curve analysis.	To study % G+C content and repetitive DNA in a given sample	Molecular Cloning Sambrook J & Green MR 2016 Fifth edition CSHL
2.	To perform zoo Botting using a specific probe.	To investigate coding & non coding regions in the given zoo DNA samples	
3.	To carry out DNA sequence analysis from the available profile.	To identify different DNA elements in the given DNA sequence.	
4.	To analyse microarray & RNA-Seq data .	To learn expression profiling by microarray and RNA-Seq in the given genome/transcriptome data	
5.	To demonstrate 2-D gel electrophoresis, excision & preparation of protein spot for mass spectrometry.	To resolve total set of proteins present in a mixture and identify proteins using mass spectrometry.	Proteomics in Practice: A guide to successful experiment design Reiner Westermeier ,Tom Naven Hans-Rudolf Hopkin Edition II Wiley -VCH
7.	To perform co-immunoprecipitation technique to determine protein-protein interaction.	To study proteins undergoing interaction.	
8	Predicting possible microRNAs targeting the gene of interest.	Learn to look for target microRNAs by genome-wide scanning.	http://www.targetscan.org/vert_71/, http://mirdb.org/ and http://www.exiqon.com/microrna-target-prediction

SEMESTER VI

MB 601	Biomedical Devices and Instruments	3	0	4	7	5
MB 602	Biosensor and Artificial Organs.	3	1	0	4	4
MB 603	Health Care Law Management	3	1	0	4	4
MB 604	Molecular Diagnostics	3	0	4	7	5
MB 605	Metabolic Engineering and Systems Biology	3	0	4	7	5
MB 606	Nanomedicine	3	0	4	7	5
	Total	**18**	**2**	**16**	**36**	**28**

TITLE OF THE COURSE: BIOMEDICAL DEVICES & INSTRUMENTS

COURSE CODE: MB 601 **L T P Hr C**

MARKS: 200 **3 0 4 7 5**

OBJECTIVE:

The objective of the course is to familiarize the students with various modern biomedical equipments.

LEARNING OUTCOME:

At the end of the course, the students will understand basic principle and use of various equipments used in clinics.

PREREQUISITES:

Students must have basic knowledge of physics and electronics as well understanding of human anatomy and physiology.

COURSE DESCRIPTION:

Seq. No.	Topic	Description	Hrs
1	**BIOELECTRIC SIGNALS AND ELECTRODES**	Action Potential and Resting Potential - Electrodes for ECG, EEG, EMG – Electrode – Electrolyte Interface – Half Cell Potential – Bioelectric Amplifiers – Isolation Amplifiers – Optically Coupled and Transformer Coupled Isolation Amplifier	**8**
2	**CARDIAC ACTIVITY MEASUREMENT SYSTEM**	ECG, sources of ECG, normal and abnormal waveform, diagnosis interpretation – ECG Leads – ECG Recorder – Blood Flow measurement – Blood Pressure Measurement – Cardiac Output Measurements – Phonocardiography – Vector Cardiography.	**6**
3	**RESPIRATORY SYSTEM MEASUREMENTS**	**:** Mechanics of Breathing – Parameters of Respiration – Respiratory Volume Measurement – Impedance Pneumograph – Spirometers – Respiratory Gas Analyzers – Oxygen Therapy – Intermittent Positive Pressure Breathing Therapy – Ventilators - Types	**8**
4	**DIAGNOSTIC EQUIPMENTS:**	Patient Monitoring Systems – Bedside Monitors – Central Monitors – Measurement of heart rate, respiration rate and temperature – Audiometers – Endoscopy – Thermography.	**4**
5	**INSTRUMENTATION FOR MEASURING BRAIN FUNCTION**	**:** EEG Signal Amplitudes and frequency bands – EEG Machine – Visual and auditory evoked potential recordings – Electroencephalography – CT scan – MRI scan	**4**
6,	**BIOMEDICAL IMAGING**	Radiography, Magnetic Resonance Imaging (MRI), Nuclear medicine, Ultrasound, Elastography, Tactile Imaging, Photoacoustic imaging, Thermography, Tomography,	**8**

		Echocardiography	
7	**PATIENT SAFETY INSTRUMENTATION**	**:** Electric Shock Hazards – Microshock – Macroshock – Leakage Currents – Types of Leakage currents – Precautions to minimize Electric Shock Hazards – Methods to reduce leakage current – Test equipments for checking safety parameters of	**8**

		biomedical equipments.	
Total number of Lectures			**46**

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

TEXT BOOK:

1. Joseph J Carr and John M Brown, "Introduction to Biomedical Equipment Technology", John Wiley & Sons, New York, 1997.
2. John G Webster, "Medical Instrumentation Application and Design", John Wiley & Sons, New York, 1998.
3. Khandpur R S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 1997.

REFERENCES:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 1997
2. Joseph J Carr and John M Brown, "Introduction to Biomedical Equipment Technology", John Wiley & Sons, New York, 1997.
3. US Patents website, www.freepatentsonline.com.

PRACTICALS IN BIOMEDICAL DEVICES LABORATORY (4 Hrs. Per Week)
MARKS : 100

LIST OF EXPERIMENT

1) Study of Biological Preamplifiers.
2) Measurement of BP, heart sounds using Electronic Stethoscope and Analysis.
3) Determination of Pulmonary function using Spirometer.
4) Measurement of Respiration rate using Thermistors / other electrodes.
5) Measurement of Pulse rate using Photo electric transducer.
6) ECG Recording and Analysis.
7) EEG Recording and Analysis.
8) EMG Recording and Analysis.
9) Study of Phonocardiograph
10) Multichannel data acquisition system.
11) X-Ray Image Acquisition and Analysis
12) MRI Image Acquisition and Analysis
13) CT Scan Image Acquisition and Analysis
14) Ultra sound Image Acquisition and Analysis
15) Blood Flow Measurement Using Doppler Unit
16) Audio Measurement and Analysis.
17) Study of Dialyser and Diathermy.
18) Study of Pacemaker and Defibrillator
19) Measurements Using Patient Monitoring Systems
20) Real time Biomedical signal Acquisition and processing

EVALUATION SCHEME (PRACTICAL)

Examination	**Duration**	**Marks**
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

REFERENCES:

1. Joseph J Carr and John M Brown, “Introduction to Biomedical Equipment Technology”, John Wiley & Sons, New York, 1997
2. Laboratory Manual prepared by Department of Biomedical Engineering.

TITLE OF THE COURSE: BIOSENSOR AND ARTIFICIAL ORGANS.

COURSE CODE: MB 602 **L T P Hr C**

MARKS: 100 **3 1 0 4 4**

OBJECTIVE OF THE COURSE:

The objective of the course is to familiarize the students with advanced research area and basic concept in biosensors and artificial organs

LEARNING OUTCOME

At the end of the course, the students will have sufficient scientific understanding of different types of biosensors and artificial organs.

PREREQUISITES

Students should have basic human anatomy and physiology

COURSE DESCRIPTION:

Sr. No.	Topic	Description	Hrs
1	**INTRODUCTION TO BIOSENSORS**	History of biosensors, Role of enzymes, enzyme action in biosensors, introduction to biosensor instruments.	**3**
2	**BIOSENSORS PROPERTIES**	Principles in various biosensors, characteristics of best biosensors-transducer importance.	**4**
3	**BIOSENSORS-TYPES**	Calorimetric biosensor, Potentiometric biosensor, amperometric biosensors, optical biosensors, Piezo-electric biosensors, Immunosensors.	**3**
4	**ARTIFICIAL ORGANS:**	Introduction, Substitutive medicine, outlook for organ replacement, design consideration, evaluation process	**6**
5	**ARTIFICIAL HEART AND CIRCULATORY ASSIST DEVICES**	**:** Engineering design of artificial heart and circulatory assist devices, Cardiac Valve Prostheses: Mechanical valves, tissue valves, current types of prostheses, tissue versus mechanical, engineering concerns and haemodynamic assessment of prosthetic heart valves, implications for thrombus deposition, durability, current trends in valve design.	**8**
6	**ARTIFICIAL KIDNEY**	kidney disease, renal failure, renal transplantation, changes in the body fluids in renal disease, artificial kidney, dialysers, membranes for haemodialysis, haemodialysis machine, portable kidney machine, peritoneal dialysis equipment-therapy format, fluid and solute removal, peritoneal membrane physiology and transport properties.	**8**
7	**ARTIFICIAL LUNGS:**	Cardiopulmonary bypass (heart-lung machine) - principle, block diagram and working, artificial lung versus natural lung. Tracheal replacement devices, laryngeal replacement devices,	**8**

		artificial oesophagus Liver Functions: hepatic failure, liver support systems, general replacement of liver functions.	
8	**ARTIFICIAL BLOOD,**	Artificial oxygen carriers, fluorocarbons, haemoglobin for oxygen carrying plasma expanders, haemoglobin based	**8**

	PANCREAS, SKIN	artificial blood. Structure and functions of pancreas, endocrine pancreas and insulin secretion, diabetes, insulin, insulin therapy, insulin administration systems. Vital functions of skin, current treatment of massive skin loss, design principles for permanent skin replacement	
		Total Lecture	**48**

METHODOLOGY

The course would be taught through lectures, demonstrations and practicals.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

1. **Biosensors: Fundamentals and applications, Oxford, U.K: Oxford University Press by Turner, A.P.F., Karube, I. & Wilson, GS**
2. Bronzino J.D., "Biomedical Engineering Handbook", CRC Press / IEEE Press, Volume2 (2nd Edition), 2000.

REFERENCES BOOKS:

Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill Publishing Company Ltd, New Delhi, 2005.

Park JoonBu, "Biomaterials Science and Engineering", Plenum Press, 1990

TITLE OF THE COURSE: HEALTH CARE LAW AND MANAGEMENT

COURSE CODE: MB 204	**L**	**T**	**P**	**Hr**	**C**
MARKS: 100	**3**	**1**	**0**	**4**	**4**

OBJECTIVE OF THE COURSE:

The objective of the course is to develop management skills among students focusing healthcare services.

LEARNING OUTCOME

The course would enable the student to understand the management aspect of healthcare services and clinical oriented research.

PREREQUISITES

Since the course is very basic in nature, there are no prerequisites.

COURSE DESCRIPTION

Sr. No.	**Topic**	**Description**	**Hrs**
1.	Overview	Need of management, organizational hierarchy, management definition, function and competencies.	4
2.	Strategic planning	Purpose and importance of planning, SWOT analysis, strategy identification and selection, rollout ad implementation, strategy execution, role of health care manager	6
3.	Healthcare marketing	Marketing basics, history of marketing I health care, the strategic marketing management, healthcare buyer behaviour,	4
4.	Quality improvement basics	Defining quality in health care, why quality is important, key leaders in quality improvement, common elements and tools in quality improvement	5
5.	Use of information technology	Use of information system by managers, the electronic medical record, challenges to clinical system adaptation,	4
6.	Financing health care and insurance	Introduction and history of health insurance, characteristic of health insurance, social insurance, coverage and costs, uninsured	4
7.	Managing cost and revenue	financial management definition and importance, financial governance, reimbursement from third party, controlling cost and accounting, setting charges; managing working capital, account receivable, material and inventory, budget,	6
8.	Managing healthcare professionals	Physicians and nurses, home health aids, midlevel practitioners, allied health professionals,	3
9.	Fraud and abuse	Defining fraud and abuse, emergency medical	4

		treatment, antitrust issue, corporate compliance program	
10.	Helathcare law	Human materials, organ and tissue procurement, laws related to procurement and sell of body parts.	3

11.	Reproductive law	Laws for Sell and procurement of ovum and sperms, abortion, and contraception	3
		Total	46

METHODOLOGY

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

RECOMMENDED BOOKS :

1. Introduction To Health Care Management, Sharon B. Buchbinder, Nancy H. Shanks, **Publisher:** Jones & Bartlett Learning; 2 edition, **ISBN-13:** 978-0763790868
2. Management Principles for Health Care Professionals, Fourth Edition, Joan Gratto Liebler, Charles McConnell, **Publisher:** Jones and Bartlett Publishers, Inc.; 4 edition, **ISBN-13:** 978-0763733209
3. Health Care Management and the Law: Principles and Applications: Principles and Applications, by Donna K. Hammaker, Cengage Learning, 2010
4. Introduction to Health Services Stephen Joseph Williams, Paul Roger Torrens Cengage Learning, 2007

TITLE OF THE COURSE: MOLECULAR DIAGNOSTICS

COURSE CODE: MB 204	**L T P Hr C**
MARKS: 200	**3 0 4 7 5**

OBJECTIVE OF THE COURSE:

The objective of the course is make aware students about the various medical diagnostic techniques and their use in diagnosing various disorders in humans.

LEARNING OUTCOME :

The course would enables the student to understand various medical diagnostic techniques.

PREREQUISITES :

Since the course is advance in nature, knowledge of anatomy, physiology, and cytology is a required.

COURSE DESCRIPTION :

Sr. No	Topic	Description	Hrs
1.	Understanding disorders	Biochemical disorders, Immune disorders Infectious diseases, Parasitic diseases, Genetic disorders chromosomal disorders, single cell disorders and complex traits	8
2.	Chromosomal disorder diagnosis	autosomal; sex chromosomal; karyotype analysis. G-banding, in situ hybridization (FISH and on-FISH), and comparative genomic hybridization (CGH).	8
3.	Cancer cytogenetics	Sspectral karyotyping	2
4.	DNA diagnostics	PCR based diagnostics; ligation chain reaction, southern blot diagnostics, array-based diagnostics, DNA sequencing, genetic profiling, single nucleotide polymorphism.	9
5.	Diagnosis of certain disorders	Haemoglobinopathies. Neuro developmental disorders. Neuro degenerative disorders. Dynamic mutations.	5
6.	Biochemical diagnostics	inborn errors of metabolism, haemoglobinopathies, mucopolysaccharidoses, lipidoses, and glycogen storage disorders.	6
7.	Immunodiagnostics:	diagnosis of infectious diseases, respiratory diseases (influenza, etc.)Viral diseases-HIV etc., bacterial diseases, enteric diseases, parasitic diseases and mycobacterium diseases. Phage display, immunoarrays, FACs.	8
		Total	46

METHODOLOGY

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME (THEORY)

Examination	Duration	Marks
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

RECOMMENDED BOOKS

Molecular Diagnostics: Fundamentals, Methods, & Clinical Applications, Maribeth L. Flaws Ph.d , Lela Buckingham Publisher: F A Davis Co;

Molecular Diagnostics: Techniques and Applications for the Clinical Laboratory Wayne W. Grody, Robert M. Nakamura, Frederick L. Kiechle, Charles Strom, Publisher: Academic Press;
ASIN: B003FQM2OI

PRACTICALS IN MOLECULAR DIAGNOSTICS **(4 Hrs. Per Week)**
MARKS : 100

LIST OF EXPERIMENTS:

1) G-banded chromosomal preparations for detection of autosomes of autosomal /sex chromosomal disorders. (Translocation, deletion, Down‟s syndrome, Klumefelter, syndrome, Turner‟s syndrome, etc.)
2) FISH for detections of : translocations, inversions (using appropriate probes) (e.g., chro 9-22 translocation; X-Y translocation)
3) PCR bases diagnosis (e.g. fragile-X syndrome; SRY in sex chromosomal anomalies). Southern blot-based diagnosis (e.g. trinucleoide expansions in fragile-X syndrome, SCA, etc.) DNA sequencing of representative clones to detect mutation(s)
4) PCR-SSCP to detect mutations (e.g., sickle cell anaemia, thalassemia) SNP analysis for known SNPs.
5) PAGE: band detection of enzyme variants. Immunodiagnostics.
6) Production of monoclonal antibodies. Immunogenetics of mice-fusion of myeloma cells.

EVALUATION SCHEME (PRACTICAL)

Examination	**Duration**	**Marks**
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

TITLE OF THE COURSE: CELL BIOLOGY

COURSE CODE: MB 605 **L T P Hr C**

MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

The objective of the course is to familiarize the students with the Metabolic Engineering and Systems Biology

LEARNING OUTCOME:

At the end of the course, the students will have sufficient scientific understanding of the Metabolic Engineering and Systems Biology

PREREQUISITES:

Since the course is an advanced level course, the student should have sufficient knowledge of biochemistry, organic chemistry, mathematics, statistics and computer.

COURSE DESCRIPTION:

Sr. No.	Topic	Description	Hrs
1	Course Description	Learning the basic biochemical concepts of metabolic pathways Understanding the role of Bioinformatics in the study of metabolic pathways Learning the Bioinformatics-based approaches for predicting and engineering metabolic pathways Classification of Enzymes Classification of Metabolic Pathways	8
2	Metabolic Pathway database	KEGG, EMP, Malaria Parasite Metabolic Pathways, ECoCYC aetaCyc Boerhringer Mannheim- Biochemical Pathways	4
3	Enzymes, Compounds and Reaction databases	LIGAND-Biochemical Compound and Reaction ENZYME-Enzymes BRENDA- Comprehensive Enzyme Information System Full Genome Annotation through knowledge of Metabolic Pathways Organism Specific Metabolic Pathways Comparison of Metabolic Pathways Engineering of Metabolic pathways Representation of Metabolic Pathways Generation and Dynamic Representation of Metabolic Pathways Knowledge	8

		Deriving Common Principles from the Metabolic Pathways knowledge	
4	Modelling biochemical systems	Michaelis-menten kinetics, substrate inhibition, generalized mass action kinetics, systems	6

		equations, kinetics and models of biological systems, tools and formats of modelling,	
5.	Model fitting	Parameter estimation, reduction and coupling of models, model selection	4
6.	Analysis of high throughput data	High throughput experiments, analysis of gene expression data, gene expression models	4
7.	Stochastic systems and variability	Stochastic modelling of biochemical reactions, fluctuation in gene expression, variability and uncertainty, robustness,	6
8.	Network structure	Structure of biochemical networks, networks, modularity, optimality, evolutionary game theory,	6
		Total	46

METHODOLOGY:

The course would be taught through lectures and demonstrations.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

1. Metabolic engineering edited by Sang Yup Lee and Deleterious T. Papoutsakis
2. Metabolic engineering - Principles and Methodologies by Gregory N. stephanopoulos, Aristos A. Ariostidou and Jens Nielsen.
3. Systems Biology, Edda Klipp, Wolfram Liebermeister, Christoph Wierling , Axel Kowald, Hans Lehrach, Ralf Herwig, *Publisher: Wiley-Blackwell; ISBN-13: 978-352731874*

TITLE OF THE COURSE: LABS IN METABOLIC ENGINEERING (4 Hrs. Per Week)

OBJECTIVE:

Objective of course is to familiarize the students with practical aspects of enzymes like calculation of activity, specific activity and kinetic parameters etc.

LEARNING OUTCOME:

At the end of the course, the students will be able to study & correlate and compare the activity and kinetic properties of enzymes from same class and from same physiological source. It will also help to understand basic aspects of metabolic engineering.

PREREQUISITES:

This is a basis course regarding study basic enzymology and metabolic engineering.

COURSE DESCRIPTION

Sr. No.	Topics	No. of Lectures
1	Estimation of specific activity of salivary α-amylase .	04
2	Estimation of specific activity of fungal amylase from Neozyme tablets. Comparison of activities of salivary & fungal amylase.	04
3	Estimation of specific activity of salivary β-amylase from sweet potato.	04
4	Determination of acrolic point of amylases.	04
5	Estimation of specific activity of acid phosphatase from germinated pea seeds.	04
6	Estimation of specific activity of alkaline phosphatase from germinated Bengal gram seeds	04
7	Estimation of specific activity of protease (Neozyme tablets)	04
8	Determination of proteolytic activity from serratia peptidase	04
9	Determination of optimum PH & temperature of amylases.	04

METHODOLOGY

The course will be covered through practical work supported by Laboratory work. Students would be made to achieve skills in practical aspects regarding enzymes. They would be taught how to correlate the rhetorical & practical aspects of enzymology & metabolic engineering.

EVALUATION SCHEME (PRACTICAL)

Examination	Duration	Marks
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

TITLE OF THE COURSE: NANOMEDICINE

COURSE CODE: MB 606 **L T P Hr C**

MARKS: 200 **3 0 4 7 5**

OBJECTIVE:

The objective of the course is to create general understanding amongst the students in the subject of Core nanotechnology and its applied parts Nanomedicine through in-depth lectures & laboratory practicals. The objective of the course is to understand them a general overview, concepts and basic principles in the subject of Nanomedicine with emphasis for project in the field of nanotechnology.

LEARNING OUTCOME:

At the end of the semester, it is expected that students understood the basic principles of core nanotechnology and Nanomedicine. It is expected that they will be more confident to use the basic knowledge for their short term projects during the semesters.

PRE-REQUISITES:

This is an advanced level course. Students are expected to have an understanding of introductory knowledge in Physical science, material science, polymer science, micro-fabrication, organic and synthetic chemistry, and molecular biology.

COURSE DESCRIPTION

S. No	Topic	Description	Hrs
1	**Introduction and Basics**	Basics of nanotechnology, nanomaterials and nanoparticles, nanotools,	**2**
2.	**Nanoparticles in cancer therapeutics**	Nanoparticles and hyperthermal ablation, targeting nanoparticles for tumour ablation, in vivo anticancer platform delivery	**4**
3	**Nanofiber based scaffolds ad tissue engineering**	Composition and types of nanofiber, synthesis of nanofiber, application of nanofibers in tissue engineering, nanofibers in controlled drug delivery,	**6**
4	**Nanotechnology in neuroscience**	Nonmaterial scaffolds and neurogeneration, neuroprotection by nonmaterial, .	**8**
5	**Nanotechnology and surgery**	Implant and surgical instrument design, nonplusses, Nanocoatings, laser assisted nanosutures, nanofiber based bandage, intracellular nanosurgery	**6**
6	**Nanomaterials for cell culture**	2D and 3D cell cultures, synthetic and natural nanofiber scaffolds, cellularisation of nanofiber,	**5**
7	**Nanoparticles based drug delivery**	Targeted drug delivery basics, nanoparticles for drug delivery, types of nanoparticles based drug delivery systems,	**6**
8	**Nanodiagnostics**	*In vitro* nanodiagnostics− nanobiochips and nanobiosensors, cantilever biosensors, nanoproteomics In vivo nanodiagnostics− gold nanoparticles, nanotubes, quantum dots,	**8**
		Total Lecture	**45**

EXAMINATION SCHEME (THEORY)

Examination	Duration	Marks
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

Books recommended:

1) Understanding Nanomedicine: An Introductory Textbook, Rob Burgess, Publisher: Pan Stanford Publishing; ISBN-13: 978-9814316385
2) Bionanotechnolgy: Lesson from Nature, David S. Goodsell, Willey-Liss, First edition, 2004
3) Nanoscale technology in Biological Systems by Ralph Creco, Fritz Prinz and R. Lane Smith; CRC Press, First edition, 2005.
4) Nanobiotechnology: Concepts, applications and Perspectives, Christof M. Niemeyer (editor), Clad AMirkin (Editor), Wiley VCH, First edition, 2004.
5) Nanobiotechnology: Bioinspired Devices and Material of Future by OdedShoseyov and Ilan levy, Human Press, First edition, 2007.
6) Nanobiotechnology protocols (Methods in Molecular biology) by Sandra J Rosenthal David W. Wright, Human Press, First edition, 2005
7) The Nanobiotechnology Handbook, YubingXie, CRC press,
8) Introduction to Nanoscience, S.M. Lindsay, Oxford universal Press, First Edition, 2010 Nanotechnology: Understanding small system, Ben Rogers, SumitaPennathur and Jesse Adams, CRC Press, Second edition, 2011
9) Introduction to Nanotechnology, Charles Poole and Frank Owen, Wiley, First Edition, 2006 Nanocomposites Science and Technology Pulickel M. Ajayan, Linda Schadler, Paul Braun, Wiley-VCH Verlag, 2003.

PRACTICAL IN NANOMEDICINE **(4 Hrs. Per Week)**
MARKS: 100

LIST OF EXPERIMENT

1. Preparation of silver nanoparticles by chemical methods.
2. Characterisation of ZnS nanoparticles by using bacteria.
3. Biological synthesis of silver nanoparticles using plant extract.
4. Study of antimicrobial activity of silver nanoparticles.
5. Protein tagging of nanoparticles.
6. Internalization of nanoparticles in mammalian cells.
7. Synthesis of quantum dots.
8. Drug attachment to nanoparticles.
9. DNA attachment to nanoparticles.
10. Characterization of silver nanoparticles by SEM /TEM (Demonstration)

EVALUATION SCHEME (PRACTICAL)

Examination	**Duration**	**Marks**
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
Total		**100**

SEMESTER VII						
MB 701	Clinical Trials	3	1	0	4	4
MB 702	Forensic Biotechnology	3	0	4	7	5
MB 703	Molecular Basis of Drugs	3	1	0	4	4
MB 705 / MB 706	Elective 1	3	1	0	4	4
MB 707 / MB 708	Elective 2	3	1	0	4	4
MB 704	Seminars in Medical Biotechnology	3	1	0	4	4
Total		**18**	**5**	**4**	**27**	**25**
Elective 1 : (MB 705 : Vaccine Technology), (MB 706 : Personalized Medicine)						
Elective 2 : (MB 707 : Biomimetics), (MB 706 : Biomechatronics)						

TITLE OF THE COURSE: CLINICAL TRIALS

COURSE CODE: MB 701 **L T P Hr C**

MARKS: 100 **3 1 0 4 4**

OBJECTIVE OF THE COURSE:

The objective of the course is to prepare students competent in the field of clinical research and clinical trial. The aim of the course is to make students aware about designing and executing clinical trials.

LEARNING OUTCOME:

At the end of the semester it is expected that student must be capable to design, execute and interpret data of clinical trials.

PREREQUISITE:

This is an introductory course and there is no prerequisite.

COURSE DESCRIPTION

Sr. No.	Topic	Description	Hrs
1	**Introduction to clinical trials and Ethical issues**	Introduction to clinical trial, Clinical Trial phases, Study protocol, Planning, designing, conducting and reporting a trial.	5
2	**Design of the study**	Selection of question, defining study population, randomized and nonrandomized control trials, database, cross-over, factorial, group allocation, and hybrid design, masking principals and procedures	8
3.	**Randomization process and blindness**	Types and mechanics of randomization. Types of blindness in trials and methods of protecting blind design , bias control procedures, stratification, variance control	5
4.	**Sample size, participants and treatment**	Study group, comparison group, Response variables, sample size calculation, understanding baseline, recruiting participants, placebo treatment, sham treatment, control treatment	5
5.	**Data collection and quality control**	Quality monitoring of the data, minimizing poor quality data	2
6.	**Adverse effect and health**	Determination, analysis, and reporting adverse effect; assessment of health related quality of life.	4
7	**Adherence and survival**	Adherence monitoring, estimation and comparison of survival curves.	4
8.	**Data analysis**	Data analysis, competing events, covariance adjustment, subgroup analysis, cutpoints, meta- analysis,	4
9.	**Closeout**	Termination of the trial, procedure of termination, post study follow up, evaluation of the trial	3
10	**Reporting and interpretation of**	Reporting a trial, interpretation and publication bias, comparing results between studies, clinical implication of the	8

	results	findings, multicenter trials, globalization of trials	
Total No. of Lecturer			**48**

METHODOLOGY

The course would be covered through lectures, supported by quizzes and case history discussion. A participation in ongoing clinical trial will help their understanding. The students will be evaluated based pm twp class test, lecture attendance, class participation, Write-up and power point presentation.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

Fundamentals of clinical trials, by Friedman, LM; Furberg, CD; Demets, DL; 2010. ISBN 978-1-4419-1585-6, Publisher Springer

Clinical Trials Handbook: Design and Conduct, Cutis L. Meinert, ISBN 978-1-1182-1846-4, Publisher Wiley

TITLE OF THE COURSE: FORENSIC BIOTECHNOLOGY

COURSE CODE: MB 702 **L T P Hr C**

MARKS: 200 **3 0 4 7 5**

OBJECTIVE OF THE COURSE:

The objective of the course is to develop insight of Forensic Biotechnology with respect to various modern forensic techniques. The course is well equipped to deal with branches of Forensic Biotechnology.

LEARNING OUTCOME:

The course would enable the student to understand various aspects of Forensic Biotechnology such as use of DNA in establishing human identity.

PREREQUISITES:

Since the course is advance in nature knowledge in biochemistry, genetics & molecular biology is essential to take the course.

COURSE DESCRIPTION:

Sr. No	Chapter	Description	Hours
1.	Introduction	Scope of forensics History of forensics Services offered by crime labs	2
2.	Nature of Physical Evidence	Recognizing types of physical evidence Collecting and storing physical evidence Keeping careful records,	4
3.	Forensic Anthropology Mini-unit	Names of major human bones Identifying skeletal remains and forensic anthropology	4
4.	Drugs	Commonly used drugs and their effects on the human body Chemical tests, chromatography, & spectrophotometer	4
5.	Forensic Toxicology	Alcohol & it relationship to human anatomy & metabolism Testing for drugs and poisons using pH. TLC, immunoassay, & chemical tests	4
6.	Forensics and the Law (Preparing for Mock Trial)	Types of laws Types of crimes Court proceedings	4
7.	Forensic Serology	ABO blood types & their inheritance Testing for blood using gel diffusion, Kastle-Meyer, & luminal, Analysis of blood stain patterns Testing for other bodily fluids	5
8.	DNA : Typing	Review of DNA structure, DNA Samples, DNA isolation	4
9.	DNA analysis	DNA analysis using PCR, restriction enzymes, RFLP analysis, and STR analysis, Use of mDNA	6
10.	Interpreting DNA typing results	Complicating factors, multiple contributors, Extraneous substances, system specific interpretational issues, DNA bank.	5

11.	Fingerprints	Detection & analysis of fingerprints	4
Total No. of Lecturer			**46**

METHODOLOGY:

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME (THEORY) :

Examination	Duration	Marks
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

RECOMMENDED BOOKS:

1. An Introduction to Forensic DNA Analysis, First Edition [Paperback], Norah Rudin and Keith Inman, **Publisher:** CRC Press; **ISBN-13:** 978-0849381171
2. Fundamentals of Forensic DNA Typing, by John M. Butler **Publisher:** Academic Press; **ISBN-13:** 978-0123749994

Teaching hours per week and credits for practicals: 4hrs per week and 2 credits

Sr. No	Name of Experiment	Learning objective
1.	Isolation of genomic DNA from body fluid of different individuals and comparing the band pattern after restriction digestion	To study genetic dissimilarities between individuals
2.	Amplification of DNA from body sample	To learn to amplify genomic DNA from unknown sources
3.	Testing of drug from individual body fluid by using pH/ chemical tests	To identify presence of drug in body fluid using chemical method.
4.	Testing of drug from individual body fluid by using TLC/ immunoassay	To identify presence of drug in body fluid using chromatography/immunological assays.
5.	Testing of poison from individual body fluid using pH/ chemical tests	To identify presence of poison in body fluid using chemical method.
6.	Testing of poison from individual body fluid by using TLC/ immunoassay	To identify presence of poison in body fluid using chromatography/immunological assays.
7.	Crossover Electrophoresis for Species Determination	To determine the species origin of bloodstains and tissues
8.	Hair microscopy	To study hair sample of different origin
9.	Blood stain pattern analysis	To study and analysis of bloodstains at a known or suspected violent crime scene with the goal of helping investigators draw conclusions about the nature, timing and other details of the crime
10.	Field trip	

TITLE OF THE COURSE: MOLECULAR BASIS OF DRUGS

COURSE CODE: MB 703	**L**	**T**	**P**	**Hr**	**C**
MARKS: 200	**3**	**0**	**4**	**7**	**5**

OBJECTIVE OF THE COURSE:

The objective of the course is to develop and teach the concept and technology behind rational drug designing and physiology involved i drug action.

LEARNING OUTCOME

The course would enables the student to understand the drug designing and physiology involved in drug action.

PREREQUISITES

Since the course is advance in nature. knowledge in immunology, cell and molecular biology, and chemistry is required.

COURSE DESCRIPTION

Sr. No.	Topic	Description	Hrs
1.	Rational Drug Design	Structure activity relationships in drug design, Molecular modelling, Molecular docking and dynamics, Electronic structure methods and quantum chemical methods, De novo drug design techniques and Informatics methods in drug design.	6
2.	Fundamental of Drug Actions:	Inter and intramolecular interactions: Weak interactions in drug molecules; Chirality and drug action; Covalent, ion, ion-dipole, hydrogen bonding, C-H hydrogen bonding, dihydrogen bonding, van der waals interactions and the associated energies. Cation-and-OH interactions. Receptorology : Drug-receptor interactions, receptor theories and drug action; Occupancy theory, rate theory, induced fit theory, macromolecular perturbation theory, activation-aggregation theory. Topological and stereochemical consideration.	8
3.	Drug development	Introduction, nature and components of drug development	4
4.	Targets and receptors	Process of drug discover, needs of new drugs, target identification and validation, drug interaction with targets and receptors, enzymes as target, assay development	4
5.	Drug Discovery: Small molecule drug	Irrational and rational approach, antisense approach, RNA interference approach, chiral drugs	4
6.	Drug Discover: Large molecules	Vaccine, antibodies, cytokines, hormone,	2

7.	Targets and receptors	Process of drug discover, needs of new drugs, target identification and validation, drug interaction with targets and receptors, enzymes as target, assay development	4
8.	Pharmacological Screening and	General principles of screening, correlations between various animal models and human situations.	7

	Assays :	Pharmacological screening models for therapeutic areas. Correlation between in-vitro and in-vivo screens; Special emphasis on cell-based assay, biochemical assay, radiological binding assay, high through put screening, specific use of reference drugs and interpretation of results.	
9.	Regulatory Aspects:	Drug Laws, FDA, OECD, ICH, Schedule Y, Design non clinical toxicity studies and clinical development, clinical risk/benefit analysis. Drug registration : Regulatory affairs, WTO, Patent regime, Accreditation and harmonization process. Regulations of human pharmaceuticals and biological products.	7
Total No. of Lecture			**46**

METHODOLOGY

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

RECOMMENDED BOOKS

1. New Drug Development, Design, Methodology and Analysis. J. Rick Turner, Wily Interscience, ISBN 978-0-470-07373-5
2. Introduction to the principles of Drug design and Action, Ed. H. John Smith, Harwood Academic Publishers, ISBN 90-5702-037-8

TITLE OF THE COURSE: SEMINARS IN MEDICAL BIOTECHNOLOGY
COURSE CODE: MB 704 **L T P Hr C**
MARKS: 100 **3 1 0 4 4**
Elective 1

TITLE OF THE COURSE: VACCINE TECHNOLOGY
COURSE CODE: MB 705 **L T P Hr C**
MARKS: 100 **3 1 0 4 4**

OBJECTIVE OF THE COURSE:

The objective of the course is to develop teach the concept and technology behind vaccine production and development.

LEARNING OUTCOME:

The course would enables the student to understand the technology involved in discovery and development of new vaccine.

PREREQUISITES :

Since the course is advance in nature. knowledge in immunology, cell and molecular biology is required.

COURSE DESCRIPTION:

Sr. No	Topic	Description	Hrs
1.	Introduction	Concept and scope of modern vaccine	2
2.	Principles of vaccine design	Stimulation of innate immunity, antigen processing, mucosal immune system, immunological memory, mouse and primate as model for vaccine design	8
3.	Antigen discovery	Computational approach for vaccine discovery and design, high throughput proteomic screening, phage library	6
4.	Antigen Engineering	Attenuated bacteria vaccine, antigen scaffold, recombinant MVA vaccine, adenovirus, avipoxvirus, cancer immunotherapy, nucleic acid vaccination. Artificial antigen presenting cells	10
5.	Delivery systems	Vaccine patch deliver system, needle free jet injection system, oral vaccine. Adjuvants.	6
6.	Evaluating vaccine efficacy	Immune monitoring design, clinical developmental strategy	6
7.	Implementing immunizations	Mass immunization strategy, mathematical models, vaccine safety	6
		Total	44

METHODOLOGY

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

RECOMMENDED BOOKS

1. Vaccinlogy: Principles and Practice. By (Ed) W W. John W. Morrow (Editor), Nadeem A. Sheikh (Editor), Clint S. Schmidt (Editor), D. Huw Davies (Editor), ISBN-13: **978-1405185745,** Wiley-Blackwell;
2. Development of Vaccines: From Discovery to Clinical Testing, Manmohan Singh (Editor), Indresh K. Srivastava (Editor), **Publisher:** Wiley; **ISBN-13:** 978-0470256374

TITLE OF THE COURSE: PERSONALIZED MEDICINE

COURSE CODE: MB 706 **L T P Hr C**

MARKS: 100 **3 1 0 4 4**

OBJECTIVE OF THE COURSE:

The objective of the course is to develop insight of Personalized medicine In relation to cancer treatment.

LEARNING OUTCOME

The course would enables the student to understand the implications of Personalized medicine in cancer treatment.

PREREQUISITES

Since the course is advanced in nature knowledge of molecular biology, genetic engineering ad genetics is required.

COURSE DESCRIPTION

Seq. No	*Topic*	*Description*	*Hrs*
1.	Introduction	Genes to personalized medicine. Genetic variations in personalised medicine, polymorphic genetic variations.	4
2.	Nuclear transplantation	Introduction of nuclear transplantation, techniques in nuclear transplantation, genetic reprogramming and its application	6
3.	Models for gene therapy	Genetic manipulation in mouse, model for monogenic disorder, polygenic disorder, multifactorial disorder, human cell xenograft	6
4.	Vectors in gene therapy	Introduction, viral vector used for gene therapy, retroviral vectors, adenovirus vectors, non-viral vectors, oligonucleotides	6
5.	Gene targeting	Background and challenge, introducing DNA into cell, nonviral DNA transfer vehicles, recombinational and repair enzymes in gene targeting, insertion of fragments,	8
6.	Gene therapy in treatments	Treating cardiovascular disease, neurological disorders, and cancer via gene therapy	5
7.	Ethical issues in gene therapy and molecular medicine	Background and introduction, ethical issues in clinical context and policy level	5
8.	Commercial implication	Background and introduction, proprietary technology, DNA production in large quantity, and its quality control measures.	6
		Total	46

METHODOLOGY :

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME (THEORY)

Examination	Duration	Marks
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

RECOMMENDED BOOKS

1. Pharmacogenetics, Kinetics, And Dynamics For Personalized Medicine [Paperback] David F. Kisor (Author), Michael D. Kane (Author), Jon E. Sprague (Author), Jeffery N. Talbot (Author) , Publisher: Jones & Bartlett Learning; ISBN-13: 978-1449652739
2. An introduction to molecular medicine and gene therapy, by Thomas F. Kresina, willy Liss Inc
3. Molecular Medicine, Fourth Edition: Genomics to Personalized Healthcare, by R J Trent, Academic Press

TITLE OF THE COURSE: BIOMIMETICS

COURSE CODE: MB 704 **L T P Hr C**

MARKS: 100 **3 1 0 4 4**

OBJECTIVE OF THE COURSE:

The objective of the course is to develop the understanding of Biomimetics and its implication in development of biocompatible materials.

LEARNING OUTCOME

The course would enables the student to understand the Biomimetics and its implication in development of biocompatible materials.

PREREQUISITES

Since the course is very advance nature knowledge in biomaterial, chemistry & cell and molecular biology is a prerequisite.

COURSE DESCRIPTION

Seq. No	*Topic*	*Description*	*Hrs*
1.	Biomaterials	Marine origin biopolymers, hydrogels, collagen based material, silk based material, elastin,	6
2.	Biomimetic molecular recognition	Biological chemoreception, host-guest interaction, theory of interaction, supramolecular chemistry, Biomolecular materials	8
3.	Surface engineering	Cell-material adhesion, electrochemical desorption, photobased desorption, self assembling monolayers	6
4.	Biointerface	Fibronecting at cell-material interface, fibronectin structure, fibronectin, material driven fibronectin fibrillogenesis	7
5.	Control of cell behaviour on biointerface	Biomimetics of cell environment. Surface pattering, surface nanotopography, linking system, nanostructures in stem cells.	8
6.	Surface attachment	Theory of wetability, superhydrophobic surface, cell interactions with surface, blood interaction with surface	6
7.	Bio-inspired reviersible adhesive	Dry and wet adhesives, tilted structure, responsive adhesive patterns.	5
		Total	46

METHODOLOGY

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

RECOMMENDED BOOKS

1. Biomimetic approaches for biomaterials development. Ed. Joao F Mano, **Publisher:** Wiley-VCH; **ISBN-13:** 978-3527329168
2. Biomimetics: Biologically Inspired Technologies, Yoseph Bar-Cohen, **Publisher:** CRC Press; **ISBN-13:** 978-0849331633

TITLE OF THE COURSE: BIOMECHATRONICS

COURSE CODE: MB 708 **L T P Hr C**
MARKS: 100 **3 1 0 4 4**

OBJECTIVE OF THE COURSE:

The objective of the course is to develop the understanding of Biomechatronics and its implication in development of biocompatible mechanical devices.

LEARNING OUTCOME

The course would enables the student to understand the Biomechatronics and its implication in development of biocompatible mechanical devices.

PREREQUISITES

Since the course is very advance nature knowledge in engineering, biomaterial, chemistry & cell and molecular biology is a prerequisite.

COURSE DESCRIPTION

Seq. No	*Topic*	*Description*	*Hrs*
1.	Introduction	Scope of design, definition of Biomechatronics product, principles of Biomechatronics, history of Biomechatronics	6
2.	Conceptual design theory	Systematic design, basics of technical system, general working methodology	5
3.	Biotechnology and mechatronic design	Transduction in biological sciences, applying mechatronic theory .	5
4.	Mechatronic design tools	Introductions, target specification, concept generation chart, concept screening matrix, concept screening matrix, hubka-eder mapping, function interaction matrix, anatomical blue print	9
5.	Microarray devices	Principles methods and applications of microarray, fabrication methods, design of mircoarray,	5
6.	Microbial and cellular bioreactors	Conventional bioreactors, recombinant protein production in CHO cells. Bioreactors with immobilized cells, bioreactors for tissue and stem cells.	9
7.	Bioartificial organ-stimulating	Design of Bioartificial organ-stimulating devices, analyses of bioartificial liver system.	7

	devices		
		Total	**46**

Methodology

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
Total		**100**

RECOMMENDED BOOKS

Introduction to Biomechatronics, Graham Brooker (Author), **Publisher:** SciTech Publishing; **ISBN-13:** 978-189112127

Biomechatronics in Medicine and Healthcare, Raymond Tong Kaiyu (Editor) **Publisher:** Pan Stanford Publishing; **ISBN-13:** 978-9814241618

Biomechatronic Design in Biotechnology: A Methodology for Development of Biotechnological Products, Carl-Fredrik Mandenius, Mats Björkman **Publisher:** Wiley; 1 edition **ISBN-13:** 978-0470573341

Elective 5. MB 709. Database design and management

Objective of the course:

The objective of the course is to develop capability to develop computer databases required to maintain and analyse huge data obtained during clinical research and trials.

Learning Outcome

The course would enables the student to be capable to develop computer databases required to maintain and analyse huge data obtained during clinical research and trials.

Prerequisites

Since the course is advance in nature knowledge in computer is essential to take the course.

Course Description

Sr. No	*Chapter*	*Description*	*Hours*
1.	Introduction	Introductory concepts, Introduction and Overview of database, Exploring Access	2
2.	Database	Database Planning, Design Document , Database Architecture Entity-Relationship Model: Entities, Attributes, Keys, Entity-Relationship Model: Relationships, Roles and Dependencies, Additional E-R Modeling Issues	4
3.	Intro to the Relational Model	Relation model and relation algebra	6
4.	Functional Dependencies	Embedded SQL Object Data Model Universal Modeling Language Extended Entity Relationship Model	8
5.	PHP	ISAM and B-trees Hash Files Review and more on file organizations	6
6.	Database construction	Recovery Atomicity and Durability Query Optimization Overview Sorting, Projection, Union, Difference Selection and Join Computation Distributed DB Overview	8
7.	Databases and the Internet	Databases and the Internet Overview of XML Social and Ethical Issues OLAP and Data Mining MYSQL slide presentation Hadoop	8
		Total	42

Methodology

The entire course is covered through lectures, group discussions and with the help of teaching aids. **Evaluation**:

	Time (Hrs)	Marks
Minor Test 1	**1**	**15**

Minor Test 2	**1**	**15**
Class assignments	**-**	**10**
Semester end test	**3**	**60**
	Total Marks	**100**

Recommended Books

1. *Databases Illuminated 2nd Ed.*, Catherine Ricardo, Jones and Bartlett, 2012 (ISBN 978-1-4496-0600-8)
2. PostgreSQL Reference Documentation
3. Any elementary Java or C++ programming text will serve as a language reference.
4. *A Student's Guide to Unix*, Hahn, 2nd Edition, or
   Just Enough Unix, Anderson, 4th or 5th Edition, or any other simple reference to Unix systems.

PHP reference http://www.php.net/manual/en/