Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.

Curriculum under Choice Based Credit &

Grading System

M.Sc. (BIOPHYSICS)

Semester-I & II

Run at College level from the

Academic Year 2015-16

M.Sc. [BIOPHYSICS] COURSE

Preamble

The University Grants Commission (UGC) has stressed on speedy and substantive academic and administrative reforms in higher education for promotion of quality and excellence. The Action Plan proposed by UGC outlines the need to consider and adopt Semester System, Choice Based Credit System (CBCS), and Flexibility in Curriculum Development and Examination Reforms in terms of adopting Continuous Evaluation Pattern by reducing the weightage on the semester-end examination so that students enjoy a de-stressed learning environment. Further, UGC expects that institutions of higher learning draw a roadmap in time bound manner to accomplish the above.

Dr Babasaheb Ambedkar Marathwada University, Aurangabad plans to bring about radical changes in the curriculum, teaching and evaluation. The vision of the university is to groom the finest breed of citizens equipped with knowledge and talent to serve the society. The university aspires to march forward to achieve benchmarking of our academic practices against world class standards.

The CBCS System

Dr Babasaheb Ambedkar Marathwada University, Aurangabad and affiliated colleges have adopted a credit-based system from the academic year 2015-16. This provides the flexibility to make the system more responsive to the changing needs of our students, the professionals and society. It gives greater freedom to students to determine their own pace of study. The credit-based system also facilitates the transfer of credits.

Eligibility Criteria for M.Sc. Biophysics Course:

A Candidate shall be held eligible for admission to Two year course for the Master's Degree (M.Sc.) in Biophysics under faculty of Science, if candidate is

B.Sc.with Physics or Chemistry or Zoology or Biochemistry or Botany or Microbiology or Mathematics or Electronics or Biotechnology or Bioinformatics or Computer Science or Forensic Science or Analytical Chemistry as one of the Optional Subjects**. OR B.Sc. [Integrated]** Biotechnology or Bioinformatics **OR B.Pharm.**

0.885 : Admission / Promotion

Admission to the course in the concerned department will be done on the performance of CET score and / or on their performance in the qualifying graduate level examination. The student will apply on the application form provided with the prospectus. Once the student is admitted to the concern department/course, he/she will be promoted to next semester with full carryon; subject to the registration of student in every consecutive semester. Dropout student will be allowed to register for respective semester as and when the concerned courses are offered by the department, subject to the condition that his/her tenure should not exceed more than twice the duration of course from the date of first registration at parent department. The admission of concern student will be automatically get cancelled if he/she fails to complete the course in maximum period (Four years/Eight semesters).

M.Sc. Biophysics Course structure:

The Choice Based Credit Grading System is adopted progressively from the academic year 2015-2016. Every student has to complete 100 Credits to obtain M.Sc. Biophysics degree. Out of 100 Credits 96 Credits should be earned from the concerned subject, includes theory, practical/ field work demonstration work, mini project and 04 Credits from Service Course/s

0.886 : Credits and Degrees

i) A candidate who has successfully completed all the core courses, Elective/ Specialized courses and, seminars and project prescribed and or optional service courses approved by the University for the programme with prescribed CGPA shall be eligible to receive the degree.

ii) One Credit shall mean one teaching period of one hour per week for one semester (of 15 weeks) for theory courses and two practical/ laboratory/field/demonstration hours/ week for one semester.

iii) Every student will have to complete at least 100 credits to obtain the masters degree (Post graduate degree) in the subjects having practicals /laboratory work/field work/ /demonstration work, out of which 96 credits should be from their respective subject and four credits from service courses. However the affiliated college or committee appointed by the university can design the curriculum of more credits and it will be compulsory for the students from that department to complete the credits in their subject accordingly.

R.1927 : Courses*(i) Core Course* ***:*** *A core course is a course that a student admitted to a particular P.G. programme must successfully complete to receive the degree. Normally no theory course shall have more than 4 credits.*

*(ii) Elective Course****:*** *Means an optional course from the basic subject or specialization.*

*(iii) Service course (SC)****:*** *The service courses will be offered in third and fourth semesters in different departments of the University. Student should complete at least one service course in any semester.*

(iv) Each Course shall include lectures / tutorials / laboratory or field work / Seminar / Practical training / Assignments / mid-term and term end examinations/ paper / Report writing or review of literature and any other innovative practice etc., to meet effective teaching and learning needs. .

*(v) Attendance****:*** *Students must have 75% of attendance in each Core and Elective course for appearing the examination. However student having 65% attendance with medical certificate may apply to the Principal for condonation of attendance.*

R.1928: Registration for Service Course:-

i) The student will register the service course of his interest after the start of semester in the concerned college department on official registration form. The teacher in-charge of the respective course will keep the record of the students registered. Maximum fifteen days period will be given from the date of admission for completion of registration procedure. The admission committee of the college shall follow a selection procedure after counseling to the students etc. to avoid overcrowding to particular course(s) at the expense of some other courses.

ii) No student shall be permitted to register for more than one service course in a semester.

iii) The University department shall decide the maximum number of students in each service course taking into account the teachers and Physical facilities available in the college.

iv) The college may make available to all students a listing of all the courses offered in every semester specifying the credits, the prerequisites, a brief description or list of topics the course intends to cover, the instructor who is giving the courses, the time and place of the classes for the course. This information shall be made available on the college website.

v) Normally no service course shall be offered unless a minimum of 10 students are registered.

vi) The student shall have to pay the prescribed fee of Rs.100/- only per course per semester/year for the registration as decided by the University

M.Sc. Biophysics course is covered in Four semesters.

Semester -1: 24 Credits including :

- Four Core Courses each of 03 Credits,
- One Foundation Course of 01 Credit,
- Three Lab Courses each of 03 Credits based on Core Courses
- One Lab Course of Credit 02 based on Fundamental Course.

Semester -2: 24 Credits including:

- Four Core Courses each of 03 Credits,
- One Skill Enhancement Course of 01 Credit,
- Three Lab Courses each of 03 Credits based on Core Courses
- One Lab Course of Credit 02 based on Skill Enhancement Course.

Semester -3 : 24 Credits including :

- Two Compulsory Core Courses each of 03 Credits,
- Two Elective Courses each of 03 Credits
- Three Lab Courses each of 03 Credits based on Core & Elective Courses
- One Mini Project of Credit 03 .

Semester – 4: 28 Credits including:

- Two Compulsory Core Courses each of 03 Credits,
- Two Elective Courses each of 03 Credits
- Four Lab Courses each of 03 Credits based on Core & Elective Courses
- One Service Course of Credit 04.

M.Sc. Biophysics First Year [Semester -1]

Total Credits for Semester -1: 24 (Theory : 08;Tutorial : 04; Practical : 09 ; FC: 03)

(FC: Foundation Course; L-Lecture; T- Tutorial; P-Practical)

Course Code & Type		Course Title	Pattern (hrs.)			Credits	WL/wk Hrs.	Marks			Exam duration hrs.
			L	T	P			C.A	U.A	Total	
BPT - 101	C	Molecular Biophysics	2	1	0	03	03	20	80	100	3
BPT -102	C	Biophysical Chemistry	2	1	0	03	03	20	80	100	3
BPT - 103	C	Cellular Biophysics	2	1	0	03	03	20	80	100	3
BPT-104	C	Molecular Enzymology	2	1	0	03	03	20	80	100	3
BPT-105	FC	Biostatistics & Computer Fundamentals	1	0	0	01	01	20	80	100	2
BPP-111	LC	Lab Course -1 (Based on BPT-101 & 102)	0	0	6	03	06	10	40	50	6
BPP-112	LC	Lab Course -2 Based on BPT - 103)	0	0	6	03	06	10	40	50	6
BPP - 113	LC	Lab Course -3 (Based on BPT - 104)	0	0	6	03	06	10	40	50	6
BPP-114	FC	Lab Course -4 (Based onBPT- 105)	0	0	4	02	04	10	40	50	6
		Total	9	4	22	24	35	140	560	700	-

M.Sc. Biophysics First Year [Semester -2]

Total Credits for Semester -2 : 24 (Theory : 08 ; Tutorial : 04 ; Practical : 09 ;SEC : 03)

(SEC: Skill Enhancement Course; L-Lecture; T- Tutorial; P-Practical)

Course Code & Type		Course Title	Pattern (hrs)			Credits	WL/wk Hrs.	Marks			Exam hrs.
			L	T	P			C.A	U.A	Total	
BPT - 201	C	Physiology & Biophysics	2	1	0	03	03	20	80	100	3
BPT -202	C	Membrane & Ion channel Biophysics	2	1	0	03	03	20	80	100	3
BPT - 203	C	Physicochemical Techniques	2	1	0	03	03	20	80	100	3
BPT- 204	C	Molecular Biology & Genetics	2	1	0	03	03	20	80	100	3
BPT-205	SEC	Research Methodology	1	0	0	01	01	20	80	100	2
BPP- 211	LC	Lab Course -5 (Based on BPT-201&202)	0	0	6	03	06	10	40	50	2
BPP-212	LC	Lab Course -6 (Based on BPT - 203)	0	0	6	03	06	10	40	50	6
BPP-213	LC	Lab Course -7 (Based on BPT- 204)	0	0	6	03	06	10	40	50	6
BPP-214	SEC	Science Communication Skills	0	0	4	02	04	10	40	50	3
		Total	9	4	22	24	35	140	560	700	-

M.Sc. Biophysics Second Year [Semester -3]

Total Credits for Semester - 3: 24 (Theory: 12; Practical: 09; Mini-project: 03)

(L-Lecture ; T- Tutorial ; P-Practical; MP-Mini Project)

Course Code & Type		Course Title	Pattern (hrs)			Credits	WL/wk Hrs.	Marks			Exam hrs.
			L	T	P			C.A.	U.A	Total	
BPT - 301	C	Biophysical & Bio-analytical Techniques	2	1	0	03	03	20	80	100	3
BPT -302	C	Bioinformatics & Structural Biology	2	1	0	03	03	20	80	100	3
BPT - 303	E	Elective Group -A	2	1	0	03	03	20	80	100	3
BPT- 304	E	Elective Group-B	2	1	0	03	03	20	80	100	3
BPP –311	LC	Lab Course -9 (Based on BPT–301 & 302)	0	0	6	03	06	10	40	50	2
BPP-312	LC	Lab Course -11 (Based on BPT -303)	0	0	6	03	06	10	40	50	6
BPP-313	LC	Lab Course -12 (Based on BPT -304)	0	0	6	03	06	10	40	50	6
BPMP	MP	Mini Project	0	0	6	03	06	50	100	150	3
		Total	8	4	24	24	36	160	540	700	

Elective Group A :

1. Electrophysiology
2. Protein Engineering
3. Biomedical Imaging
4. Environmental Biophysics

Elective Group B :

1. Photo biophysics
2. Nanobiophysics
3. Cellular and Molecular Neurophysiology
4. Recombinant DNA technology

M.Sc. Biophysics Second Year [Semester – 4]

Total Credits for Semester - 4 : 28 (Theory : 12 ; Practical : 12 ; SC : 04)

(L-Lecture ; T- Tutorial ; P-Practical)

Course Code & Type		Course Title	Pattern (hrs)			Credits	WL/wk Hrs.	Marks			Exam hrs.
			L	T	P			C.A.	U.A.	Total	
BPT - 401	C	Radiation Biophysics	2	1	0	03	03	20	80	100	3
BPT -402	C	Immunology & Immunotechniques	2	1	0	03	03	20	80	100	3
BPT - 403	E	Elective Group - C	2	1	0	03	03	20	80	100	3
BPT- 404	E	Elective Group -D	2	1	0	03	03	20	80	100	3
BPP– 411	LC	Lab Course -13 (Based on BPT-401)	0	0	6	03	06	10	40	50	6
BPP-412	LC	Lab Course -14 (Based on BPT-402)	0	0	6	03	06	10	40	50	6
BPP-413	LC	Lab Course -15 (Based on BPT-403)	0	0	6	03	06	10	40	50	6
BPP - 414	LC	Lab Course -16 (Based on BPT-404)	0	0	6	03	06	10	40	50	6
BPSC-2	SC	Service Course*	To be completed in other dept.			04*	60 hrs/ sem.	100	--	100	
		Total	8	4	24	28	36	220	480	700	3

***Student should complete at least one Service Course in any semester (Either 3 or 4)**

Elective Group C

1. Medical Biophysics
2. Nuclear Medicine
3. Genomics & Proteomics
4. Neurobiophysics

Elective Group D

1. Bioelectronics & Medical Instrumentation
2. IPR, Bio-safety & Bioethics
3. Molecular Oncology
4. Developmental Biology & Assisted Reproductive Technology

M.Sc. Biophysics Course workload and general Instructions:

1. Every Core Course will have workload of 45 periods, each of 60 minutes duration, distributed unit wise as indicated in this syllabus.
   [3 periods/wk X 15 weeks= 45 distributed as (30 lectures +15 tutorials)]
2. Every Lab Course will have workload of 90 periods, each of 60 minutes duration.
   [6 periods/wk X 15 weeks=90]
3. The Foundation Course will have workload of 15 periods, each of 60 minutes duration.
   [1 period/wk X 15 weeks =15]
4. The Lab Course based on Foundation Course will have workload of 60periods, each of 60 minutes duration **[4 periods/wk X 15 weeks=60]**
5. The Skill Enhancement Course will have workload of 15 periods, each of 60 minutes duration. **[1 period /wk X 15 weeks =15]**
6. The Lab Course based on Skill Enhancement Course will have workload of 60 periods, each of 60 minutes duration**[4 periods/wk X 15 weeks=60]**
7. In **Semester 3,two Elective Courses** from group A & B to be chosen and in **Semester 4 two Elective courses** from Group C & D to be chosen depending on faculty and facility available in the concern department.
8. In **Semester -3 One Mini-project** may be allotted depending on student's efficiency, Faculty/expertise and resources available
9. Every student is expected to complete **Service Course** of **04 Credits** either in **Semester-3 or Semester -4** with an approval from the concern department.
10. The university evaluation method, grade awards, Grievances Redressal, computation of SGPA(Semester Grade Point Average) and CGPA(Cumulative Grade Point Average),Grade card and cumulative grade card are as per university rule narrated below

11. The internal evaluation process include the events viz. test,tutorial,seminar,journal paper presentation, group discussion,open book test and mid-term exam(based on 40% completed syllabus)and term-end exam (based on 60% completed syllabus).The internal marks are computed by taking average of marks obtained in these internal evaluation events.The number of internal evaluation events and pattern of paper are decided by departmental internal evaluation committee in respective department.

12. The practical component in lab courses,fundamental courses, skill enhancement courses and mini-projects are performed in respective semesters.However the semester end examination of pratical components will be held at the end of respective academic year as per rules of university.

R.1929 :Monitoring Committee of Post Graduate Programme:

Every P. G. programme of the University/College shall be monitored by a committee constituted for this purpose by the college. The Committee shall consist of Principal as a Chairman and all the teachers of the college as its members.

R.1930 Results Grievances Redressal Committee:-

The college shall form a Grievance Redressal Committee for each course in each department of the college with the Course Teacher and the Principal. This Committee shall solve all grievances relating to the Assessment of the students.

0.887: Grade Awards :-

(i) A ten point rating scale shall be used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master.s Programme. Grade points are based on the total number of marks obtained by him/her in all the heads of examination of the course. These grade points and their equivalent range of marks are shown separately in Table-I.

Table I: Ten point grades and grade description

Sr. No.	Equivalent Percentage	Grade Points	Grade	Grade Description
1	90.00-100	9.00-10	O	Outstanding
2	80.00-89.99	8.00-8.99	A+ +	Excellent
3	70.00-79.99	7.00-7.99	A+	Exceptional
4	60.00-69.99	6.00-6.99	A	Very Good
5	55.00-59.99	5.50-5.99	B+	Good
6	50.00-54.99	5.00-5.49	B	Fair
7	45.00-49.99	4.50-4.99	C+	Average
8	40.01-44.99	4.01-4.49	C	Below Average
9	40.00	4.00	D	Pass
10	< 40	0.00	F	Fail

ii.) Non appearance in any examination/assessment shall be treated as the student has secured zero mark in that subject examination/ assessment.

iii.) Minimum D grade (4.00 grade points) shall be the limit to clear / pass the course/subject. A student with F grade will be considered as .failed. in the concerned course and he/she has to clear the course by reappearing in the next successive semester examinations. There will be no revaluation or recounting under this system.

iv.) Every student shall be awarded Grade points out of maximum 10 points in each subject (based on 10 Point Scale). Based on the Grade points obtained in each subject, Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) shall be computed. Results will be announced at the end of each semester and cumulative Grade card with CGPA will be given on completion of the course.

0.888 : Computation of SGPA (Semester grade point average) & CGPA (Cumulative grade point average)

The computation of SGPA & CGPA, will be as below:

a. Semester Grade Point Average (SGPA) is the weighted average of points obtained by a student in a semester and will be computed as follows:

$$\text{SGPA} = \frac{\text{Sum [Course Credit*Number of Points in concerned course gained by the students]}}{\text{Sum [Course Credit]}}$$

The Semester Grade Point Average (SGPA) for all the four semesters will be mentioned at the end of every semester.

b. The Cumulative Grade Point Average (CGPA) will be used to describe the overall performance of a student in all semesters of the course and will be computed as under –

$$\text{CGPA} = \frac{\text{Sum(All four semester SGPA)}}{\text{Total Number of Semesters}}$$

Equivalent Percentage of CGPA should be shown on Grade sheet as equivalent percentage= CGPA (10) The SGPA and CGPA shall be rounded off to the second place of decimal.

0.889 : Evaluation method :-
Each theory course will be of 100 Marks and be divided in to internal examination (Sessional) of 20 Marks and Semester end examination of 80 Marks. (20+80 = 100 Marks) Each Practical course will be of 50 marks. Research project if any, will be of 100 marks.

a. Internal Evaluation Method
There shall be two mid semester examinations, first based on 40 percent syllabus taught and second based on 60 percent syllabus taught. The setting of the question papers and the assessment will be done by the concerned teacher who has taught the syllabus. Average score obtained out of two mid semester examinations will be considered for the preparation of final sessional marks/grade.

b. Term end examination and evaluation
i. Semester end examination time table will be declared by the departmental committee and accordingly the concern course teacher will have to set question paper, conduct theory examination, conduct practical examination with external expert, evaluate, satisfy the objection / query of the student (if any) and submit the result to DC.
ii. The semester end examination theory question paper will have two parts (20+60 = 80 Marks)
Part A will carry short question of 2-3 marks (fill in the blanks/multiple choice questions/ match columns / state true or false / answer in one sentence) as ***compulsory questions*** and it should cover entire syllabus. (20 Marks)
Part B will carry 7 questions out of which there shall be at least one question from each unit, student will have to answer any five questions out of 1 (60 marks)
iii. Semester end practical examinations will be of 50 marks each and students will examined by one external and one internal examiner. Project work and seminar if any,will be evaluated by the external examiners along with guide.
iv. At the end of each semester the university authorities shall assign grades to the students.
v. The university authorities shall prepare the copies of the result sheet in duplicate.
vi.The university authorities shall display the grade points and grades for the notice of students.

R.1931 Grade Card
The University shall issue at the beginning of each semester a grade card for the student, containing the grades obtained by the student in the previous semester and his Semester Grade Point Average (SGPA).
The grade card shall list:
(a) the title of the courses along with code taken by the student
(b) the credits associated with the course,
(c) the grade and grade points secured by the student,
(d) the total credits earned by the student in that semester.
(e) the SGPA of the student,
(f) the total credits earned by the students till that semester and
(g) the CGPA of the student (At the end of the IVth Semester) .

R.1932 Cumulative Grade Card
At the end of the IVth semester, the University shall issue Cumulative Grade Card to the Students showing details of Grades obtained by the student in each subject in all semesters along with CGPA and total credits earned.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.

MSc. Biophysics First Year [Semester -1]
Syllabus Based on Choice Based Credit & Grade System

Total Credits for Semester -1: 24 (Theory : 08;Tutorial : 04; Practical : 09 ; FC: 03)

(FC : Foundation Course ; L-Lecture ; T- Tutorial ; P-Practical)

Course Code & Type		Course Title	Pattern (hrs.)			Credits	WL/ wk Hrs.	Marks			Exam duration hrs.
			L	T	P			C.A	U.A	Total	
BPT - 101	**C**	**Molecular Biophysics**	2	1	0	**03**	03	20	80	100	3
BPT -102	**C**	**Biophysical Chemistry**	2	1	0	**03**	03	20	80	100	3
BPT - 103	**C**	**Cellular Biophysics**	2	1	0	**03**	03	20	80	100	3
BPT-104	**C**	**Molecular Enzymology**	2	1	0	**03**	03	20	80	100	3
BPT-105	**FC**	**Biostatistics & Computer Fundamentals**	1	0	0	**01**	01	20	80	100	2
BPP-111	**LC**	**Lab Course -1 Based on (BPT- 101 & 102)**	0	0	6	**03**	06	10	40	50	6
BPP-112	**LC**	**Lab Course -2 Based on BPT - 103)**	0	0	6	**03**	06	10	40	50	6
BPP - 113	**LC**	**Lab Course -3 (Based on BPT - 104)**	0	0	6	**03**	06	10	40	50	6
BPP-114	**FC**	**Lab Course -4 Based on (BPT- 105)**	0	0	4	**02**	04	10	40	50	6
		Total	**9**	**4**	**22**	**24**	**35**	**140**	**560**	**700**	-

BPT-101 : Molecular Biophysics

[Total Marks: 100] [Exam Duration: 3 hrs] [Total Workload: 45hrs] [Credits: 3]

Unit 1: Atomic & Molecular Structures. (10 hrs.)

Structure of Atom, Schrodinger's theory, Quantum numbers, Pauli's exclusion principle, Hund's rule, Periodic table, Bonds between atom & molecules, Ionic, Covalent, Hydrogen, Electrostatic, Disulphide & Peptide bonds, Vander waals forces, Bond energies, Bond angles, Bayer's strain, Weak interactions, Molecular orbital theories, Hybridization of orbitals, σ and π bonds .

Unit 2: Thermodynamics & Bioenergetics. (12 hrs.)

Laws of Thermodynamics, Concept of free energy, Unavailable energy & Entropy, Negative entropy change in living system, Heat content of food, Bomb calorimeter.

Energy generation & energy transfer processes in biochemical reactions, Metabolism of glucose & formation of ATP. Energy requirements in cell metabolism, Role & Structure of mitochondria, High-energy phosphate bond, Electron transfer phenomenon & biological energy transfer.

Unit 3: Redox Potentials. (11 hrs.)

Oxidation & Reduction, Equivalence of electrical & chemical energy, Electro chemical cell, Contact potentials, Galvanic cell, Potential of half cell, Redox potentials & its calculations by Nerst equation, Examples of Redox Potential in biological system.

Unit 4: Molecular alphabets of Life.(12 hrs.)

Amino acid, Nucleic acid bases & Lipids, Classification & Properties of Amino acid, Peptides & Polypeptides, Nucleosides, Nucleotides, Polynucleotides, Pentose & Hexose Polysaccharides, Amino acid to Peptides, Polypeptides, Different types of linkages.

Recommended books: Refer annexure for book titles.

1,2,4,5,6,7,10,11,14,15,18,19,20,21,23,24,26,29,30,31,32,58,60,61,69,70,72,73,74,105,114,

115,118,155.

BPT-102 : Biophysical Chemistry

[Total Marks: 100] [Exam Duration: 3 hrs] [Total Workload: 45 hrs] [Credits : 3]

Unit 1: Water, Acids & Bases.(8 hrs)

Molecular structure, Association of Water molecules through H- bonding, Nature of hydrophobic interactions, Physico Chemical properties of Water, State of Water in biostructures & its significance.

Acids and Bases, Mole & Normality, Weak acids, Amphoteric electrolytes, pH, Calculation of pH from H & OH Concentration, measurements of pH, Henderson Haselbatch equation, Titration curve & pK values, Buffers & Stability of their pH, Numerical problems.

Unit 2: Proteins.(12 hrs.)

Structural level of proteins & stabilizing forces, Conformational properties of polypeptides, Ramchandran plot, Helical parameters & Conformation, organization & interaction of angles, Conformational structure of alpha-keratin, Silk fibrin, Collagen, Actin, Myosin, Folded conformation of globular proteins (e.g.- Haemoglobin, Myoglobin, Lysozyme, Cytrochromes) mechanism & side chain conformation, Classification & role of Beta- bends & bulges, Super secondary structure, Domain & motiffs, Proteins in solution & protein sequencing, Concept of protein evolution, Cytochrome & Haemoglobin evolutionary studies.

Unit 3: Nucleic Acids. (10 hrs.)

Double helical structure of DNA, Conformational parameters of Nucleic acids & their constituents, Chargff's rule, DNA polymorphism, DNA supercoiling, Hyperchromicity, Circular DNA, Types & structure of RNA, mRNA, rRNA, tRNA & modified nucleotides, nucleic acid sequencing.

Unit 4: Other Biological Polymers. (5 hrs.)

Structure and conformation of polysaccharide cellulose, Amylase, Chitin, Carbohydrates conjugates, Classification & biological role of vitamins & hormones.

Unit 5: Macromolecular Interactions. (10 hrs.)

Ligand interaction at equilibrium, Identical independent sites, Scatchard plot, Multiple classes of independent sites, Interaction between binding sites, Allosterism, MWC model, Sequential model, Oxygen Hemoglobin binding, Binding of two different ligands, Energetics and dynamics of binding, Structures of protein- ligand complexes, Relationship between protein conformations and binding, Binding of Immunoglobulins and DNA binding proteins, Free radicals in biology and medicine.

Recommended books: - Refer Annexure for detail book titles.
1,2,4,5,6,7,12,14,15,18,19,20,21,23,24,26,27,29,30,32,58,60,65,69,70,73,74,82,86,87,105,106,118,155.

BPT -103 : Cellular Biophysics.

[Total Marks: 100] [Exam Duration: 3 hrs] [Total Workload: 45hrs][Credits : 3]

Unit I: Cell Organization and Function (7 hrs.)

Cell as the basic structural unit, Origin & organization of Prokaryotic and Eukaryotic cell, Cell size & shape, Fine structure of Prokaryotic & Eukaryotic cell organization (Bacteria, Cyanobacteria, plant & Animal cell), Internal architecture of cells, cell organelles, compartment & assemblies membrane system, Ribosome, Polysomes, Lysosomes & Peroxisomes, Connection between cell & its environment, Glycocalyx, Extracellular Matrix.

Unit II: Tools in Cell Biology (10 hrs)

Light microscopy – Design and working of Compound, Phase contrast , Interference , Dark field Polarizing & Fluorescence microscope, Electron microscopy – Design and working of Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Cyto-photometry, Flow cytometry & cell sorting, autoradiography ,Cell disintegration methods.

Unit III: Cell Growth & Division (10 hrs.)

Kinetics of cell growth, The Cell Cycle, Interphase-G1,S,G2,M molecular events at different cell cycle phases, A cytoplasmic clock times, cell cycle in early embryogenesis, Polypeptide Growth Factors &Control of cell proliferation, Mitosis & Cell division- Molecular mechanism , Events in mitosis, Role of mitotic apparatus, Meiosis & Sexual reproduction, Molecular mechanism of meiosis, DNA metabolism during meiosis, Dividing & Non-dividing cells, Synchronization of cell cycles, Cell transformation & Malignancy, Cell aging & death-Apoptosis, Cell Cycle Control, Role of MPF, Cd2 Proteins & G-1* Cyclins.

Unit IV: Cell-Cell Interaction (12 hrs)

Connection between the cell and its environment, Glycocalyx, Extracellular Matrix, collagen, Elastin, Fibronectin, Lamin, Proteoglycans, Integrins, Cell Junctions, Desmosomes, Gap junction, Tight Junctions, Plasmodesmata, Synapse and synaptic vesicles*, Cell Signaling, General principle of cell signaling, Paracrine, Autocrine, Endocrine &synaptic signaling, Heat Shock Proteins, G-Protein structure and role in signaling, Intracellular Cyclic AMP, Role Ca ++ in cell signaling, CAM Kinases, (Calmodulin/Ca++ dependent protein kinases), Interaction between cyclic AMP & Ca++. Role of Methylation in adaptation & bacterial chemotaxis.

Cell differentiation, General characteristics of cell differentiation, Localization of cytoplasmic determinants, Molecular mechanism of cell differentiation, Morphological movements & the shaping of body plains* Cell memory, Concept of positional values, maintenance of differentiated state, Tissue with permanent cells, neuronal networks & centre of the lens of adult eye.

Unit V: Cell & Tissue Culture (6 hrs)

Plant & Animal Cell Culture:Callus Culture, Suspension culture, Estimation of growth, Cell viability Test, Totipotency in culture, Importance of totipotency, Cyto-differentiation in cultured cells, rganogenesis, Somaclonal variations, Somatic embryogenesis, Artificial seeds, Embryo Culture, Protoplast Fusion & Somatic hybridization, Cryopreservation & its application in cell & tissue culture. Applications of cell & Tissue culture.

Culturing techniques for bacteria and virus

Recommended books: - Refer annexure for detail book titles.
3,5,6,7,10,11,15,16,18,21,22,24,27,29,30,58,61,64,68,69,72,77,78,110,118.

BPT-104 : Molecular Enzymology

[Total Marks: 100] [Exam Duration: 3 hrs] [Total Workload: 45hrs][Credit : 3]

Unit 1: Basic principles of chemical kinetics. (8 hrs.)

Velocity, Order and Molecularity of a chemical reaction, Kinetic equations for zero, first, second & third order reactions, Determination of order of the reaction, Arrhenious equation, Activation energy & its estimation, Collision & transition state theories of reaction rate, Catalysts, Mode of action of catalysts, Nucleophilic, Electrophilic & Acid-Base Catalysis.

Unit 2: Enzymes as Biocatalysts. (7 hrs.)

Remarkable properties of Enzymes as Catalysts, Active sides, three point attachment, Mechanism of enzyme action, Flexible enzymes, Induced-fit hypothesis, Catalytic efficiency of enzymes, Micro environmental approach to enzyme dynamics, Nomenclature & classification, Hydrolases & Transferases, Peptidases, Esterases, Kinase, ATPases, Oxidoreductases, Lyases, some examples of Isomerisation, Rearrangement & condensation reactions, Molecular dynamics & Transient states of Enzyme catalysis.

Unit 3: Enzymes Kinetics.(12 hrs.)

Kinetics of single substrate reaction, Michaelies equation, steady state kinetics, transient phases of enzyme reactions, Lineweaver-Burk, Eddie-Hofstee plot, Woolf plot. Effect of pH, temperature, metal ions on enzyme activity. Enzymes turn over mechanisms of multisubstrate enzyme reactions (conceptual approach), kinetics of reversible enzyme inhibition, Mechanisms of action of Chymotrypsin and Ribonuclease.

Unit 4: Enzyme Regulation. (8 hrs.)

Control of enzyme activity, feedback inhibition, kinetic behavior of allosteric enzymes, mechanism of allosteric interactions, subunit structures and protein assembly-Aspartic transcarbamylase, Proton ATPase, Metalloenzymes-carboxypeptidase A, Role of Zinc.

Unit 5: Enzyme Technology.(10 hrs.)

Enzyme Immobilization techniques, use of isolated enzymes in industrial processes, Enzymes in clinical diagnosis, Isozymes, Abezymes, Ribozymes, Enzyme therapy, Extremozymes, Solventogenic and non-aqueous enzymes.

Recommended books:- Refer Annexure for detail book titles
2,5,11,12,15,18,21,24,25,26,30,56,60,64,66,67,69,71,73,74,82,83,84,85,86,119,155

BPT-105: Biostatistics and Computer Fundamentals

[Total Marks: 50] [Exam Duration: 2hrs] [Total Workload: 15hrs] [Credits : 1]

Unit 1: Biostatistics : (10 hrs.)

1. Preliminary Concepts.
   Biostatistics terminology, variables in biology, Levels and measurements of biological data, Classification, tabulation and frequency distribution of the data, graphical representation by histogram. Polygon, Ogive curve and pia diagram.
2. Data Management.
   Measures of central tendency (Mean, Median, Mode) Measures of dispersion (Range, quartile deviation, mean deviation, standard deviation, coefficient of variation), Correlation and regression, Positive and Negative correlation and calculation of Karl-Peasrsons Co-efficient of correlation, Linear regression and regression equation, multiple linear regression, Calculation of an unknown variable using regression equation, Types of estimation, Confidence interval level of confidence. Confidence interval estimate of mean and of proportion.
3. Statistical Analysis.
   Tests of significance: - Small sample test, chi-Sqhare test, F test, large sample test (z-test), Concept of probability and probability distributions, Studies in Binomial, Poison and Normal distribution with illustrative examples.
4. Errors in measurements.
   Errors, Accuracy, Precision, general theory of Errors, Classification, Ways of expression of precision, Accuracy detection of determinates errors, Statistical analysis of biochemical data with spread sheet applications regression analysis, Use of statistical packages, Data management with computer

Unit 2 : Computer fundamentals (05 hrs.)

Computer system at a glance processor (CPU, ALU) Memory (ROM, RAM, CACHE data and address bus) Storage, Input & Output devices, Computer peripherals, Binary code and binary system, Algorithms and Flow charts, Software & Hardware, Operating systems (Dos, Windows) Application software's (MS-office) Super computer, Mainframe computers, Mini computers, Micro computers, Workstation, Concept of multimedia and its applications. Network concepts (LAN, WAN) and its topology, Network media and hardware. Design and application of modern data communication over telephone lines and Digital telephone lines. Internet protocols HTML, XML, WWW (World wide webs) Internet connectivity, search engines. Interactive communication on Internet, Programming concepts in c++, Introduction to Bioperl, Biojava, Bioxml.

Recommended books: - Refer annexure for detail book titles.

120,123,135,136,137,138,141,142,143,144,145,146,147.

BPP -111 : Lab Course- I : Practicals based on BPT-101 & 102

[Total Marks: 50] [Exam Duration: 6 hrs] [Total Workload: 90hrs] [Credits: 3]

1. To verify the Lambert Beer's law.
2. To determine the beer's limit and measurement of molar and percent extinction coefficient.
3. To estimate the percent purities of dyes and inorganic compounds.
4. To establish the absorption spectrum and determine the absorption maxima of p-Nitro phenol.
5. To study the characteristics of UV absorption spectra of Aromatic Amino Acids.
6. To study the characteristics of UV absorption spectra of Proteins.
7. To study the characteristics of absorption spectra of Nucleic Acids and Nucleotides.
8. To study the mutarotation of simples Sugars using Polarimetry.
9. Spectrophotometric assay of electron transport in intact Mitochondria using Dye Reduction methods.
10. Light induced proton pumping (uptake) in hypotonically swollen Chloroplast from Spinach Leaves.
11. To estimate light driven Chloroplast electron transport by Dye Reduction method.
12. Acid – Base titration using pH meter and Determine the pK values: - Strong acid Vs Strong base, Weak acid Vs Strong base, Mixture of Strong and Weak acid Vs Strong base..
13. To estimate the inorganic phosphate.
14. To analyze of Oil-Iodine number, saponification value & acid number.
15. Model building using Space filled & Ball and Stick models.
16. To estimate the DNA molecules.
17. To estimate the RNA molecules.
18. Studies the simple molecular structures using DTMM and other basic molecular modeling softwares
19. To prepare the buffers & measurement of pH.
20. To determine the titration curve of amino acids & calculate the pKa values.
21. To determine the titration curve of Proteins & calculate the pKa values.
22. To determine the Tm of DNA.
23. Denaturation & Renaturation of DNA.
24. To isolate the Proteins- Casein from milk, Hb from RBC.
25. Study of UV absorption spectra of Proteins.
26. Study of UV absorption spectra of Nucleic acids.
27. To study the macromolecular interactions using ultrasonic interferometer.
28. To study the effect of temperature, concentration, macromolecular size, shape on ultrasonic velocity
29. To isolate the Phospholipids from Egg Yolk.
30. To study the interactions of Acridine orange with DNA.
31. To estimate quantitatively the Amino acids using the ninhydrin reaction.
32. To estimate proteins by Biuret assay.
33. To estimate the Protein by Folin's-Lowry method.
34. To prepare the Cytochrome C & its chracterization.
35. To identify the C-terminal Amino acids of a protein.
36. To identify the N-terminal Amino acids of a protein.
37. To study the protein structure by using DTMM (Desk top molecular modeling)
38. To analyze the major types of vertebrate collagen by SDS PAGE.

BPP-112 : Lab.Course-2 : Practicals based on BPT -103

[Total Marks: 50] [Exam Duration: 6 hrs] [Total Workload: 90hrs] [Credits: 3]

1. To familiarize with bright field, phase contrast, fluorescence & polarizing microscopes.
2. To observe the stained & unstained Prokaryotes & Eukaryotes
3. To characterize the sub cellular fractions.
4. To study the chromosomal DNA morphology by Feulgen reaction (root tip cells)
5. To identified the cellular carbohydrate by the Acid Schiff (PAS) reaction.
6. Demonstration of Chemo taxis.
7. To identify the Cytochemical DNA/RNA with the Methyl green-pyronin method.
8. Blood analysis: Estimation of RBC count, WBC count, Differential count, Hb%, Packed cell volume, E.S.R.
9. To measure the mean corpuscular diameter.
10. To count the Reticulocytes & Platelets.
11. Microscopic studies of Mitosis & Meiosis stages & determination of mitotic index.
12. To establish the cell growth curve & determination of generation time.
13. To maintain the cell culture protocols.
14. To study the charge characteristics of cells through micro Electrophoresis.
15. To study the histochemical localization of Alkaline & Acid Phosphatase, Glycogen & Lipids in the tissue.
16. To Isolate and characterize the bacteria from leaf tissue.

BPP-113:Lab. Course-3: Practicals based on BPT 104

[Total Marks: 50] [Exam Duration: 6 hrs] [Total Workload: 90hrs] [Credits: 3]

1. To study the first order kinetics of inversion of cane sugar using Polarimetry and determination of rate constant K.
2. To determine the energy of activation for a chemical reaction.
3. To study the characteristics of different catalytic reactions (Nucleophilic, Electrophilic & Acid-Base).
4. To measure the enzymatic activity.
5. To isolate and purify the Enzymes- Isolation of muraminidase from egg white.
6. To isolate & fractionate the dehydrogenase from Yeast.
7. To study the effect of temperature on Enzyme activity & Kinetics.
8. To study the effect of pH on Enzyme activity & Kinetics.
9. To study the effect of metal ions on Enzyme activity & Kinetics.
10. To study the Kinetics of Enzyme and determination of Kinetic parameters.
11. To study the effect of substrate concentration and Inhibitors on lactate dehydrogenase.
12. To prepare the Enzyme crystals and their microscopic characterization and storage.
13. To separate the isoenzymes from lactate dehydrogenase by Polyacrylamide Gel Electrophoresis (PAGE).
14. To study the protein inhibition by Polyacrylamide Gel Electrophoresis (PAGE).
15. To study the protein-ligand interactions by Scatchard plot.
16. Immobilization of Enzyme on Solid support.
17. Comparative study of properties of Immobilized and free Enzymes.

BPP -114: Lab. Course-4 : Practicals based on BPP 105

[Total Marks: 50] [Exam Duration: 4 hrs] [Total Workload: 60hrs] [Credits: 2]

1. Representation of Statistical data by: - Histogram, Ogive curves, Pie diagram. (3 assignments)
2. Measurement of central tendencies: - Arithmetic & Geometric mean, Mode and Median. (3 assignments)
3. To calculate the measures of dispersion.:(6 assignments)
    a) Mean deviation.
    b) Standard deviation and Coefficient of variation.
    c) Quartile deviation.
4. Test of Significance. (6 assignments)
    a) Chi-Square test.
    b) t- test.
5. To evaluate the standard error & interpretation of results in terms of Accuracy and precision. (4 assignments)
6. Basic operating procedures of computer. To create File, Folder, Directories. (2 assignments)
7. Familiarity with the Basic operations of MS-office. (7 assignments)
8. Familiarity with use of Internet, Search engines, Web sites, Surfing, Browsing, Downloading text and Graphics. (4 assignments)
9. Creating Email account, Sending and Receiving mails.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.

MSc. Biophysics First Year [Semester -2]

Syllabus Based on Choice Based Credit & Grade System

Total Credits for Semester -2 : 24 (Theory : 08 ; Tutorial : 04 ; Practical : 09 ;SE : 03)
(SEC : Skill Enhancement Course ; L-Lecture ; T- Tutorial ; P-Practical)

Course Code & Type		Course Title	Pattern (hrs)			Credits	WL/ wk Hrs.	Marks			Exam hrs.
			L	T	P			C.A.	U.A.	Total	
BPT - 201	**C**	**Physiology & Biophysics**	2	1	0	**03**	03	20	80	100	3
BPT -202	**C**	**Membrane & Ion channel Biophysics**	2	1	0	**03**	03	20	80	100	3
BPT - 203	**C**	**Physicochemical Techniques**	2	1	0	**03**	03	20	80	100	3
BPT- 204	**C**	**Molecular Biology & Genetics**	2	1	0	**03**	03	20	80	100	3
BPT-205	**SEC**	**Research Methodology**	1	0	0	**01**	01	20	80	100	2
BPP – 211	**LC**	**Lab Course -5 (Based on BPT – 201& 202)**	0	0	6	**03**	06	10	40	50	2
BPP-212	**LC**	**Lab Course -6 (Based on BPT - 203)**	0	0	6	**03**	06	10	40	50	6
BPP-213	**LC**	**Lab Course -7 (Based on BPT- 204)**	0	0	6	**03**	06	10	40	50	6
BPP-214	**SEC**	**Science Communication Skills**	0	0	4	**02**	04	10	40	50	3
		Total	**9**	**4**	**22**	**24**	**35**	**140**	**560**	**700**	-

BPT-201: Physiology & Biophysics

[Total Marks: 100] [Exam Duration: 3 hrs] [Total Workload: 45 hrs][Credits 3]

Unit 1: Brain & Neurophysiology (10 hrs.)

General anatomy of brain, Central peripheral nervous system, Mylenated & unmylenated nerve cells, Blood brain barrier generating nerve impulse, Synaptic transmission, Physicochemical basis of membrane potential, Resting and action potential, Propagation of action potential, Voltage clamp and patch-clamp techniques, Hadgkin-Huxley analysis, Motor and cortical control, Sleep and consciousness Neuromuscular junction, Excitation contraction coupling Neuronal networks, Processing of information, Memory and neuropeptides.

Unit 2: Special senses (10 hrs.)

Biophysics of sensory mechanism and function of receptor cells, Cutaneous, Olfactory and gustatory sensations, Vision. Physical aspects, Neurophysiology colour vision, Visual evoked potentials. Audition: - Physical aspects, auditory transduction, Acoustic encoding.

Unit 3: Cardiovascular and Pulmonary physiology (10 hrs.)

Physical characteristics of blood, Hemodynamics principles & equations, Genesis & spread of cardiac impulse, Cardiodynamics, Regulation of blood pressure & blood volume, Heart rate, Cardiac output & venous return, Cardiovascular responses to stress (exercise, shock & hypertension),Biophysical aspects of lung expansion respiratory mechanics & gas exchange process, Gas diffusion & transport, Pulmonary circulation & ventilation, Respiratory control & response to stress, Pulmonary function test & it's significance.

Unit 4: Renal & Reproduction physiology (10 hrs.)

Ionic composition & distribution of body fluids, Body fluid osmolality dialysis & dehydration. Biophysical aspects of renal filtration & blood flow, Renal tubular function, Concepts effective circulation volume, Autoregulation, Reabsorption & secretion, Renal regulations of acid base balance. Hormonal control of reproductive mechanisms, Morphology & dynamics of sperm, kinematics parameters of sperm movement & sperm motility, Basic principles of assisted reproductive technology- IUI, IVF techniques.

Unit 5: Aviation, High Altitude, Space & Deep-sea physiology. (5 hrs.)

Effect of low oxygen pressure on body, mountain sickness, clinical lessons at high altitude, Effect of acceleratory forces on the body in aviation & space physiology. Radiation & temperature, Problems at high altitude & space, weightlessness in space, Physiological adaptation to space flight. Physiology in deep sea diving & other high-pressure operations.

Recommended books: - Refer Annexure for detail book titles.
5,7,29,34,35,42,51,95,105,121,122,124,131,156.

BPT-202: Membrane & Ion Channel Biophysics

[Total Marks: 100] [Exam Duration: 3 hrs] [Total Workload: 45hrs][Credit 3]

Unit 1: Membrane Structure. (10 hrs)

Various membrane models, Carbohydrate, Lipids & Proteins, Components of cell membrane, Composition of biological membranes- lipid molecules, proteins, glycoprotein, membrane skeletons, forms of lipids and proteins, electrical properties of lipids and proteins, Principles of membrane organization & stability, Biogenesis of cell membrane, Self-organization of lipids and proteins- linear aggregates of membranous components, aggregation of lipid molecules in mycelia and lipid double layers, biologically important non-lamellar lipid phases, formation of flexible membranous nanodomains, lateral phase separation of membranous components, aggregation of nanodomains, formation and stability of membranous nanotubes, Elastic properties of membranes: deformations in levels of a membrane, flexible energy, influence of forms of membrane components and direct interactions between membranous components in elastic properties of membranes, lateral distribution of membranous components and elastic properties of membranes, elastic properties of membranes and forms of cells and organelles, influence of cytoskeleton on forms of cells, Molecular motion in membrane & membrane fluidity, Protein lipid interactions, Phase properties of biological membranes.

Unit 2: Membrane potential. (10 hrs)

Nature & magnitude of cell surface charge, Electric properties of membranes: electric double layer, Poisson-Boltzmann theory of electric double layer, Gouy-Chapman model of electric double layer, free energy of electric double layer, influence of final size of molecule and distribution of charge within individual molecules on the properties of an electrical double layer, influence of size and distribution of electrical charge of a membrane on transport of electrified molecules through a membrane, bonds and adhesion of electrified molecules on the surface of a membrane, Hodgkin Huxley equation, membrane impedance, Relation between membrane potential & cell characteristics, Zeta, Stern & total electrochemical potential, Helmholtz-Smoluchowski equation; it's correction by Debye-Huckle theory. Thermodynamic & kinetic approaches to membrane potential, Calculation of electrochemical potential by Nernst equation, Transmembrane potential & it's measurement by microelectrodes.

Unit 3: Transport across the membrane. (10 hrs)

Osmosis and Diffusion as experimental techniques

Electrostatic interaction between membrane surfaces: influence of components of solvents on the interaction between membranes, influence of electrical properties of molecules in solvents on the interaction between membranes, adhesion of membranes, Diffusion, Fick's law. Diffusion in two compartment & multi compartment systems, Mechanisms of simple diffusion & facilitated diffusion, Diffusion of no electrolytes across the membrane, Rate theory of membrane transport, electro diffusion, Osmosis, Osmotic pressure, Osmotic equilibrium, Donnan equilibrium, flow of water & of solute, Electro osmosis, Molecular basis of aqueous channels. **Surface tension-** Definition, angle of contact, interfacial tension, capillary rise, determination of surface tension, temperature effect, prepration of liposomes & their utility ,significance of surface tension in membrane biophysics.

Unit 4: Active transport. (10 hrs)

Nature, Selective permeability of biomembrane, Selectivity & ion specificity of biomembrane, Ion channel structure and gating function, Ion channel types and characterization, Role of carriers in ion transport (ex: -Valinomycin & gramicidin), Transporting ATPase-Na-K ATPase, Calcium ion transporting ATPase of sarcoplasmic reticulum, Transport of macromolecules with & without vesiculation & by intermediate mechanism, Transport and communication between cells and organelles: mechanisms of micro- and nano-vesiculation, influence of electrical properties of membranes and solvents on the vesiculation of membranes, endocytosis, exocytosis, fusion of vesicles, encapsulation of nano-particles and DNA, influence of detergents and nano-particles on vesiculation and forms of membrane, mechanisms of stability and formations of membrane nanotubes and their role in the transport of substances between cells and between cell organelles. Microvesiculation of membranes and its role in spreading tumours and creation of blood clots. Mechanisms of creation and stability of membrane pores.

Unit 5: Membrane Energetics. (5 hrs)

Flow sheet of Membrane Energetics, Chloroplast membrane & energy transduction, Energy transduction through mitochondrial membrane.

Recommended books: - Refer Annexure for detail book titles.
1,3,5,6,7,11,13,14,15,16,18,21,22,24,29,30,32,58,60,61,64,69,70,73,74,78,102,103,105, 106,107,108,110,111,112,113,115,116,117,118,155

BPT-203: Physicochemical Techniques

[Total Marks: 100] [Exam Duration: 3 hrs] [Total Workload: 45 hrs][Credits 3]

Unit 1: Hydrodynamic Techniques. (10 hrs.)

Centrifugation & Ultracentrifugation - Basic principles, Forces involved, RCF Centrifugation, techniques- principles, types and applications. Centrifuges &Ultracentrifuges-types, optical methods used and applications of preparative [Differential, Density Gradient] and analytical [sedimentation velocity, sedimentation equilibrium] ultracentrifugation.

Viscometry- General features of fluid flow nature of viscous drag for streamlined motion. Definition of viscosity coefficient. Stroke's law and terminal velocity. Determination of viscosity coefficient of liquids, viscometric measurement, Types of viscometers, Relation between intrinsic viscosity and molecular weight, Measurement of Viscoelasticity,

Unit 2: Physicochemical Fractionation (10 hrs.)

Chromatography -Basic Concepts of Adsorption & Partition Chromatography, Principle Experimental set-up, Methodology & Applications of all types of Adsorption & Partition Chromatography methods-chromatography using paper, thin layer, HPTLC column (gel filtration, ion exchange, affinity), gas(GC,GLC)and HPLC: types of HPLC**,** Mobile phase elution , normal phase and reverse-phase HPLC, column packing material, efficiency of column ,types of HPLC – principles of methodologies ; HPLC pumps -efficiency and suitability, Different injectors and Detectors; Ion Chromatography.

Membrane Techniques - Criteria of protein purity, equilibrium dialysis, ultra filtration and various membrane techniques,

Unit 3: Electro-analytical Techniques. (10 hrs.)

Electrophoresis- Principle, Electrophoretic mobility(EPM) estimation, factors affecting EPM, Instrument design & set-up, Methodology & Applications of Free & Zone (Paper, Cellulose acetate, Agarose & Starch gel gel, Pulsed-field, PAGE, SDS-PAGE, Capillary) Electrophoresis techniques, Principle, Experimental set-up, Methodology & Applications isoelectric focusing, 2D electrophoresis

Unit 4 : Basic Spectroscopic techniques (15 hrs.)

Spectroscopy- Basic principles, nature of electromagnetic radiation, Interaction of light with matter, Absorption and emission of radiation; Atomic & Molecular Energy levels, Atomic & Molecular spectra , Principle , Instrumental Design, Methods & Applications of UV–Visible spectroscopy, Beer-Lambert's law; applications of UV-visible difference Spectroscopy, IR & Raman spectroscopy FT-IR, Attenuated Total Reflectance (ATR), Near infra red Spectroscopy (NIR) -theory and applications. Atomic Absorption spectroscopy- Inductively coupled plasma atomic emission spectrophotomerty .

Recommended books: - Refer annexure for detail book titles.
1,5,7,8,9,14,15,17,19,21,26,28,29,60,69,98,101,140,155.

BPT-204: Molecular Biology & Genetics

[Total Marks: 100] [Exam Duration: 3 hrs] [Total Workload: 45 hrs][Credits 3]

Unit I :Genome Organization (08hrs)

Mendelian genetics,Extra chromosomal Inheritance- Mitochondrial, chloroplast & maternal inheritance. Polygenic inheritance, heritability & its measurements, QTL mapping.

Nucleic acids as a genetic material, Topology of nucleic acid &role of topoisomerases, concept of gene, Chromosomal organization in prokaryotes, eukaryotes & Viral systems, Spatial arrangement &role of histone, chromatin subunit, Nucleosomes, Solenoid model, loops, domains & scaffolds in chromatin, Laws of DNA constancy& C-value paradox, Concept of Repetitive DNA, Selfish DNA, Split genes, Pseudogenes, cryptic genes, Promiscuous DNA, Multigene families, DNA replication in prokaryotes and eukaryotes- mechanism, enzyme involved.

Unit II: Gene Expression.(10 hrs)

Central dogma of molecular biology, Genetic code, silent features of genetic code, protein synthesis-mechanism of transcription in prokaryotes and eukaryotes, m-RNA synthesis and processing (capping , splicing, RNA editing, poly adenylation) role of ribozymes, ribosomes structure and function of different components, shine-dallgrno sequence, TATA box, termination of transcription. Mechanism of translation, formation of aminoacyl t-RNA initiation, elongation, termination of polypeptide synthesis, translation in chloroplast and mitochondria, post translational modifications.

Unit III: Regulation of Gene Expression.(09 hrs)

Regulation of gene expression in prokaryotes, concept of inducer and repressor, operons and transcriptional regulation (lac operon , tryptophan operon, leucine responsive protein (LRP)), sigma (σ) factor and transcriptional control. Post transcriptional regulation, Leader sequences and attenuators, alternative splicing, role of antisense RNA-regulation in bacteriophages Cro gene and λ repression proteins. Gene expression control in eukaryotes-role of specific DNA sequences, modifications in DNA transcripts and histone proteins. Regulation at translational level, phosporylation of translational machinery, masking of m-RNA, regulation by gene rearrangement, W-D repeat proteins.

Unit IV: Mutation and Repair.(09 hrs)

Molecular basis of Mutation, types of mutations, spontaneous mutations, base analogues (5-Bromo Uracil, 2-amino purine) tautomeric shift and frame shift mutations. chemical mutagens, intercalating substances, mutator genes, site specific mutagenesis and mutational hot spots, methods for isolation of mutants. Physical mutagen, biochemical mechanism of repair, photo reactivation, excision repair , SOS repair etc.

Unit V: Genetic Recombination.(09 hrs)

Genetic recombination between homologues DNA sequences, holyday model, Role of rec A proteins, meiotic recombination (linkage and crossing over). Transformation, transforming principle, competence, uptake and fate of DNA, conjugation- mechanism of conjugation, Role of F plasmid, Hfr. transduction-lytic and lysogenic cycles, generalized and specialized transduction. Transposition- transposable elements, insertion sequences, bacterial transposons, transposable elements in eukaryotes.

Recommended books: - Refer Annexure for detail book titles.
5,10,11,21,23,24,29,30,31,55,58,59,61,62,63,72,76,79,80,81,88,118.

BPT -205 : Research Methodology

[Total Marks: 50] [Exam Duration: 2hrs] [Total Workload: 15hrs] [Credits : 1]

1 Research meaning, objectives and motivation, Types and methods of Research, Research approaches, Significance of research & importance of knowing how research is done, Research process & Scientific methods, Criteria of good research; Problems encountered by researchers in India; Personal attributes, skills habits and attitudes for research; Psychological phases of PhD process, Research Ethics;

2 Types of Literature search Review of Literature– Formulation of Hypothesis,

3 Identification and selection of research problems, preparation of research proposal, synopsis,

4 Research designs, Features of good design;; Basic principles of experimental design ,Types of research design, sample design, measurement and scaling techniques, Experimental and modeling skills,

5 Data Collection Techniques, processing of the data, statistical analysis of data, sampling fundamentals, testing the hypothesis,

6 Meaning of Interpretations; Techniques of Interpretation, Precautions in Interpretations,

7 Thinking processes problem solving and creativity Level and styles of thinking; Common-sense and scientific thinking; Problem solving strategies-reformulation or rephrasing. Techniques of representation, Logical thinking, division into sub-problems,

8 Creativity - Some definitions, illustrations from day to day life; gift or skill; creative process; requirement of creativity- role of motivation and open v/s closed minds; Multiple approaches to a problem analytical v/s analogical reasoning, puzzle solving;

BPP-211: Lab. Course-5 : (Practicals based on BPT-201 & 202)

[Total Marks: 50] [Exam Duration: 6 hrs] [Total Workload: 90hrs] [Credits: 3]

1 To record the Respiratory movements in man using stethograph.
2 To determine the Breath holding time in man.
3 To study the effect of maximum voluntary ventilation on respiration.
4 To study the effects of swallowing, yawning and talking on respiration.
5 To study the effects of exposure to cold and hot environment on human subject.
6 To measure the pulse rates at various parts of the human body using stethoscope.
7 To measure the Heart beat rate in man using stethoscope.
8 To record the compound action potential and conduction velocity in frog's sciatic nerve.
9 To record the simple muscle twitch and study of the effect of stimulus response relationship.
10 To study the properties and excitability patterns of muscle and nerve fibre types in intact and isolated preparations.
11 To study the genesis of tetanus.
12 To study the effect of free and after loading on frog's gastronemacus muscle.
13 To study the effect of Fatigue.
14 To study the physiological changes under extreme conditions (high RCF, low oxygen pressure, zero gravity conditions.)
15 Assignments on various aspects using signal acquisition systems. ADInstruments-LAB Tutor and other protocols
16 To study the Erythrocytes Membrane Permeability and Transport effects of Hypotonic & Hypertonic shock.
17 To determine the osmotic fragility of RBC.
18 To determine the partial characteristics of Membrane Protein by SDS-PAGE.
19 To analyze the Erythrocytes membrane lipids by TLC.
20 To determine Osmolarity of solutions using Osmometer.
21 Passage of molecule through dialysis membrane and demonstrations of Donnan Membrane equilibrium.
22 To study the interactions of Detergent and other Membrane active agents with RBC membrane & effect of incubation time, Temperature & concentration.
23 To study the Permeability of model membrane (Liposome) anions.
24 To study the effect of cholesterol on the anion permeability of a Phospholipid membrane.
25 Preparation of Liposome.
26 To demonstrate the cell fusion using high DC (Direct current) field.
27 To isolate the chloroplast and characterize the chloroplast membrane protein.
28 To measure the Membrane potential using Fluorescence techniques.
29 To measure the membrane conductance.
30 To study the phase transition in lipid bilayer membrane.

BPP 212 : Lab Course - 6 : Practicals based on BPT 203

[Total Marks: 50] [Exam Duration: 6 hrs] [Total Workload: 90hrs] [Credits: 3]

1. To familiarize in the use of pH meter and Colorimeter.
2. One-dimensional Ascending & Descending Paper chromatography of Amino acids & sugars
3. Two-dimensional Ascending & Descending Paper chromatography of Amino acids.
4. One-dimensional Ascending & Descending TLC of Amino acids & sugars
5. Two-dimensional Ascending & Descending TLC of Amino acids & sugars.
6. HPTLC of Amino acids & sugars
7. Fractionation of Sugars from fruit juice using TLC/HPTLC
8. Column Chromatography for Proteins, Pigments,aminoacids.
9. Paper Electrophoresis of Amino acids.
10. Cellulose acetate strip Electrophoresis of Amino acids.
11. Paper Electrophoresis of Proteins.
12. Cellulose acetate strip Electrophoresis of Proteins
13. Agar Gel Electrophoresis of Proteins
14. Polyacrylamide Gel Electrophoresis (PAGE).
15. SDS- Polyacrylamide Gel Electrophoresis (PAGE).
16. To study the structure based visco-elastic properties of proteins, nucleic acids, sugars, lipids using Ostwald's Viscometer.
17. To perform image analysis using CCD camera of Microscopic dynamic Images.
18. To study the renal stone using Infra-Red (IR) Spectroscopy.
19. To determine the oil content of oil seeds using Nondestructive IR Spectrophotometry.
20. To perform the separation of Proteins using Capillary Electrophoresis.
21. To perform the separation of Proteins using HPLC
22. To study the co-relation between Concentration, Size, Shape of the molecules and Viscosity characteristics using digital viscometer.

BPP 213 : Lab Course - 7 : Practicals based on BPT 204

[Total Marks: 50] [Exam Duration: 6 hrs] [Total Workload: 90hrs] [Credits: 3]

1 To isolate the chromosomal DNA from Prokaryotes and Eukaryotes.
2 To isolate the RNA.
3 Induction of mutation and Isolation of Mutants.
4 To study the chromosomal aberrations due to radiation.
5 Conformation of Nucleic acid by Spectral study.
6 To isolate and characterize Plasmid DNA.
7 To hydrolyze the t-RNA and separation of Nucleotides by TLC and paper chromatography.
8 Experiments on transformation.
9 Resriction digestion and agarose gel electrophoresis of DNA
10 Demonstration on Southern Blotting.
11 Demonstration on Western Blotting.
12 To study the Giant chromosomes (Lamp brush or Polytene chromosome).
13 To isolate the Antibiotic resistant Mutants.

BPP 214 : Science Communication Skills

[Total Marks: 100] [Exam Duration: 3hrs] [Total Workload: 15hrs] [Credits: 1]

Background of skills

- Reading Skill :Reading tactics and strategies, Reading purpose and meaning, Reading outcomes, structure of meaning
- Listening Skill: Barriers to listening, Effective listening skills, Attending telephone calls, Note-taking; Speaking and discussion Skill: Component of effective talk / presentation, Effective speaking skills, Discussion skills
- Writing skills and techniques of writing,Guidelines for effective writing, Writing styles for application with personal resume, Business letter and memo including requests, complains, Technical report writing, Development of paragraph, Development of story.
- Definition and kinds of scientific documents – research paper, review paper, book reviews, thesis, conference and project reports (for the scientific community and for funding agencies). Publication – role of author, guide, co-authors. Components of a research paper – the IMRAD system, title, authors and addresses, abstract, acknowledgements, references, tables and illustrations. Structure, style and contents; Style manuals (Chicago, Harvard, Vancuvour, APA, MLA); Citation styles: Footnotes, references; Evaluation of research, Dealing with publishers – submission of manuscript, ordering reprints.
- Report writing- Significance of Report writing; Different steps in Report writing; Mechanics and precautions of writing research reports; Layout of the Research project; Types of reports
- Preparation of thesis outline & skeleton, Thesis pre-submission abstracts/synopsis, Thesis writing, Preparation and submission of research project proposals to funding agencies.
- Oral presentation, Oral and poster presentation of research papers in conferences/symposia

Assignments :

1 Performing Literature survey and compilation .
2 Writing Review articles.
3 Writing research Papers and abstracts .
4 Five assignments on Proposal writing
5 Writing book reviews,
6 Writing Conference / Symposium reports
7 Resume Writing for various employments
8 Writing research proposal for financial assistance
9 Giving Presentations in group discussion,
10 Giving oral & poster presentation
11 Writing general informative articles in science & technology

ANNEXURE: -

Recommended Books and Journals.

1. Ackerman E.A. Ellis, L.E.E. & Williams L.E. (1979), Biophysical Science, Prentice-Hall Inc.
2. Barrow. C. (1974), Physical Chemistry For Life Sciences, McGraw-Hill.
3. Berns M.W. (1982), Cells, Holt Sounders International Editors.
4. Bloomfield V.A. and Harrington R.E. (1975), Biophysical chemistry, W.A.Freeman and CO.
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6. Cantor C.R. and Schimmel P.R. (1980), Biophysical chemistry, W.A.Fremman and Co.
7. Casey E.J. (1967), Biophysics, concepts and mechanisms. Affiliated East west press.
8. Chang R. (1971), Basic principles of spectroscopy, McGraw-Hill.
9. Crabbe P. (1972), ORD and CD in chemistry and biochemistry, Academic Press.
10. De Robertis E.D.P. and De Robertis E.M.P. (1981), Essentials of cell and molecular Biology, Holt sounders International Editions.
11. Dickerson R.E.& Geis I. (1972), Proteins: structure, function and evaluation, Benjamin.
12. Dugas H. and Penney C. (1981), Bioorganic chemistry, Springer-Verlag.
13. Fleischer S. Hatefi Y. McLennan D.H. and Tzagoloff A. (1977), The molecular biology of Membranes, Plenum press.
14. Haschemyer R.N. and Haschemyer A.E.B.V. (1973), Proteins**,** John willey and sons.
15. Hughes W. (1979), Aspects of Biophysics, John willey and sons.
16. Jain M.K. and Wanger R.C. (1980), Introduction to Biological Membranes, John willey and sons.
17. James T.L. (1975), Nuclear Magnetic Resonance in Biochemistry, Academic press.
18. Lehninger A. (1981), Biochemistry, Butter Worth Publication.
19. Pesce A.J., Rosen C.G and Pasty T.L., Fluorescence Spectroscopy: An introduction for Biology and Medicine, Marcel Dekkar.
20. Pullman B. (1978), Molecular Association in Biology, Academic Press.
21. Quagliokiello E., Palmieri F. and singer, T.P. (1977), Horizons in Biochemistry and Biophysics (all volumes) Addison Wesley Publishing Company.
22. Quinn P.J. (1984), The Molecular biology of cell Membranes, Macmillan.
23. Saenge W. (1984), Principles of Nucleic acid structure, Springer-Verlag.
24. Schule G.E. and schirmer R.H. (1984), Principles of protein structure, Springer-Verlag.
25. Segel F.H. (1975), Enzyme Kinetics, John willey and sons.
26. Setlow R.B. and pollard E.L. (1962), Molecular Biophysics, Pergamon Press.
27. Sheelk P. and Birch D.E. (1983), Cell Biology Structure, Biochemistry and function, John willey and sons.
28. Spragg S.E. (1980), Physical Behavior of macromolecules with biological functions, John willey and sons.
29. Stanford J.R. (1975), Foundation of Biophysics Academic press.
30. Stryer L. (1981), Biochemistry, W.A. Freeman and Co.
31. Szekely M. (1984), From DNA to protein, Macmillan.
32. Volkenstein M.V. (1977), Molecular Biophysics, Mir Publication.
33. Bach J. F. (1978), Immunology, John willey and sons.
34. Basar E. (1976), Biophysical and physiological system Analysis, Addition-Wesley.
35. Cameron J. R. and skofronick J.G. (1978), Medical Physics, John willey and sons.
36. Casarett A.P. (1968), Radiation Biology, Prentice-hall Inc.
37. Castellan A. and Querela I.F. (1979), Synchrotron Radiation, Applied to Biophysical and Biochemical Research, Plenum Press.
38. Clause W.D. (1958), Radiation Biology and Medicine, Addison-Wesley.

39. Eisen H.N. (1980), Immunology, Harper and Row publishers.
40. Geides A. (1979), Electrodes and Measurements of Bioelectric events, John Willey and sons.
41. Grosch D.S. (1979), Biological effects of Radiation, Academic Press.
42. Guyton A.C. (1981), Textbook of Medical Physiology, Sounders co.
43. Horrocks D.L. (1971), Organic and liquid scintillation counting, Academic Press.
44. Howard L. A. (1974), Radiation Biophysics, Prentice Hall Inc.
45. Knoll G.E.(1979), Radiation detection and measurement, John willey and sons.
46. Martin A. & Harbisan S.A. (1982), An introduction to Radiation Protection, Chapman and hall Publication.
47. Moorse B.M., Panker R.P. and Pullman B.R. (1981), Physical aspects of medical imaging, John willey and sons.
48. Banks S.M. (1983), Photosynthetic system: structure function and symmetry, John willey and sons.
49. Rahatgee K.K. (1978), Fundamentals of photochemistry, John willey and sons.
50. Roit I.M. (1977), Essential immunology, Blackwell scientific Publication, Oxford.
51. Ruch J. and Patton H.D. (1973), Physiology and Biophysics (all volumes), W.B. sounders co.
52. Dhurnburn C.C. (1972), Isotopes and Radiation in Biology, Butter worth and Co.
53. Vince-Paupe D. (1975), Photoperodism in plants, McGraw Hill
54. Wilkum C.B. (1966), Fundamentals of immunology, Interscience publishers.
55. Old R.W., Primriose S.B. (1980), Principles of gene manipulation (An introduction to genetic Engineering), Blackwell sciences.
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57. David M.Gates (1981), Biophysical Ecology, Springer-verlag.
58. Geoffrey L. Zubay, William W. Parson, Dennis E. Vance. (1995), Principles of Biochemistry, Wm.c.Brown Publishers.
59. Sambrook and Russell (2001), Molecular cloning (A laboratory Manual) cold spring Harbor Laboratory Press.
60. Henry B. Bull (1971), An Introduction to physical biochemistry, F.A.Devis Co.
61. Gerald Karp (1996), Cell and Molecular biology concepts and experiments, John willey and sons, Inc.
62. Beniamin Lewin (2000), Gene-VII. Oxford Uni. Press.
63. Beniamin Lewin (1994), Gene-V. Oxford Uni. Press.
64. Loewy Sickevitz, Menninger, Gallant (1991), Cell structure and function, Sounders college pub.
65. Laszlo, Patthy (1991), Protein Evolution, Blackwell science.
66. Christopher H. Wharton, Robert Elsenthal A.B. (1981), Molecular Enzymology Thomson Litho ltd.
67. Nicholas C. Price, Lewis Stevens (1999), Fundamentals of Enzymology (The cell and Molecular Biology of catalytic proteins), Oxford University.
68. Jean Brachet (1985), Molecular cytology, Academic press.
69. Hans Netter (1969), Theoretical Biochemistry, Oliver and Boyd, Springer-verlag Press.
70. Carl Branden and John Tooze (1991), Introduction to protein structure, Garland publishing, Inc.
71. Myron L. Bender, Raymond J.Bergeron, Makoto Komlyama (1984), The Bioorganic chemistry of Enzymatic catalysis, John willey and sons.
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73. Thomas E. Creighton (1994), Proteins: Structure and Molecular properties, W. A. Freeman and co.
74. M. Satake, Y.Hayashi, M.S. Sethi & S.A.Iqbal (1997), Biophysical chemistry, Discovery publishing house.

75. N. B. Strazhevskaya (1972), Molecular Radiobiology, John willey and sons.
76. Rogor L.Miesfeld (1999), Applied molecular genetics, John willey and sons.
77. C.Edward Gasque (1992), A manual of lab. Experience in Cell biology, Universal stall.
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87. Robert K. Scopes (1994), Protein Purification Principles and practice, Narosa Pub. House.
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89. Victor Arena, Ionizing Radiation and life.
90. B.L.Diffey (1989), Radiation Measurement in photobiology, Academic press.
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96. B.R. BAIRI, B.Singh, N.C.Rathod, P.V. Narurkar (1994), Handbook of nuclear medicine instrumentation. Tata McGraw Hill.
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127.T. K. Attwood and DJ Parny. Smith (1999), Introduction to Bioinformatics: Cell and Molecular biology in action series, Pearson education Asia.
128.R. Mannhold, H. Kubinyi, H. Timmerman (2002), Bioinformatics form genomes to drugs. Vol.-I, Wiley- VCH.
129.Reiner Westermeier, Tom Naven (2002), Proteomics in practice, Wiley- VCH.
130.C. STAN TSAL (2002), An introduction to computational biochemistry John Willey and sons Inc.
131.John bullock, Joseph Boyle, Michael B. Wang (2001), Physiology, Lippincott, Williams and Wilkins.
132.Pal Kalla, Ravishankar (2000), Health effect on computer uses, Himalayas publishing House.
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135.Manisha Dixit (2000), Internet an Introduction, Tata McGraw-Hill.
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138.Pitter Norton's (1999), Introduction to Computers, Tata McGraw Hill.
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144. Bailey, (2000), Statistical Method in biology.
145. Daniel Wayle W., Biostatistics (A foundations for analysis in health sciences).
146. Khan, Fundamental of Biostatistics.
147. Lachin, Biostatistical Method.
148.Kendrick C.Smith, The Science of Photobiology, plenum Press.

149.Andreas D. Baxevanis, B. F. Francis Oulellette, (2001), Bioinformatics – A practical guide to analysis of Genes and Proteins, Wiley-Interscience.
150.Hooman H. Rashidi, Lukas K. Buehler (2000), Bioinformatics- Applications in Biological Science and Medicine, CRC.
151.Stephen Misener and Stephen A. Krawetz (2000), Bioinformatics methods and protocols, Humana press.
152.Andrew R. Leach (2001), Molecular modeling principles and applications, Prentice Hall, 153.Oren M. Becker and others, Computational biochemistry and biophysics, Marcel Dekker Inc.
154.T. Schlick (2002), Molecular modeling and simulation- an interdisciplinary guide, Springer.
155.Friefelder D, Physical Biochemistry, W. H. Freeman and co.
156.Brobeck J. R., Best and Taylor's Physiological bases of medical practice, The Williams and Wilkins co.
157.Coggle J. E., Biological effects of Radiation, Taylor and Francis.
158.Altman K. I., Gerber G.B. and Okada S. Radiation Biochemistry Vol. -I, II. Academic press.
159.Orton C. G., Radiation Dosimetry: Physical and Biological aspects, Plenum press.
160.Dunn F. & O'Brien W. D., Ultrasonic Biophysics, Dowden-Hutchinson & Ross Inc.
161.Steel C. G., The Biological basis of Radiotherapy, Elsevier.
162.Johns H. E. & Cunninghan J. R., The physics of Radiology, Charles C. Thomas USA.
163.Attix F. H., Roesch, W. C. & Tochilin, E., Radiation Dosimetry Vol.- I, II, III, Academic press.
164.Saylor W. L. & Ames T. E. Dosages calculation in Radiation therapy, Urban and Schwarzenberg, Baltimore.
165.Harbert J. C. & Rocha A. F. C. Text Book of Nuclear Medicine, Lea & Febiger, Philadelphia.
166.Sorensen J. A. & Phelps M. E. Physics of Nuclear Medicine, Grune and Stratton.
167.Belcher E. H. & Vetter H. Radioisotopes in Medical Diagnosis, Butterworths.
168.Wagner H. N. Principles of Nuclear Medicine, W. B. Saunders & Co.
169.Khandpur R. S., Handbook of Biomedical Instrumentation, Tata McGraw-Hill Publishing Co. Ltd.
170.Stuart A. Hoenig & Daphne H. Scott, Medical Instrumentation and Electrical Safety, Wiley Medical.
171.Joseph J. Carr & John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and Sons.

JOURNALS: - Recent advance Pertaining to various sections are generally reported in the following generals; Students are encouraged to keep themselves abreast of the subject from them.

Nature
Science
Scientific American
Journal of Molecular Biology
Journal of Biological chemistry
Annual Review of Biochemistry
Biochemica Biophysica Acta
Radiation Research
Immunology today.
International Journal of Radiation biology.
Radiation and Environmental Biophysics.
Photochemistry and Photobiology.
Physiological Reviews.
Current Science.
Resonance.
Annual Reviews in Biophysics and Bimolecular chemistry.
Indian Journal of Biophysics and Biochemistry.
Indian Journal of Experimental Biology.
Proceedings of Indian National Science Academy Part-B (Biological sciences).
Annual Review in plant physiology.
Annual Review in Microbiology.
Bio-techniques ……..

Most Important Note :-
The use of internet surfing for exploring the Latest Information should be compulsory to enrich the knowledge.

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