



**BHARATI VIDYAPEETH
(DEEMED TO BE UNIVERSITY), PUNE**

**FACULTY OF INTERDISCIPLINARY STUDIES
M.Sc. - Medical Biotechnology
New Syllabus**



BVDU – RGITBT – M.Sc.
Medical Biotechnology
Syllabus - 2018

**BHARATI VIDYAPEETH DEEMED TO BE
UNIVERSITY
PUNE**

**REVISED SYLLABUS FOR
MASTER OF SCIENCE
M.Sc. IN MEDICAL BIOTECHNOLOGY
UNDER
FACULTY OF INTERDISCIPLINARY
STUDIES**

**SYLLABUS OF SEM I – SEM IV UNDER
CHOICE BASED CREDIT SYSTEM
To be effective from Academic Year
2018-19**

Bharati Vidyapeeth Deemed To Be University is a multidisciplinary, multicampus university having 32 Institutions imparting quality education in various disciplines. All programmes of the University are approved by UGC and respective statutory councils. BVDU has been re accredited for the third time with 'A+' grade by NAAC in 2017. UGC has accorded 12B Status [UGC ACT1956] to the university. Ministry of Human Resource and Development, Government of India has awarded "A" category to the University in 2012 based on parameters including innovative programs, research and infrastructure facilities. The University is a member of Association of Indian Universities [AIU] which has ranked BVDU among top 10 universities of India for International students' enrollment. BVDU is also a member of International Association of Universities.

Rajiv Gandhi Institute of IT and Biotechnology is a constituent unit of BVDU established in 2003. The Institute is approved by UGC to conduct graduate and post graduate courses in Biotechnology. The Institute has excellent infrastructure, state-of-the-art laboratories and competent faculty facilitating appropriate learning environment. The Institute offers one undergraduate and four postgraduate programmes in Biotechnology.

INTRODUCTION

The Master of Science (M.Sc.) in Medical Biotechnology is a full time post graduate programme offered by Bharati Vidyapeeth Deemed University (BVDU) in its constituent unit Rajiv Gandhi Institute of IT and Biotechnology. The course was initiated in the year 2012 and was designed to facilitate empowerment of students to face cutting edge technological applications biomedical and pharmaceutical biotechnology sector. The main advantage of proposing this course was availability of the expertise in biotechnology and medical disciplines in the same campus. The course received very encouraging response from all its stakeholders. On its implementation for five years, the curriculum is being revised to embrace newer emerging disciplines and value added courses. The revised M.Sc. Medical Biotechnology is a full time 104 credits Programme to be implemented in Rajiv Gandhi Institute of IT and Biotechnology from the academic year 2017-18. The feedback of students, alumni, faculty, employers and parents has a substantial contribution in designing of this curriculum.

OBJECTIVES

1. To impart deep knowledge of the discipline
2. Develop skills in relevant areas to enhance employment opportunities
3. Introduce emerging areas of pharma and biotech sector
4. Build interdisciplinary approach
5. Foster global competence among students
6. Inculcate social and moral values and sense of scientific responsibilities in students

ELIGIBILITY FOR ADMISSION TO THE COURSE

Candidates satisfying following criteria are eligible to apply for M.Sc. Medical Biotechnology Course

1. The candidate should have passed the Bachelors degree course in Biotechnology/ any branch of life science/ Pharmacy & Medicine from the recognized university with minimum of 50% or 45% aggregate marks for open and SC / ST category respectively at graduate level university examination.
2. Subject to above conditions, the admission will be based on the merit at Entrance Examination conducted by Bharati Vidyapeeth Deemed University.

DURATION OF THE COURSE

The course will be executed in four semesters. The medium of instruction and examination will be only English.

RULES FOR THE COURSE

1. The entire course is of 104 credits.
2. One credit for theory course is equivalent to 15 lectures/tutorials; while one credit for practical course is equivalent to 25 – 30 hrs. of lab /field work or demonstration.
3. The curriculum comprises of Core and Value Added courses. The Core Courses are compulsory where as Value Added are elective.
4. The Core Courses are aimed at providing fundamental knowledge of the discipline. The Value Added Courses intend to develop skills in relevant Pharmaceutical and Biotechnology Industry sector.
5. The teaching schedule for the 3 credits and 2 credits theory courses will be 3 and 2 lectures per week respectively. All courses will have one tutorial fortnightly.
6. The respective elective course will be implemented only if more than 10 students enroll for that course.
7. Some of the core courses in Semester I and Semester II are common in two master's programmes; M.Sc. Medical Biotechnology and M.Sc. Biotechnology.
8. The teaching and evaluation for these courses will be combined for both disciplines.
9. The shared courses are coded as MBT&MedBT whereas the courses which are exclusive for M.Sc. Medical Biotechnology are coded as MedBT
10. All core courses will be evaluated by University Examination. The Elective courses will be assessed by Continuous Assessment.
11. Two extra credits will be awarded to students if there is any significant outcome of their dissertation study. The research outcome in terms of publication in indexed national/International journal; filing of patent; or commercialization of technology will be considered for the award of credits.

RULES FOR EXAMINATION

A: Nature of Examination:

1. Each course will have 40% marks for internal assessment and 60% marks for semester-end examination.
2. The assessment for 1, 2, 3 and 4 Credits courses will be as given in following table

Table 1: Evaluation pattern for One to Four Credit Courses

Course Credits	Marks for UE (60% Weightage)	Marks for IE (40% weightage)	Total Marks for evaluation
2	30	20	50
4	60	40	100

- The duration of 60 Marks UE theory paper will be 2.5 Hrs and for 30 Marks 1.30 Hrs. respectively.
- The Internal Assessments (IA) will be conducted by the Institute and an end-of-the term University Examination (UE) conducted by the university. The UE will be based on the entire syllabus.

The performances at UE and IA will be combined to obtain the Grade Point Average (GPA) for the course.

STANDARD OF PASSING

A: Grading System: A 10-point absolute grading system will be adapted for grading in each head of passing. The system will have seven grade points, the highest being 10. The grading system shall be as shown in Table-1 below. The performance indicators O, A+, A, B+, B, C, and D shall respectively mean Outstanding, Excellent, Very Good, Good, Average, Satisfactory, and Poor.

Table-1: The grading system under CBCS

Range of Marks (out of 100)	Grade Point	Grade
$80 \leq \text{Marks} \leq 100$	10	O
$70 \leq \text{Marks} \leq 80$	9	A+
$60 \leq \text{Marks} \leq 70$	8	A
$55 \leq \text{Marks} \leq 60$	7	B+
$50 \leq \text{Marks} \leq 55$	6	B
$40 \leq \text{Marks} \leq 50$	5	C
$\text{Marks} < 40$	0	D

- The grade point average (GPA) for a course shall be calculated by first finding the total marks out of 100 for the course. The corresponding GP (as per the table) shall be the GPA for the course.

2. Two kinds of performance indicators, namely, the Semester Grade Point Average (SGPA) and the Cumulative Grade Point Average (CGPA) shall be computed at the end of each term. The SGPA measures the cumulative performance of a learner in all the courses in a particular semester, while the CGPA measures the cumulative performance in all courses up to and including the current semester. The CGPA of a student when he/she completes the programme is his/her final result.
3. The SGPA is calculated by the formula , $SGPA = \frac{\sum Ck \times GPAk}{\sum Ck}$ where Ck is the credit-value assigned to a course and $GPAk$ is the GPA obtained by the student in the course. In the above, the sum is taken over all the courses that the student has undertaken for the study during the semester, including those in which he/she might have failed or those for which he/she remained absent. **The SGPA shall be calculated up to two decimal place accuracy.**
4. The CGPA is calculated by the formula , $CGPA = \frac{\sum Ck \times GPAk}{\sum Ck}$ where Ck is the credit-value assigned to a course and $GPAk$ is the GPA obtained by the student in the course. In the above, the sum is taken over all the courses that the student has undertaken for the study from the time of his/her enrolment and also the during the semester for which CGPA is calculated, including those in which he/she might have failed or those for which he/she remained absent. **The CGPA shall be calculated up to two decimal place accuracy.**
5. The CGPA, calculated after the minimum credits specified for the programme are 'earned', will be the final result grace marks of 1, 2 or 3 may be awarded to a candidate at UE as per the university rules. **B: Standards of Passing and ATKT rules:**

1. For all Core Courses, both UE and IE constitute separate heads-of-passing (HoP). In order to pass in such courses and to 'earn' the assigned credits

- (a) the learner must obtain a minimum grade point of 5.0 (40% marks) at UE and also a minimum grade point of 5.0 (40% marks) at IA;

OR

- (b) If he/she fails in IA, then also the learner passes in the course, **provided that a minimum of 25% is obtained in IA and GPA for the course is at least 6.0**

(50%marks) in aggregate. The GPA for a course will be calculated only if the learner passes in that course.

1. A student who fails at UE in a course has to reappear only at UE as a backlog candidate and clear the HoP. Similarly, a student who fails in a course at IA has to reappear only at IA as a backlog candidate and clear the HoP. **A student who passes in aggregate in a course need not reappear even if he failed at IA if he/she obtains 25% at IA.**
2. The students of Semester I and II & III will be admitted to next Semester even if he/she gets backlog in any of the course. They can reappear in the next semester examination as a backlog candidate.

C: Award of Honours:

1. A student who has completed the minimum credits specified for the programme shall be declared to have passed in the programme. The final result will be in terms of letter grade and CGPA only and is based on the CGPA of all courses studied and passed. The criteria for the award of honours are given in Table 2.

Table 2: Criteria for the award of honours at the end of the programme

Range of CGPA	Final Grade	Performance Descriptor	Equivalent Range of Marks (%)
$9.50 \leq CGPA \leq 10.00$	O	Outstanding	$80 \leq Marks \leq 100$
$9.00 \leq CGPA \leq 9.49$	A+	Excellent	$70 \leq Marks \leq 80$
$8.00 \leq CGPA \leq 8.99$	A	Very Good	$60 \leq Marks \leq 70$
$7.00 \leq CGPA \leq 7.99$	B+	Good	$55 \leq Marks \leq 60$
$6.00 \leq CGPA \leq 6.99$	B	Average	$50 \leq Marks \leq 55$
$5.00 \leq CGPA \leq 5.99$	C	Satisfactory	$40 \leq Marks \leq 50$
CGPA Below 5.00	F	Fail	Marks below 40

THE FORMAT OF THE TRANSCRIPTS

The transcripts may be acquired by the students indicating his/her performance in every semester examination. The transcript shall show the performance indicators given in the following table, in addition to any other information.

Course	Course	Number	University	IA/CA	Grade	Result

Number	Discription	of Credits	Examination				Point Average (GPA)	
			Grade	Grade Point	Grade	Grade Point		
Total Cumulative Credits Completed		SGPA	CGPA	Equivalent Marks (%)	Note: GPA is calculated by adding the UE marks out of 60 and IA marks out of 40. The total marks out of 100 are converted to Grade Point, which will be GPA			

PATTERN FOR ASSESSMENT

A: Pattern of Evaluation for Internal Assessment of Theory Courses:

The weightage for Internal Assessment is 40%. Students for IA of every theory course will be assessed for total of 30 marks for 3 credit course and for 20 marks for 2 credit course which will be cumulative marks obtained in two separate assessments specified below.

1. Two internal written examinations of 15 marks each for 3 credit course and 10 marks each for 2 credit course. A total of the two tests will be considered.
2. An optional assignment/ oral/ open book examination may be undertaken if desired.

B. Pattern of Evaluation for Internal Assessment of Practical Courses:

The Internal Assessment for every practical course will be of 20 Marks for 2 credits and 40 marks for 4 credits practical courses. The students for IA will be assessed on the basis of;

1. Performance for every practical: 10 Marks/20 Marks for 2/4 Credits practical courses respectively. (Marks to be distributed depending on total number of practicals)
2. Assignment/ Oral examination/Tour Report: 10/20 Marks for 2/4 Credits courses

C: Pattern of question paper at University Examination

University Examination for 3 credit and 2 credit theory course will be of 45 marks and 30 marks respectively. **For 3 credit course**, the question paper will comprise of 6 questions, 3 questions each in section I and section II. Q1 of section I will be of 6 marks while Q2 and Q3

will be of 8 marks each .Q 4 of section II will be of 7 marks while Q 5 and Q6 will be of 8 marks each.All questions will be compulsory. The pattern of question paper will be as given on next page.

Pattern of question paper for 3 credit course of university theory examination of M.Sc. Medical Biotechnology 2018 CBCS Course

(Total Marks:45, Tme:2.00 Hrs.)

Instructions to Paper Setter:

- I. Question paper of each course will comprise of total 6 questions,
- II. Section I will have 3 questions and Section II 3 questions.
- III. All questions will be compulsory. Each question will carry an internal option of one extra sub-question.
- IV. Q. no 1 will be objective, comprising of 7 questions of 1 mark each. They will be based on entire portion of Section I. Students will have to attempt any 6 out of these.
- V. Q no 4 will be objective, comprising of 8 questions of 1 mark each. They will be based on entire portion of Section II. Students will have to attempt any 7 out of these.
- VI. Questions 2 & 3 of **Section I** and 5 & 6 of **Section II** will be descriptive and contain 3 sub-questions of 4 marks each out of which students will attempt any two.
- VII. Q 2 and 3 will be based solely on Unit I and II whereas Q 5 and 6 will be based on Unit III and IV of the syllabus respectively..
- VIII. Students will attempt answers to Section I and Section II in separate answer books

SECTION I

Q. 1 Attempt Any Six of the following (06)

- a.
- b.
- c.
- d.
- e.
- f.
- g.

Q. 2 Attempt Any Two of the following (08)

- a.
- b.
- c.

Q. 3 Write short notes on Any Two of the following (08)

- a.
- b.
- c.

SECTION II

Q. 4 Attempt Any Seven of the following (07)

- a.
- b.
- c.
- d.
- e.
- f.
- g.
- h.

Q. 5 Attempt Any Two of the following (08)

- a.
- b.
- c.

Q. 6 Write short notes on Any Two of the following (08)

- a.
- b.
- c.

For 2 credit course, the question paper will comprise of 4 questions, 2 questions each in section I and section II. Q1 of section I and Q3 of section II will be of 7 marks each while Q2 and Q4 will be of 8 marks each. All questions will be compulsory. The pattern of question paper will be as given on next page.

Pattern of question paper for 2 credit course of university theory examination of M.Sc. Medical Biotechnology 2018 CBCS Course
(Total Marks:30, Tme:1.50 Hrs.)

Instructions to Paper Setter:

- IX. Question paper of each course will comprise of total 4 questions,
- X. Section I will have 2 questions and Section II 2 questions.
- XI. All questions will be compulsory. Each question will carry an internal option of one extra sub-question.
- XII. Questions 1 of section I and 3 of section II will be objective, and contain 8 questions of 1 mark each out of which students will attempt any 7. They will be based on entire portion of Section I and section II respectively.
- XIII. Questions 2 of **Section I** and 4 of **Section II** will be descriptive and contain 3 sub-questions of 4 marks each out of which students will attempt any two.
- XIV. Q 2 and 4 will be based solely on Unit I and II of the syllabus respectively..
- XV. Students will attempt answers to Section I and Section II in separate answer books

SECTION I

Q. 1 Attempt Any seven of the following (07)

- i.
- ii.

- iii.
- iv.
- v.
- vi.
- vii.
- viii.

Q. 2 Attempt Any Two of the following (08)

- i.
- ii.
- iii.

SECTION II

Q.3 Attempt Any seven of the following (07)

- i.
- ii.
- iii.
- iv.
- v.
- vi.
- vii.
- viii.

Q. 4 Attempt Any Two of the following (07)

- i.
- ii.
- iii.

Pattern of Question Paper for 2 and 4 Credits Practical Courses at University Examination

D: Pattern for question paper of University Practical Examination of M.Sc. Medical Biotechnology 2018 CBCS Course

(Total Marks:30/60 for 2/4 credit courses, Time: 3 .00/6.00 Hrs.)

Q.1 Major Practical	(10/20)
Q.2 Spotting/Minor Experiment	(10/20)
Q.3 Viva	(05/10)
Q.4 Journal	(05/10)

Course structure of M.Sc. Degree Course in Medical Biotechnology
Under Choice Based Credit System

SEMESTER I

Course No. & Description	Title	Credits	IA	Univ. Exam	Total Credits
MBT&MedBT 101 Core Course-Theory	Microbiology	3	40	60	25
MBT&MedBT 102 Core Course –Theory	Biochemistry	3	40	60	
MBT&MedBT 103 Core Course –Theory	Cell & Developmental Biology	3	40	60	
MBT&MedBT 104 Core Course –Theory	Genetics	3	40	60	
MBT&MedBT 105 Core Course –Theory	Molecular Biology	3	40	60	
MBT&MedBT 106 Core Course –Practical	Biochemistry & Molecular Biology Lab	4	40	60	
MBT&MedBT 107 Core Course –Practical	Cell Biology & Genetics Lab	4	40	60	
MBT&MedBT 108 Core Course –Practical	Microbiology Lab	2	40	60	

SEMESTER II

Course No. & Description	Title	Credits	IA	Univ. Exam	Total Credits
MBT&MedBT 201 Core Course –Theory	Genetic Engineering	3	40	60	31
MBT&MedBT 202 Core Course –Theory	Analytical Biotechnology	3	40	60	
MBT&MedBT 203 Core Course –Theory	Immunology	3	40	60	
MBT&MedBT 204 Core Course –Theory	Genomics & Proteomics	3	40	60	
MBT&MedBT 205 Core Course - Theory	Nanobiotechnology	2	40	60	
MedBT 206 Core Course -Theory	Human Physiology	3	40	60	
MBT&MedBT 207 Core Course –Practical	Genetic Engineering and GenomicsLab	4	40	60	
MBT&MedBT 208 Core Course –Practical	Analytical Techniques and Proteomics Lab	4	40	60	
MBT&MedBT 209	Immunology	4	40	60	

Core Course - Practical	& Nanobiotechnology Lab			
MBT&MedBT 210 Elective Course I	Elective Bioentrepreneurship/ IPR I	2	Continuous Assessment	

Elective Courses in Sem II: 1) MBT 210: Elective Course I; Option I: Bioentrepreneurship, Option II: IPR I

SEMESTER III

Course No. & Description	Title	Credits	IA	Univ. Exam	Total Credits
MedBT 301 Core Course –Theory	Animal Tissue Culture & Stem Cell Biology	3	40	60	28
MedBT 302 Core Course –Theory	Medical Biochemistry & Drug Discovery	3	40	60	
MedBT 303 Core Course –Theory	Infectious Diseases	3	40	60	
MedBT 304 Core Course –Theory	Pharmaceutical Biotechnology & Molecular Diagnostics	3	40	60	
MBT&MedBT 305 Core Course-Theory	Biostatistics	2	40	60	
MBT&MedBT 306 Core Course-Theory	Research Methodology	2	40	60	
MedBT 307 Core Course-Practical	ATC & Pharma Biotech Lab	4	40	60	
MedBT 308 Core Course-Practical	Infectious Diseases & Biostatistics Lab	4	40	60	
MedBT 309 Core Course-Practical	Medical Biochemistry & Drug Discovery Lab	2	40	60	
MBT&MedBT 310 Elective Course II	Biomedical Waste Management/ Drug designing/ IPR II	2	Continuous Assessment		

Elective Courses in Sem III: 1) MBT 310: Elective Course I; Option I: Biomedical Waste Management, Option II: Drug designing, Option III: IPR II

SEMESTER IV

Course No. & Description	Title	Credits	IA	Univ. Exam	Total Credits
MBT&MedBT 401 Core Course	Research Project	20	40	60	20

Total Credits Offered: 25 C, Sem I+ 31 C, Sem II +28 C, Sem III+ 20C, Sem IV = 104 C

SEMESTER I

MBT&MedBT 101: Microbiology		Total
Core Course – Theory; 3 Credits		45L
UNIT I		
1	Microbial diversity: Bacteria Archaea	3
2	Cell structure and functions of bacteria.	3
3	Cell structure and functions of archaea and fungi.	4
UNIT II		
4	Microbial growth: Growth kinetics, cytokinesis, factors affecting growth of microorganisms.	4
5	Growth on different environment Extremophiles and their adaptations	3
6	Anaerobic microorganisms, cultivation and applications.	3
UNIT III		
7	Microbial interactions: Symbiotic interactions, parasitism, ammensalism and competition;	5
8	Microbial flora of healthy human host: Distribution and occurrence of normal flora in humans	5
9	Microbial pathogenesis: Host-microbe interactions; Bacterial, fungal and protozoalpathogenesis in humans.	4
UNIT IV		
10	Effect of Antimicrobial drugs: on bacterial, fungal and viral pathogens	4
11	Virology: Diversity, Classification of virus, Cytopathic effect of virus	3
12	Taxonomy, Molecular methods, Bergey's manual of systematic bacteriology.	4
References		
1. Brock Biology of Microorganisms 13 th eds, , Michael T.Madigan		
2. Prescott's Microbiology, 9 th eds, Joanne M. Willey		
3. Microbiology–6th Edition (2006), Pelczar M.J., Chan E.C.S., Krieg N.R., The McGraw Hill Companies Inc. NY		
4. General Microbiology - Stanier R.Y., 5th edition, (1987)Macmillan Publication UK.		
5. Introduction to Microbiology, 2nd Edn. Ingraham, J. L. and Ingraham C. A., Thompson Asia Pvt. Ltd., Singapore (2002).		

MBT&MedBT 102: Biochemistry		Total
Core Course – Theory; 3 Credits		45L
UNIT I: Biomolecules structure, functions		
1	Introduction: Scope and importance of biochemistry in biotechnology.	1
2	Carbohydrates, lipids and proteins - Structure, properties and biological role (functions) of carbohydrates, Proteins and lipids. Protein structure and Lectins- overview. Lipids and cell membranes – types of membrane lipids, phospholipids and glycolipids from bimolecular sheets. Monoglycerides and diglycerides- structure, properties and applications.	7

3	Hydrolytic products of polysaccharides & their applications. Bulk production of Malt, peptides, malto-dextrin, glue.	3
UNIT II: Metabolism		
4	Metabolism of carbohydrates and protein- Glycolysis, Glucogenesis, Citric acid cycle and Glycogen metabolism. Protein turnover and Amino acid catabolism, Biosynthesis of amino acids, urea cycle. Biosynthesis of carbohydrate and proteins-overview	5
5	Fatty acid metabolism and nucleic acid metabolism- Overview of Fatty Acid Metabolism, synthesis and degradation of fatty acids, De novo synthesis of Nucleotides	4
6	Oxidative phosphorylation and photophosphorylation Oxidative Phosphorylation – regulation – light reactions of Photosynthesis	3
UNIT III: Enzymology		
7	Introduction to enzymes- Classification of enzymes, specificity of enzyme action – monomeric and oligomeric enzymes. Allosteric enzymes. Structural Components of Enzymes – apoenzymes, prosthetic group, cofactors,	4
8	Mechanisms of reactions catalysed by enzymes – Metal activated enzymes – metalloenzymes –involvement of co enzymes, Enzyme Inhibition	4
9	Biotechnological applications of enzymes in various industries like fruit juice extraction, leather processing, Meat tenderization, Baking and dairy industry.	3
UNIT IV: Techniques		
10	Free and immobilised enzyme kinetics- Rationale and Methods of immobilization of enzymes: covalent coupling, cross-linking and entrapment methods. Properties of immobilized enzymes, Whole cell immobilization, Advantages of immobilization, Types of Carriers,. Applications of Immobilized enzymes:Production of High fructose corn syrup, invert sugar, synthetic penicillin.	4
11	Chromatography- Principle, types- gel, affinity, ion exchange, applications	3
12	Electrophoresis Principle of separation, factors affecting separation, types -paper, agarose gel, PAGE, 2D- gel electrophoresis, western blotting	4
References		
1.	Biochemistry by Jeremy M.Berg, John L.Tymozko, LubertStryer, 5th Eds,	
2.	Lehninger Principles of Biochemistry Edition 4, Nelson, David L. Cox, Michael M. Lehninger, Albert L. W, H Freeman & Co	
3.	Student Companion to Accompany Biochemistry, Richard I. Gumpport, Jeremy M. Berg, Nancy Counts Gerber, Frank H. Deis, Jeremy Berg, W H Freeman & Co	

MBT&Med BT 103: Cell & Developmental Biology		Total
Core Course – Theory; 3 Credits		45L
UNIT I		
1	Structure of cell Structure of cell organelles: Endoplasmic reticulum, mitochondria, golgi apparatus, lysosomes, chloroplast, nucleus, cell wall. Comparison of prokaryotic and eukaryotic cells	6
2	Cytoskeleton: Organization and functions cytoskeleton, Actin filaments, actin binding proteins, Intermediate filaments, Microtubules, Structure and functions of cilia and flagella.	5

UNIT II		
4	Plasma Membrane: Plasma membrane structure and functions, membrane models, Transport across membrane- passive diffusion, osmosis, active transport, Ion Channels, Na ⁺ and K ⁺ pump, Ca ²⁺ ATPase pump, co-transport, symport, antiport, endocytosis and exocytosis. Membrane vesicle trafficking	7
5	Specialized Cells (Muscle & Nerve cells): Structure & functions of muscles (Straited, nonstraited and cardiac). Structure of neuron, Neurotransmitters and their receptors	4
UNIT III		
6	Cell – Cell Interactions Cell adhesion molecules, cadherins, Integrins, transmembrane proteoglycanc, Claudins and occludens, gap junctions, tight junctions, adherens, desmosomes and hemidesmosomes, plasmodesmata	3
7	Cell Cycle Molecular events of cell division and cell cycle, regulation of cell cycle events- Cyclins, Cyclin dependent kinases, inhibitors. Apoptosis and necrosis.	2
8	Cell Signaling General principles of cell signaling, signaling via G-protein coupled receptors, kinase receptors, role of secondary messengers.	6
UNIT IV		
9	Developmental Biology Gametogenesis (Spermatogenesis, Oogenesis), Meiosis and its significance, types of eggs, fertilization and implantation, types and patterns of cleavage, Blastulation	5
10	Stages of fetal development Gastrulation in Frog, Germ layer formation, fetal membranes, placenta formation in mammals	4
11	Concept of dedifferentiation, redifferentiation, transdifferentiation and regeneration	3
References		
1.	Alberts, B., Bray, D., Lewis, J., Raf, M., Roberts, K., Watson, J.D. (1994). Molecular Biology of the Cell	
2.	Cooper, G.M. (1997).The Cell: A molecular approach, ASM Press, USA.	
3.	Hallwell, B., Gutteridge, J.M.C. (2002). Free Radicals Biology and Medicine. Oxford Press.UK.	
4.	Karp, G. (1996). Cell and Molecular Biology concepts and experiments, John Wiley and Sons Inc. NY.	
5.	Lodish, H., Baltimore, D., Berk, A., Zipursky, B.L., Mastsydaira, P., Darnell, J. (2004). Molecular Cell Biology, Scientific American Books Inc. NY.	
6.	Matthews, C.A. (2003). Cellular physiology of nerve and muscle. 4thEdn. Blackwell publishers.	
7.	Development Biology, 9th edition, (2010), Gilbert S.F.(Sinauer Associates, (USA).	
8.	Human Embryology and Developmental Biology, Author: Carlson, Bruce M.Edition: 3, Publisher: Elsevier - Health Sciences Division ISBN-13: 9780323014878.	
9.	Balinsky : introduction to Embryology (CBS College Publishers)	
10.	Subramanyan, T : Developmental Biology (Narosa Publishing House) Arumugam N.A.	

text book of embryology (Saras publication)

MBT&Med BT 104: Genetics	Total
Core Course – Theory; 3 Credits	45L
UNIT I	
1 Overview of genetics: Genes and Expression, Allele, multiple alleles, pseudoallele, complementation tests, Genetic variation, Molecular basis of allelic variation. Methodologies used in genetic studies, Model organisms. Genes-Environment interaction.	5
2 Modes of inheritance: Mendelian and Non Mendelian Inheritance: Lethal alleles, Epistasis, Penetrance and expressivity, Pleiotropy, Phenocopies, mitochondrial inheritance	6
UNIT II	
3 Structure and function of human chromosome: Ultra structure of human chromosome, Classification of chromosomes, Sex chromosome, Origin of Y chromosome, SRY genes and its effects. Dosage compensation	3
4 Human chromosomal Abnormalities: Aneuploidy and Structural, associated syndromes	4
5 Pedigree analysis of human: X linked and autosomal disorders. Linkage maps, Lod scores to assess linkage in human pedigrees	2
6 Diagnostics: Prenatal diagnosis, Karyotype analysis, FISH, Genetic counseling	3
UNIT III	
7 Population genetics: Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.	5L
8 Brain, Behavior and Evolution: Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.	6L
Unit IV	
9 Cancer genetics; genetic control of cell cycle, mutations that prevent normal checkpoints, inherited cancer syndromes, cancers acquired due to chromosomal abnormalities	6L
10 Reproductive Technologies	5L
References:	
1. Human genetics: Concepts and applications. Ricky Lewis. 11 th Ed. Mc Graw – Hill Higher Education Inc Publ 2015	
2. Essential genetics, A genomics perspective. Daniel L. Hartl. 6 th Ed. Burlington, Mass	

- Jones & Bartlett Learning Publ. USA, 2014
3. Human molecular genetics, 4th Ed. T Stranahan and A. Read. Garland Publishing, Taylor & Francis Group, NY, USA. 2010
 4. Human Genetics. A Gardner, T. Davies. 2nd Ed. Springer VerlagPubl 2010.

MBT&Med BT 105: Molecular Biology	Total
Core Course – Theory; 3 Credits	45L
UNIT I	
1 Genomes and its content	8
Basic concepts, flow of information transfer, genetic code, types of mutations Genome sizes of different organisms, C Value Gene families, clusters, pseudogenes, super-families, organelle genomes Organization of prokaryotic genome, Structure of nucleosome and organization of chromatin, structure of chromosome, centromere and telomere	
UNIT II	
2 DNA replication & repair	6
DNA polymerases, mechanism of replication in prokaryotes and eukaryotes, DNA damage, Mechanisms of DNA repair in prokaryotes and eukaryotes,	
3 Homologous and site specific recombination	4
Insertion elements	3
UNIT III	
4 Transcription and posttranscriptional mechanisms	12
RNA polymerase and mechanism of prokaryotic transcription Eukaryotic RNA polymerases and their promoters, activating transcription, role of enhancers, gene silencers, CpG Islands, post transcriptional modifications, RNA splicing reactions, catalytic RNA, Regulatory RNA, MicroRNAs & RNA interference	
Unit IV	
5 Translation	7
Mechanism of translation in prokaryotes and eukaryotes, post translational modifications, transport of proteins, role of chaperons	
6 Gene regulation	5
Operon, Induction and repression, positive and negative regulation, attenuation, lactose, arabinose and tryptophan operon, Eukaryotic transcription regulation	
7 Epigenetic effects	2
Heterochromatin nucleation, Chromatin remodeling, epigenetic inheritance, genomic imprinting.	
References:	
1. Human genetics: Concepts and applications. Ricky Lewis. 11 th Ed. Mc Graw – Hill Higher Education IncPubl 2015	
2. Essential genetics, A genomics perspective. Daniel L. Hartl. 6 th Ed. Burlington, Mass Jones & Bartlett Learning Publ. USA, 2014	
3. Human molecular genetics, 4 th Ed. T Stranahan and A. Read. Garland Publishing, Taylor & Francis Group, NY, USA. 2010	
4. Human Genetics. A Gardner, T. Davies. 2 nd Ed. Springer VerlagPubl 2010.	

MBT&Med BT 106: Biochemistry & Molecular Biology Lab**Core Course –Practical; 4 Credits****Biochemistry Lab**

- | | | |
|---|--|---|
| 1 | To prepare an Acetic - Na Acetate Buffer system and validate the Henderson-Hasselbach equation. | 2 |
| 2 | To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer- Lambert's Law. | 2 |
| 3 | Titration of Amino Acids and separation of aliphatic, aromatic and polar amino acids by TLC. | 2 |
| 4 | AN ENZYME PURIFICATION THEME (such as E.coli Alkaline phosphatase or any enzyme of choice).
(a) Preparation of cell-free lysates
(b) Ammonium Sulfate precipitation
(c) Ion-exchange Chromatography
(d) Gel Filtration
(e) Affinity Chromatography
(f) Generating a Purification Table | 6 |
| 5 | Enzyme Kinetic Parameters: Km, Vmax and Kcat | 3 |
| 6 | Assessing purity by SDS-PAGE Gel Electrophoresis | 2 |
| 7 | Estimation of diagnostic markers- glucose, urea | 3 |

Molecular Biology Lab

- | | | |
|----|---|---|
| 1 | Understanding of basic principles, equipments and molecular biology grade reagents, Preparation of buffers and reagents | 1 |
| 2. | Isolation of DNA from bacteria and eukaryotic cells, blood & plant | 5 |
| 3. | Analysis of DNA preparations by UV spectrometry and agarose gel electrophoresis | 2 |
| 4. | Isolation and estimation of RNA from bacteria/yeast/eukaryotic cells | 2 |
| 5. | Amplification of DNA by PCR | |
| 6. | Evaluation of gene expression using Real Time PCR (Demonstration) | 2 |
| 7. | DNA sequencing (Demonstration) | 1 |

References:

1. Sambrook J and Russell D. (2011) Molecular cloning A Laboratory Manual 3rd Ed, Cold spring harbor laboratory press, New York.
2. Wilson K. and Walker J. (2005) Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, New York.

MBT&Med BT 107: Cell Biology & Genetics Lab**Core Course –Practical; 4 Credits****Cell Biology Lab**

- | | | |
|---|--|---|
| 1 | Study of mitosis with onion root tip chromosomes | 1 |
| 2 | Observation of permanent slides of meiosis | 1 |
| 3 | Temporary preparation of Polytene chromosomes from Chironomus salivary gland | 2 |
| 4 | Isolation of nuclei from rat liver | 2 |
| 5 | To determine Erythrocyte (RBC) & Leucocytes (WBC) count of a blood sample | 2 |

6	Chlorophyll estimation: Spectrum and light scatter	1
7	Study of frog development, observation of frog embryo of different development stages	2
8	Study of eggs and sperms from animal samples	2
Genetics Lab		
1	Planting of blood culture	1
2	Preparation of chromosome spreads from lymphocyte culture	2
3	Banding of metaphase slides	1
4	Karyotyping and analysis	1
5	Isolation and staining of lampbrush chromosomes	2
6	Cultivation of drosophila and study of Mendelian inheritance	5
7	Demonstration of cytogenetic analysis using FISH	1
References:		
1.	Development Biology, 9th edition, (2010), Gilbert S.F.(Sinauer Associates, (USA)	
2.	Principles of Development, 4th edition (2010), Wilbert L and Tickle C, Publisher: Oxford University Press, USA.	
3.	Developmental Biology Laboratory Manual. S.R. Scadding and S. Frombach. 5 th Ed.	
4.	Essential genetics, A genomics perspective. Daniel L. Hartl. 6 th Ed. Burlington, Mass Jones & Bartlett Learning Publ. USA, 2014	
5.	Human molecular genetics, 4 th Ed. T Stranahan and A. Read. Garland Publishing, Taylor & Francis Group, NY, USA. 2010	
6.	Human Genetics. A. Gardner, T. Davies. 2 nd Ed., Springer VerlagPubl, 2010	

MBT&MedBT 108: Microbiology Lab		
Core Course – Practical; 2 Credits		
1	Microscopy	2
2	Isolation of thermophile / halophile from soil, (media preparation, serial dilution, spread plating, streaking, staining and microscopy)	3
3	Checking the purity of pharmaceutical samples.	3
4	Use of deferential media for isolation of various bacteria	2
5	Isolation of fungi from soil / clinical samples	2
6	Isolation of actinomycetes from soil/ water samples.	2
7	Cultivation of lactiobacillus under anaerobic condition	2
8	Antibiotic susceptibility testing	2
9	Ames test	2
References:		
1.	Brock Biology of Microorganismsm 13 th eds, , Michael T.Madigan	
2.	Prescott's Microbiology, 9 th eds, Joanne M. Willey	
3.	Microbiology–6th Edition (2006), Pelczar M.J., Chan E.C.S., Krieg N.R., The McGraw Hill Companies Inc. NY	
4.	General Microbiology - Stanier R.Y., 5th edition, (1987)Macmillan Publication UK.	
5.	Introduction to Microbiology, 2nd Edn. Ingraham, J. L. and Ingraham C. A., Thompson Asia Pvt. Ltd., Singapore (2002).	

SEMESTER II

MBT&Med BT 201: Genetic Engineering		Total
Core course- Theory; 3 credits		45L
UNIT I : Fundamental techniques and Vectors		
1	Restriction-modification systems, Various enzymes in gene manipulation: nucleases, polymerases, kinases, phosphatases, ligases.	1
2	Cohesive and blunt end ligation	1
3	Plasmid based vectors (pBR and pUC)	1
4	λ based vectors	1
5	Cloning vectors for eukaryotes	2
6	Special purpose vectors e.g. expression vectors, tag vector	3
7	DNA labelling methods	1
8	Different methods to introduce recombinant DNA into host cell	1
UNIT II : Gene cloning and Sequencing		
9	Construction of genomic and cDNA library	1
10	Library screening methods (hybridization and immunochemical methods)	1
11	Polymerase chain reaction and its types e.g. real time PCR, multiplex PCR Reverse transcriptase PCR, Inverse PCR, Nested PCR	3
12	DNA sequencing- Maxam-Gilbert method, Sanger's Dideoxychain termination method, Automated DNA sequencing method.	3
13	Pyrosequencing- microarrays technology	2
14	Human genome sequencing	1
15	Genetic and Physical mapping techniques	1
UNIT III: Gene Expression and Mutagenesis		
16	Tools for analyzing gene expression: Reporter genes, Analysis of gene regulation, Techniques for transcript analysis	3
17	Techniques for analysis of translation product	1
18	Introduction to si RNA technology: principle and applications	2
19	Micro RNA and detection methods	1
20	Differential gene expression, Protein-protein interactions: phage-display, yeast two-hybrid system	2
21	Mutagenesis techniques	1
22	Nucleic acid hybridization assays and micro-assays	2
UNIT IV : Applications		
23	Production of recombinant proteins from pro and eukaryotic hosts	2
24	Expression of industrially important products	1
25	Electrophoretic methods for mutation detection: SSCP, hetero-duplex analysis, DGGE MCC (Mismatch Chemical Cleavage), ASA (Allele Specific Amplification), PTT (Protein Truncation Test)	3
26	Gene therapy – ex vivo, in vivo, gene delivery systems, viral and non viral	3
27	Bio-pharming	1
References:		
1. Brown T. A., 7 th edition (2016), Gene cloning and DNA analysis, Blackwell publishing, UK		
2. Primrose S., Twyman R. M. , 8 th edition (2016), Principles of Gene Manipulation and Genomics, Blackwell Publishing, UK		

3. Nicholl D. S. T., 2nd edition (2002), Introduction to Genetic Engineering, Cambridge University Press, UK
4. Channarayappa (2006), Molecular Biotechnology: Principles and Practices, University Press, New Delhi, India
5. Watson J. and Stephen, 7th edition (2014), Molecular biology of the gene, Pearson, US
6. From Genes to Genomes, 2nd edition, (2008), J.Dale and M.Schantz, John Wiley & Son Ltd.USA
7. From Gene to Clones ; Introduction to gene technology, 4th edition, (2003), E. Winnacker, Panima Publisher, India
8. Molecular Biology Problem solver: A laboratory guide (2004), A. Gerstein, A John Wiley & Sons, Inc., Publication, USA

MBT&Med BT 202: Analytical Biotechnology		Total
Core Course – Theory; 3 Credits		45L
UNIT I		
1	Introduction: Scope and importance of various techniques in biotechnology. The goal of structural biology.	2
2	Cell disruption methods: physical and chemical	2
3	Filtration techniques: Gross filtration, steri-pad filtration, membrane filtration (macro-filtration, micro-filtration, ultra-filtration), reverse osmosis, dialysis, their applications in industry. Merits and limitations	5
UNIT II		
4	Centrifugation- Table top, high speed, microfuge, refrigerated, ultra, density gradient centrifugation, applications in biotech industry.	3
5	Microscopy: Structure and working of bright field and dark field microscopes. Principle, working and applications of phase contrast microscope,	4
6	Advance microscopy: confocal microscopy, fluorescence microscope, electron microscope, atomic force microscopy,	4
UNIT III		
7	Biophysical methods: Analysis of biomolecules using UV/visible spectrophotometer, fluorescence, circular dichroism	4
8	NMR and ESR spectroscopy, structure determination using X-ray diffraction	3
9	Different types of mass spectrometry, MALDI-TOF and surface plasma resonance methods.	4
Unit IV		
10	Radio labeling techniques: Properties of different types of radioisotopes normally used in biology, their detection and measurement; safety guidelines. Incorporation of radioisotopes in biological tissues and cells. Molecular imaging of radioactive material	3
11	HPLC- Concept, principle, procedure (analytical and preparatory), separation on the basis of detectors, accuracy, applications in research and quality control	4
12	GC: Concept, principle, procedure (analytical and preparatory), separation on the basis of detectors, accuracy, applications in research and quality control	4
References:		
1.	Principles and Techniques of Biochemistry and Molecular Biology, Wilson, K. and Walker, J. Cambridge University Press, New York (2005).	

2. Analytical Biotechnology, C. van Dijk, Elsevier Science, The Netherlands,
3. Analytical Biotechnology, Thomas G.M. Schalkhamer, Springer Basel AG, 2002
4. Analytical Biochemistry & Separation Techniques, Dr. P. Palanivelu, IV Edition - Lab manual (IV Edition, 2009), Twenty first Century Publications
5. Techniques and Methods in Biology, Ghatak K.L. Prentice Hall India Learning Private Limited (2011)

MBT&Med BT 203: Immunology Core Course – Theory; 3 Credits	Total 45L
UNIT I : Introduction	
1 Immunity – Types of Immunity, components of Innate and Acquired Immunity Cells and organs of immune system, Antigen presenting cells, endogenous and exogenous pathways of antigen presentation, presentation of non-peptide antigens	4
2 Antigens - Immunogenicity versus Antigenicity, Factors that influence immunogenicity, Epitopes - Properties of B-cell epitopes and T-cell epitopes, haptens and adjuvants, Antigen engineering-Increasing Immunogenicity	3
3 Antibodies - Basic structure of Immunoglobulins - The role of multiple myeloma in understanding Ig structure, domains-variable and constant region, Immunoglobulin classes and functions, application and engineering of monoclonal antibodies	3
UNIT II : Lymphocyte ontology	
4 B- cell maturation, activation and differentiation Antigen dependant and antigen independent stages of B- cell maturation, B-cell activation and proliferation by Thymus independent and Thymus dependant antigens, B-cell differentiation, class-switching and generation of plasma cells and memory cells, primary and secondary response kinetics, significance in vaccination programs.	3
5 T cell maturation, activation and differentiation Stages of T cell maturation, Positive and negative selection in thymus, role of TH1 and TH2 cells, mechanism of CTL mediated cytotoxicity, co-stimulatory molecules and signals, super antigen induced T cell activation, NK cell mediated lysis, ADCC	3
6 Complement system and Cytokines Classical, alternate and lectin pathways of complement activation and function of complement system, Types and general properties Cytokines, receptors, cytokine network, Immunoregulatory role of IL-4, IFN- γ and TNB- β .	3
UNIT III : Immunogenetics	
7 Immunoglobulin genes and proteins Multigene organization of Ig genes, Generation of antibody diversity.	3
8 TCR genes, gene products and co-repressors: Structure and types ($\alpha\beta$ and $\gamma\delta$), gene organization and rearrangement, T cell accessory membrane molecules, Role of TCR-CD3 complex in immune activation and signal transduction pathways.	3
9 Major Histo-compatibility complex General organization and inheritance of MHC; MHC Haplotypes, the structure of MHC class-I and class-II molecules; organization of MHC class I and class II genes, peptide binding of MHC molecules, Polymorphism of MHC class I and	3

class II molecules; the role of HLA typing in organ transplantation and disease susceptibility/resistance.	
Unit IV : Clinical Immunology	
10 Clinical Immunology	2
Hypersensitivity – Type I, II, III and IV- outline of mechanism with examples.	
11 Immune tolerance and autoimmunity - establishment and failure of tolerance; Autoimmunity; Types of autoimmune diseases with one example; Mechanism and role of CD4+ T cells.	3
12 Transplantation immunology - basis and manifestation of graft rejection, General immune-suppressive therapy. Specific immune suppressive therapy. Immune tolerance to allograft.	3
13 Tumor immunology - Malignant transformation of cells and immune responses. Tumor antigens, Tumor evasion of the immune system, immuno-surveillance,Cancer immune-therapy.	3
14 Immunotechniques :Immuniprecipitation, agglutination, RIA, ELISA, ELISPOT, Western blotting, fluorescence based imaging technique, HLA typing, Flow cytometry, and animal systems	
References:	
1. Immunology and Serology in Laboratory Medicine Turgeon Mary Louise4 th Ed. 2009	
2. A Textbook of Microbiology & Immunology, ParijaSubhash Chandra 2009	
3. Immunology , Kuby, 7 th edition, Richard A. Goldsby, T. J. Kindt and B. A. Osborna, WHfreeman and Co., New-York	
4. Riott’s essential Immunology, I. M. Riott, Evan M. riot and Peter J. Delves, 10 th edition	

MBT&Med BT 204: Genomics and Proteomics	Total
Core Course – Theory; 3 Credits	45L
UNIT I	
1 Introduction to Bioinformatics:	1
Introduction to Bioinformatics: Definition, History, Goal, Scope, Applications, Limitations	
2 Introduction to Biological Databases:	5
Hierarchy of Biological databases: Primary, Secondary, Derived and knowledgebase	
3 Sequence Alignment & Analysis	6
<ul style="list-style-type: none"> • Sequence alignment methods: Local and global, Pairwise sequence alignment, Multiple sequence alignment • Sequence alignment algorithm: Needleman &Wunsch , Smith & Waterman • Sequence Similarity Search Tools: Dot Plot, BLAST, FASTA, ClustalW, ClustalX • Sequence analysis methods: AMAS, CINEMA, MaxAlign 	
UNIT II	
4 Genomics:	3
Genome sequencing: strategies & approaches, conventional DNA sequencing methodologies, NGS(Next generation sequencing), Third generation	

	sequencing, Microarray Technology	
5	Genomics Tools:	6
	<ul style="list-style-type: none"> • Tools for Genomic Data Mining: Basic Aspects of Genome Annotation • Database Search Engines: Special tools for searching genomic data • Prediction of genes: ORFs, Prediction of Signal sequences (Promoters, Primers, splice sites, UTRs etc.), Operons • Identification of Disease Genes: Identification of Drug Targets, Metabolic diseases and Pathogenic diseases, Gene Expression Analysis • Structural Genomics and Functional Genomics • Genetic Disorders Databases: OMIM, OMIA, Genetic Association Database, Genetic Disorder Guide, IGDD, DisGenet, Genetic Disorder UK 	
6	Genome mapping: Genetic maps and physical maps	2
	UNIT III	
7	Comparative genomics and it's applications Methods:	4
	<ul style="list-style-type: none"> • Genome Alignments: BLAST2, MUMmer , PipMaker , VISTA • Comparison of Gene Order: GeneOrder , Gene synteny • Comparative Genomics of organisms: Viruses, Microbes, Pathogens, Eukaryotes • Comparative GenomicsDatabases : COG, VirGen, CORG, HOBACGEN, Homophila, XREFdb 	
8	Proteomics:	1
	Introduction to proteomics, scope	
9	Classification of proteins: Primary, secondary, tertiary, quaternary.	6
	Protein Primary Databases: Protein database on NCBI/ Protein database on EMBL, PIR-PSD, UniProt KB/SwissProt, Expsy, InterPro	
	Unit IV	
10	Proteomics Applications:	4
	Strategies for protein identification, Protein sequencing, Protein engineering: Protein chips and functional proteomics; Clinical and biomedical application of proteomics.	
11	Proteomics tools:	5
	Structural databases: PDB, MMDB, SCOP, CATH.	
	3D structure visualization tools: Rasmol, Pymol, SPDBV, Cn3D	
	Secondary structure prediction algorithms: Chou Fasman, Jpred, Psipred, GOR methods; analysis of results.	
	3D structure validation databases: PROSA, Ramchandran Plot, Procheck	
12	Protein-protein interaction :	2
	Protein-Protein Interaction Networks, databases and software:	
	BIND - Biomolecular Interaction Network Database, STRING	
	References:	
	1. Guide to Human Genome Computing by Martin J. Bishop, Academic Press. ISBN 0-12-102051-7.	
	2. From Genome to Therapy: Integrating new technologies with drug development by Novartis Foundation, John Wiley. ISBN 0-471-62744-5.	
	3. Genome mapping and sequencing By Ian Dunham, Horizon, ISBN1-898486-50-6.	
	4. The Genome by Ram S. Verma, VCH, ISBN 1-56081-043-2.	

5. Bioinformatics - from genomes to drugs (vol. 1), basic technologies (vol.1) by Lengauer, T., Germany, Wiley-VCH, 2002.
6. Principles of Genome Analysis And Genomics (3rd Ed.) by Primrose, S.B. & Twyman, R.M., UK. Blackwell Publishing Company, 2003.
7. Bioinformatics approach Guide to the analysis of genes and proteins by AndceasBaxevanis and B.F. Francis Ouellettee. John Wiley 2004.
8. Fogel, G.B. and Corne, D.W., Evolutionary Computation in Bioinformatics.
9. Patterson, B.K., Techniques in Quantification and Localization of Gene Expression.
10. Singer, M. and Barg, P. Exploring Genetic Mechanism.
11. Bowtell, D. and Sambrook, J. DNA Microarrays.
12. Fundamentals of Data Mining in Genomics and Proteomics, By Werner Dubitzky, Martin Granzow, Daniel P. Berrar, 2007, Springer Science + Bussiness Media, LLC.

MBT&MedBT 205: Nanobiotechnology		Total
Core Course – Theory; 2 Credits		30L
UNIT I		
1	Introduction to nanoscience , properties of nanoparticles, Types of nanomaterial Carbon nanomaterials (fullerene, nanotube, nanofibres, nanowires) Quantum dots, magnetic nanoparticles	5
2	Nanostructures: Organic and Inorganic nanoparticles, Bionanostructures-protein, carbohydrate and lipid, DNA based	4
3	Synthesis of nanoparticles , Top down and Bottom up approach, Physical, Chemical and Biological methods of synthesis	5
UNIT II		
4	Characterization of nanoparticles: Optical (UV-Vis, FTIR, Photoluminescence spectroscopy) X-ray diffraction, Microscopy (SEM,TEM,AFM,STM) Surface and composition (ECSA, EDAX), Particle size analysis and charge distribution analysis, Toxicity Evaluation of nanomaterials; Cyto-toxicity, Geno-toxicity In vivo tests/assays etc containment	7
5	Applications of Nano-Materials in Biosystems; Nanomedicines, Targeted Drug Delivery, Disease diagnosis at proteomic level, Biosensors (Nucleic acid based, protein based), Lab on Chip, Applications in Gene therapy, cancer Biology. Bionanomachines	5
6	Application of nanobiotechnology in agriculture and environment: desalination, monitoring water quality, detection of pollutants	4
References:		
1. T. Pradeep, Nano, The Essentials, Understanding Nanoscience and Nanotechnology, Tata McGraw-Hill Limited, 2007		
2. Tuan Vo, Dinh. Ed. Nanotechnology in Biology and Medicine: methods, device and applications. CRC Press, 2007		
3. NANOBIO TECHNOLOGY BioInspired Devices and Materials of the Future, Shoseyov, Oded, Levy, Ilan, Springer, 2008		
4. Nanoscience: Nanobiotechnology and Nanobiology, Boisseau, Patrick, Lahmani,		

Marcel, Springer, 2009.

5. Nanobiotechnology Inorganic Nanoparticles vs Organic Nanoparticles, Jesus M. de la Fuente and V. Grazu, Elsevier, 2012

Med BT 206: Human Physiology Core Course – Theory; 3 Credits	Total 45L
UNIT I	
1 Introduction to various systems, complexities of system	3
2 Digestive system - Digestion, absorption, energy balance, BMR.	3
3 Blood and circulation - Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.	5
UNIT II	
4 Respiratory system - Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.	4
5 Nervous system - Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.	4
6 Sense organs - Vision, hearing and tactile response.	3
UNIT III	
7 Excretory system - Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of.	4
8 Water balance, blood volume, blood pressure, electrolyte balance, acid-base balance. Water, Minerals including trace elements, Vitamins, Recommended dietary allowances	3
9 Thermoregulation - Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization	4
UNIT IV	
10 Endocrinology and - Endocrine glands, basic mechanism of hormone action, hormones and diseases; neuroendocrine regulation	
11 Reproductive system: reproductive processes, gametogenesis, ovulation	
12 Nutrition: The relationship between nutrition, health and disease, Proximate principles, Balance Diet, Energy Metabolism, Nutrition throughout life cycle, Malnutrition and Chronic Energy Deficit, Micronutrient disorders, Maternal and child nutrition, Nutrigenomics and nutrient gene interaction	
References:	
1. Guyton and Hall Textbook of Medical Physiology, 13e (Guyton Physiology) by John E. Hall PhD, 2015, Saunders Publisher	
2. Clinical Biochemistry Second Ed., Godkar, P. B. and Godkar, D. B., Bhalani Publishing House, Mumbai 2003	
3. A Textbook of Human Physiology by H. Gurumurthy, H. K. Makari, H. S. Ravi Kumar Patil, and S. V. Sowmya	

MBT&Med BT 207: Genetic Engineering and Genomics Lab

Core Course – Practical; 4 Credits

Genetic Engineering Lab

1	Competent cells preparation and GFP cloning in <i>E.Coli</i>	4
2	Southern Hybridization	3
3	DNA fingerprinting	2
4	Phage titration	3
5	Restriction mapping	2
Genomics Lab		
1	Explore primary resource institutes NCBI, EBI, DDBJ	5
	Explore Genomic databases	
	Explore Sequence Alignment & Analysis	
	<ul style="list-style-type: none"> Sequence Similarity Search Tools: Dot Plot, BLAST, FASTA, ClustalW, ClustalX Explore Sequence analysis methods: AMAS, CINEMA, MaxAlign 	
2.	Explore comparative genomics databases:	5
	<ul style="list-style-type: none"> COG VirGen, CORG, HOBACGEN, Homophila, XREFdb, Grameneetc 	
3.	Explore Comparative genomics and it's applications Methods:	5
	<ul style="list-style-type: none"> Genome Alignments: BLAST2, MUMmer , PipMaker , VISTA Comparison of Gene Order: GeneOrder , Gene synteny Comparative Genomics Databases : COG, VirGen, CORG, HOBACGEN, Homophila, XREFdb Explore NGS data analysis methods: Bowtie, TopHat 	
References:		
1.	Green and Sambrook, 4 th edition (2012), Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press	
2.	Molecular cloning: a laboratory manual, Volume 1, Joseph Sambrook, E. F. Fritsch, Tom Maniatis, Edition 2, Cold Spring Harbor Laboratory, ISBN 0879693096, 9780879693091.	
3.	Guide to Human Genome Computing by Martin J. Bishop, Academic Press. ISBN 0-12-102051-7.	
4.	From Genome to Therapy: Integrating new technologies with drug development by Novartis Foundation, John Wiley. ISBN 0-471-62744-5.	
5.	Genome mapping and sequencing By Ian Dunham, Horizon, ISBN 1-898486-50-6.	
6.	The Genome by Ram S. Verma, VCH, ISBN 1-56081-043-2.	
7.	Bioinformatics - from genomes to drugs (vol. 1), basic technologies (vol.1) by Lengauer, T., Germany, Wiley-VCH, 2002.	
8.	Principles of Genome Analysis And Genomics (3 rd Ed.) by Primrose, S.B. & Twyman, R.M., UK. Blackwell Publishing Company, 2003.	
9.	Bioinformatics approach Guide to the analysis of genes and proteins by Andreas Baxevanis and B.F. Francis Ouellette. John Wiley 2004.	
10.	Bioinformatics in the Post-Genomic Era: Genome, Transcriptome, Proteome, and Information-Based Medicine, Jeff Augen Addison-Wesley Professional , 2004 ISBN: 0321173864.	
11.	Fundamentals of Data Mining in Genomics and Proteomics, By Werner Dubitzky,	

Martin Granzow, Daniel P. Berrar, 2007, Springer Science + Business Media, LLC

MBT&Med BT 208: Analytical Techniques and Proteomics Lab

Core Course – Lab; 4 Credits

Analytical Techniques Lab

- | | | |
|---|---|---|
| 1 | Sterilization of bioactive molecules by membrane filtration | 2 |
| 2 | Separation of biomolecules using dialysis technique | 2 |
| 3 | Fractionation sub-cellular components by density gradient centrifugation | 2 |
| 4 | Separation of biomolecules by size exclusion chromatography | 2 |
| 5 | Determination of pKa value of p-nitrophenol by using UV-visible spectrophotometer | 2 |
| 6 | Visit to research institute or Biotechnology Industry/institutes | 2 |

Protein Analysis Lab

- | | | |
|---|---|---|
| 1 | Explore Protein Primary Databases: Protein database on NCBI/ Protein database on EMBL, PIR-PSD, UniProt KB/SwissProt, ExPasy, InterPro | 5 |
| 2 | To explore: <ul style="list-style-type: none"> • Structural databases: PDB, MMDB, SCOP, CATH. • 3D structure visualization tools: Rasmol, Pymol, SPDBV, Cn3D • Secondary structure prediction algorithms: Chou Fasman, Jpred, Psipred, GOR methods; analysis of results. • 3D structure validation databases: PROSA, Ramchandran Plot, Procheck | 5 |
| 3 | Explore Proteomics databases: <ul style="list-style-type: none"> • Trans-Proteomic Pipeline (TPP) • PeptideProphet • iProphet • ProteinProphet • Xpress &ASAPRatio • SpectraST • Corra& PIPE2 • PeptideAtlas&SRMATlas • PIPE2, TIQAM, & ATAQS | |
| 4 | Explore Protein-Protein Interaction Networks, databases and software: <ul style="list-style-type: none"> • DIP (Database of Interacting Proteins) • PPI Server • BIND - Biomolecular 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 | |
| 5 | To explore: | |

- Structural databases: PDB, MMDB, SCOP, CATH.
- 3D structure visualization tools: Rasmol, Pymol, SPDBV, Cn3D
- Secondary structure prediction algorithms: Chou Fasman, Jpred, Psipred, GOR methods; analysis of results.
- 3D structure validation databases: PROSA, Ramchandran Plot, Procheck

6 Explore Proteomics databases:

5

- Trans-Proteomic Pipeline (TPP)
- PeptideProphet
- iProphet
- ProteinProphet
- Xpress &ASAPRatio
- SpectraST
- Corra& PIPE2
- PeptideAtlas&SRMAtlas
- PIPE2, TIQAM, & ATAQS

References:

1. Introductory Practical biochemistry, S.K sawhney&Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 195-303
2. Standard Methods of Biochemical Analysis, S.K Thimmaiah (ed), Kalayani Publishers, Ludhiana ISBN 81-7663-067-5, p12-18
3. Experimental Biochemistry: A Student companion, BeeduSasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 13-17, p 49-72
4. Practical Biochemistry, R.C Gupta & Bhargava (eds) CBS Publishers and distributors, New Delhi, ISBN 81-239-0124-0 p 9-27
5. Practical Clinical Chemistry, Harold Varley, CBS Publishers and distributors, New Delhi.
6. Gradwhols Clinical Laboratory Techniques. Stanley & Raphael. W.E. company, London, UK
7. <http://www.proteomecenter.org>
8. Protein Microarray Technology ,Kambhampati, D. (ed) (2004) Front Matter, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, FRG. doi: 10.1002/3527601554.
9. Bioinformatics in the Post-Genomic Era: Genome, Transcriptome, Proteome, and Information-Based Medicine, Jeff AugenAddison-Wesley Professional , 2004 ISBN:0321173864.
10. Modern Protein Chemistry: Practical Aspects edited by Gary C. Howard, William E. Brown, 2002. CRC Press.
11. Fundamentals of Data Mining in Genomics and Proteomics, By Werner Dubitzky, Martin Granzow, Daniel P. Berrar, 2007, Springer Science + Bussiness Media, LLC.
12. Protein Arrays, Biochips and Proteomics: The Next Phase of Genomic Discovery edited by Joanna S. Albala, Ian Humphery-Smith, ISBN-0-8247-4212-1, 2003, Marcel Dekker

MBT&Med BT 209: Immunology and Nanobiotechnology Lab**Core Course – Practical; 4 Credits****Immunology Lab**

1	Ouchterlony double diffusion	1
2	Radial immune diffusion	1
3	Lymphocyte separation from blood	1
4	Lymphocyte transformation	2
5	ELISA	2

Nanobiotechnology Lab

1	Synthesis of Gold nanoparticles by reduction method	1
2	Synthesis of Silver nanoparticles by reduction method	1
3	Synthesis of Metal oxide nanoparticles (MONs)	1
4	Purification of nanoparticles	1
5	Synthesis of Magnetic nanoparticles co-precipitation method	1
6	Green Synthesis of nanoparticles (Using Microorganisms, Plants)	1
7	Characterization of nanoparticles using UV-Vis absorption technique	1
8	Study on stabilization of nanoparticles	2
9	Effect of Gold and silver nanoparticles on growth of pathogenic bacteria and fungi	2
10	Visit to different laboratories	

References:

1. Goldsby A., Thomus J.K., Barbara A. O. and Kuby J. Immunology, 5th eds.
2. Deives P.J., Seamus J.M. and Raoitt E. M. (2006) Essential Immunology, 11th eds. Blackwell Publ.
3. Jaeway C. Travers, Walport and Shlomchik Immunobiology 6th eds. Garland Sc. Publ.
4. 4. Nanoscience: Nanobiotechnology and Nanobiology, Boisseau, Patrick, Lahmani, Marcel, Springer, 2009.

MBT&Med BT 210: Option I (210.1) Bio-entrepreneurship**Total****Elective Course I – Theory; 2 Credits****30L****UNIT I**

1	Sectors: Pharma, Biotech, Food, Agri-biotech, Research, Diagnostics, Analytic Labs	3
2	Developing flair for business in students	1
3	Short-term opportunities available for business	2
4	Import substitute product list	2
5	Regulatory Affairs: SSI, MSME, FICCI, MCC, IEC	3
6	Firm registration, GST registration, SME Loan, ISO 22000/14000 etc.,	3
7	Export counsel	1

UNIT II

8	Finance: Banking, MoFPI, SIDBI, Foreign collaboration, Investors	3
9	Subsidies: BIRAC, SSI, MSME, MoFPI	2
10	Marketing: Promotion, Distribution, Rolling Cycle	2

11	Business Concept and Competitors' knowledge	1
12	Export benefits, procedures	2
13	Make In India	1
14	Knowledge about taxation, GST, custom duty, excise	3
15	Packaging suitability knowledge	1
References:		
1. Forbat, John, "Entrepreneurship" New Age International. 2. Havinal, Veerbhadrappa, "Management and Entrepreneurship" New Age International 3. Joseph, L. Massod, "Essential of Management", Prentice Hall of India.		
2. Principles of Management – P.C.Tripathi, P.N.Reddy – Tata McGraw Hill,		
3. Dynamics of Entrepreneurial Development & Management – Vasant Desai – Himalaya Publishing House 3. Entrepreneurship Development – Poornima.M.Charantimath – Small Business Enterprises – Pearson Education – 2006 (2& 4). 4. Management Fundamentals – Concepts, Application, Skill Development – RobersLusier – Thomson – 5. Entrepreneurship Development – S.S.Khanka – S.Chand& Co. 6. Management – Stephen Robbins – Pearson Education/PHI – 17 th Edition, 2003.		

MBT&MedBT 210: Option II (210.2) – Intellectual property rights I (IPR-I)		Total
Elective Course I – Theory; 2 Credits		30L
UNIT I		
1	Introduction to Intellectual Property	15
General Introduction to IP & IPR; Introduction, History & role of International Conventions & Treaties- GATT, WTO, WIPO, TRIPS, Budapest Treaty, CBD, Nagoya Protocol; International framework for the protection of IP; IP as a factor in R&D; IPs of relevance to Biotechnology, Agriculture, Bioinformatics and Pharma sector		
UNIT II		
2	Types of IP Industries: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Plant variety and Protection of New GMOs	8
3	Concept of 'prior art'	7
Need of Prior Art for IP types, Classification search and its implications; Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, India etc.); Analysis and Report formation		
References:		
1. Intellectual property rights in agricultural biotechnology By Frederic H. Erbisch, Karim M. Maredia, Biotechnology in Agriculture Series No 28,		
2. The role of intellectual property rights in biotechnology innovation By David Castle, Edward Elgar Publishing		
3. http://www.wipo.int/portal/index.html.en		
4. http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html		
5. www.patentoffice.nic.in		
6. www.iprlawindia.org/ - 31k - Cached - Similar page		

7. <http://www.cbd.int/biosafety/background.shtml>

SEMESTER III

MedBT 301: Animal Tissue Culture & Stem Cell Biology	Total
Core Course; (3 Credits, 3L)	45L
UNIT I	11
1 Introduction to animal tissue culture. Overview of its applications in research, industry & therapeutics	
2 Systems of tissue culture with distinguishing features, advantages and limitations	
3 Growth characteristics of cells growing in culture, molecular basis of cell adhesion, contact inhibition, anchorage dependent and independent cells	
4 Aseptic techniques and its significance in ATC	
5 Tissue culture media, role of balanced salt solution, individual constituents and serum; Serum free media	
UNIT II	12
6 Techniques for primary culture and routine maintenance of cell lines, quantitation of cells, estimation of viability, cryopreservation of cell lines	
7 Characterization of cells, various methods for characterization, FACS analysis	
8 Cytotoxicity assays: Viability, survival, metabolic assays, transformation and mutagenesis, testing for carcinogenicity and inflammation	
9 Scale up of anchorage independent and dependent cells, bioreactors, microcarriers, perfused monolayer cultures	
10 Applications of animal cell culture for in vitro testing of drugs, in production of monoclonal antibodies, viral vaccines and therapeutic proteins	
UNIT III	11
11 Three dimensional cell culture, organ culture, organotypic culture, advantages and limitations	
12 Stem cells – Introduction, basic properties, and classification	
13 Types of stem cells: Hematopoietic, mesenchymal, embryonic and fetal stem cells; their characteristics, isolation, culture and characterization	
14 Applications of stem cells	
UNIT IV	11
15 Introduction to tissue engineering – Morphogenesis, approaches for in vitro engineering of tissues, scope in therapeutics and drug screening	
16 Microscale patterning of cells and their environment	
17 Scaffolds – Basic properties and types	
18 Modes of cells and tissue delivery	
19 Examples of Bio-constructs and their applications	
20 Islet cell transplantation and bioartificial pancreas	
21 Bioprinting of organs and tissues	

References:

1. R.Lanza, J. Geachartet. Al. (Eds.) Essentials of stem cell biology (2009), Elsevier Academic Press
2. R. Lanza, I Klimanskaya. Essential stem cell methods. (2009), Academic Press
3. J. J. Mao, G. Wunjak – Novakovic *et. al.* (Eds): Translational approaches in tissue engineering & regenerative medicine. (2008), Artech House, INC Publications
4. Robert Lanza *et. al.* Principles of tissue engineering. 3rdEds (2007)Steinet. *al.* Human stem cell technology and biology: A research guide and laboratory manual. Wiley – Blackwell (2011)
5. Lanza *et. al.* Handbook of stem cells. Volume I – Embryonic stem cells Volume II – Adult and fetal stem cells. Academic Press (2004)
6. GordanaVunjak-Novakovic, R. Ian Freshney, *Culture of Cells for Tissue Engineering*, WIS, 2006

MedBT 302: Medical Biochemistry & drug discovery		Total
Core Course – Theory; 3 Credits		45L
UNIT I		
1	Introduction of health and disease. Molecular basis of diseases. Recent discoveries in medical and health sector	3
2	Disorders of carbohydrate metabolism: Diabetes mellitus, types, diagnosis, hypo-glycemias, ketone bodies, Glycogen storage diseases.	4
3	Physiology of lipids/lipoproteins: Lipoprotein, metabolism, fatty liver, Diagnostic tests for lipid profile, atherosclerosis. Clinical inter-relationships of lipids (sphingolipidosis and multiple sclerosis).	4
UNIT II		
4	Inborn errors of metabolism: a) Disorders of amino acid metabolism- phenylketonuria, alkaptonuria, albinism. b) Disorders of nucleic acid metabolism- Disorders in purine/ pyrimidine metabolism.	3
5	Biochemical aspects of hematology: Blood, composition, hemogram, hemoglobinopathies, thalessemias and anemias. blood clotting, Laboratory tests to measure coagulation and thrombolysis.	4
6	Detoxification in the body: Mechanism of Detoxification of Xenobiotics, Phase I Reactions, Phase II Reactions	4
UNIT III		
8	Drug discovery: History of Drug Development, Introduction to Clinical Research, Terminologies and definition in Clinical Research, Difference between Clinical Research and Clinical Practice, Types of Clinical Research	3
9	Pharmacology & Drug development: Introduction to Pharmacology, types of drugs (antidiabetic), Routes of Drug Administration, Introduction to Sources of Drugs, Approaches to Drug Discovery, Pharmacovigilance, Pharmacodynamic /pharmacokinetic (PK/PD) correlation, Factors affecting drug response,	4
10	Drug development process: Methods involved in the development of new drugs. Drug Discovery, Preclinical toxicological studies. Calculation of LD50 & ED50. Acute, subacute and chronic toxicity studies. Irwin profile test, Pre-clinical pharmacokinetic and dynamic studies. Lipinski's rule for drug like molecule.	4

Unit IV

- 10 Therapeutic drug monitoring:** Basic principles of TDM. Therapeutic index. 4
Trough level monitoring and dosage adjustments. Drug delivery systems: sustained release, enteric coated formulations and liposome etc. Pharmacovigilance, Pharmacoeconomics, Pharmacogenetics
- 11 Drug regulations:** Drugs and Cosmetics Act, Drug Price Control order, 4
Application for Investigational New Drug (IND), Application for New Drug Discovery (NDD) according to Indian Control Authority & USFDA guidelines. Ethical considerations in utilizing human subjects for drug, Ethical guidelines in utilising animals for experimental purposes.
- 12 RNA interference** and its applications in prevention of cancer, a Therapeutic 4
genome editing- ZFN, CRISPR-Cas gene editing technology (HIV), TALENS (Leukaemia)

References:

1. Lehninger Principles of Biochemistry 5th Ed By David L. Nelson and Michael M. Cox, WH Freeman and Company.
2. Medical Biochemistry (Paperback) By John W. Baynes and Marek Dominiczak. Publisher: Mosby.
3. Clinical Biochemistry: An Illustrated Colour Text (Paperback) 3rd Ed By Allan Gaw,
4. Harper's Biochemistry (Lange Medical Books) (Paperback) By Robert K. Murray, Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell. Publisher: Appelton and Lange.
5. Goodman Gillman's The Pharmacological basis of therapeutics. (2001) Ed. Hardman JG, Limbird LE (Tenth Edition) McGraw Hill press New York.
6. Applied biopharmaceutics and pharmacokinetics (1999) Ed. Sargel L. (IV Edition) Prentice-Hall, International, London.
7. Fundamentals of experimental pharmacology. (1984) Ed. Ghosh MN. Scientific book agency, Calcutta.

MedBT 303: Infectious Diseases**Total****Core Course – Theory; 3 Credits****45L****UNIT I**

- 1 Etiology, pathogenesis, laboratory diagnosis , treatment & prophylaxis of :** 11
- a. Diseases caused by Gram positive cocci- Staphylococci, Streptococci & Pneumococci
 - b. Diseases caused by Gram negative cocci- Neisseria species
 - c. Diseases caused by Gram positive bacilli- Corynebacterium species, Bacillus anthracis& Clostridium species

UNIT II

- 2 Diseases caused by:** 12
- a. Enterobacteriaceae -1
 - b. Enterobacteriaceae -2
 - c. Enterobacteriaceae -3
 - d. Vibrio
 - e. Pseudomonas
 - f. Gram negative coccobacilli
 - g. Mycobacterium tuberculosis
 - h. Mycobacterium leprae& atypical mycobacteria

- i. Spirochaetes- Treponema, Borrelia & Leptospira

UNIT III

3 Diseases caused by:	11
a. Pox viruses- Variola, Vaccinia, Small pox	
b. Herpes viruses- HSV, VZ, HZ, Cytomegalio, E-B viruses	
c. Adeno viruses	
d. Picorna viruses	
e. Orthomyxo viruses	
f. Arbo viruses	
g. Hepatitis viruses	
h. Miscellaneous viruses: Rubella, SARA, Rota viruses	
i. Oncogenic viruses: DNA & RNA viruses	
j. HIV: AIDS	

Unit IV

4 1. Diseases caused by fungi:	11
a) Superficial mycoses- surface infections, cutaneous infections, Dermatophytoses, Candidiosis	
b) Deep mycoses: subcutaneous & systemic mycoses	
c) Opportunistic mycoses	
2. Diseases caused by Parasites:	
a) Protozoal infections: EH, Trichomonas, MP, Leishmaniasis.	
b) Helminthic infections caused by- Cestodes, Nematodes & Trematodes	

References:

1. A Text Book of Microbiology by R Anantnarayan & CK Jayaram Panikar-9th edition
2. A Text Book of Medical parasitology by CK Jayaram Panikar
3. Medical parasitology- R. karyakarate-2ndedi.
4. Text book of Microbiology- Baveja C.P.
5. Text book of Medical Mycology- Chander Jagdish, 3rdedi.
6. Principles & Practices of infectious diseases- Vol-1 & 2 by Mandell G, Gerald L. Gerald L.
7. Diagnostic Medical Microbiology -colour atlas by Stephen Allen, Elmer Konman .
8. Diagnostic Microbiology by Bailey A. Forbes, Daniel Lehman & Alice S Weissfeld.
9. Parasitology & Helminthology by K D Chatterjee- 13thedi.

MedBT 304: Pharmaceutical Biotechnology and Molecular diagnostics		Total
Core Course – Theory; 3 Credits		45L
UNIT I : Chemotherapeutic agents		
1	Types of antimicrobial agents, concept of bioassay, therapeutic index, MIC and LD ₅₀	1
2	Mechanism of action of antibacterial agents; antibiotics acting on cell-wall, cell membrane, nucleic acids and protein synthesis	3
3	Anti-fungal and anti-viral drugs	2
4	Adverse drug effects and resistance to antibiotics	2
5	Multiple Drug Resistance	1
6	Cloning biosynthesis genes, synthesis of novel antibiotics, Improving antibiotic production	3
UNIT II : Vaccines		
7	Animal cell bioreactors and fermentors: types, design and controls	3

8	Vaccines; Definition and Types	1
9	Subunit Vaccines (Herpes Simplex Virus, Foot and Mouth Disease)	1
10	Peptide Vaccines	1
11	Attenuated Vaccines (Cholera)	1
12	Vector Vaccines	1
13	DNA vaccines	1
14	Safety and potency of vaccines	1
15	Sterility testing	2
16	Animal cell bioreactors and fermentors: types, design and controls	1
UNIT III : Molecular Diagnostics		
17	Immunological diagnostic procedures: ELISA, Monoclonal antibodies	2
18	Bio florescence and bio luminescent systems: coloured florescent proteins, luciferase, microbial biosensors	2
19	Nucleic acid based diagnostic systems: Hybridization Probes, DNA fingerprinting, Immunoquantitative Real-Time PCR	2
20	Molecular diagnosis if genetic diseases: Cystic fibrosis, Sickle-cell anemia	2
21	Cloning Human Disease gene: Detection of Mutations in Human Genes, Functional Gene cloning, Candidate Gene cloning	2
22	Human Gene Therapy: Ex-vivo and In-vivo	2
UNIT IV: Protein Therapeutics		
23	Human Interferons	1
24	Human Growth Hormone	1
25	DNase I and Alginate lyase	1
26	Interlekin 10	1
27	Recombinant antibodies: Hybrid Human-Mouse Monoclonal antibodies, Human Monoclonal antibodies	2
28	Antibody fragments	1
29	Chemically-linked Monoclonal antibodies	1
30	Anti-cancer antibodies	1
References:		
1.	Hugo and Russell's, 8 th edition, Pharmaceutical Microbiology, Blackwell Scientific Publications	
2.	Glick B.R., Pasternack J.J., Patten C.L., 4 th edition (2010), Molecular Biotechnology, ASM Press, Washington, DC	
3.	Gary Walsh, Pharmaceutical Biotechnology: Concepts and Applications (2007), Wiley Publications	
4.	Crommelin, Daan J. A., Sindelar, Robert D., Meibohm, Bernd (Eds.) (2013)	
5.	Pharmaceutical Biotechnology: Fundamentals and Applications	
6.	ChandrakantKokate Pramod H.J , 1 st edition (2011)Textbook of Pharmaceutical Biotechnology, Elsevier publications	

MBT&Med BT 305: Biostatistics	Total
Core Course -Theory; 2 Credits,	30L
UNIT I	
1 Introduction to Biostatistics, Common terms, notions and Applications; . Statistical population and Sampling Methods	5
2 Types of variables; Independent and dependant variables; Nominal, Ordinal,	5

	ratio and discrete variable types	
3	Classification and tabulation of Data, Diagrammatic and graphical presentation; Frequency Distribution, Measures of central value	5
UNIT II		
6	Descriptive Statistics; Measures of variability; Standard deviation, standard Error, Range, Mean, Deviation, Coefficient of variation, Analysis of variance	4
7	Inferential Statistics; Statistical power; Hypothesis testing, Test of significance; t-test, chi-square test;	3
8	Regression; Basic of regression, regression analysis, Estimation, Testing, Prediction, checking	3
9	Non-parametric statistical methods; Man-Whitney U test, Wilcoxon test; Kruskal-Wallis test.	3
10	Descriptive Statistics; Measures of variability; Standard deviation, standard Error, Range, Mean, Deviation, Coefficient of variation, Analysis of variance	3
References:		
1. Biostatistics: A guide to design, Analysis and Discovery, Peter Fritz, Elsevier India.		
2. Biostatistics: A foundation for analysis 7th Edition, Ferric Darvas		
3. Applied statistical designs for the researcher, Neil Ed Taylor and Francis Groop.		

MBT&MedBT 306: Research Methodology		Total
Core Course – Theory; 2 Credits		30L
UNIT I		
1	Basic concepts of Research Introduction, Definition and basic concepts, objectives of research, Research approaches, types of research, techniques of research, hypothesisation, literature survey, selection of topic, compiling records.	5
2	Research Design Important concepts in research design – basic principles of research design, need of research design, features of good research design.	5
3	Sampling and Data collection & Analysis Collection of primary and secondary data - parameters, techniques for data collection, methods of data presentations, classification and tabulation of data, graphical representation	5
UNIT II		
6	Data Analysis Statistical methods of data analysis: Applications of statistics in research, measures of central tendency and dispersion	4
7	Testing hypothesis What is a Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Procedure for Hypothesis Testing, Flow Diagram for Hypothesis Testing, Measuring the Power of a Hypothesis Test, Tests of Hypotheses, Important Parametric Tests, Hypothesis Testing of Means	3
8	Technical Writing: Different types of scientific documents, review paper, book reviews, research paper, thesis, project reports (for the scientific community), Plagiarism, Research Ethics, Patents and IPR.	3

Objective:

To provide the knowledge of how to define research problem, hypothesis testing, literature survey, research designs, data collection and analysis. Topics covered in this course includes, from meaning of research to technical writing.

Teaching – Learning Methodology:

Lectures and Tutorials: This is a compulsory subject offered by RGITBT for all M Sc. Biotech students. Lectures, tutorials, group discussion, paper presentation, assignments will be used as a teaching – learning process. There will be a recommended course books. Students are expected to read the research / review articles of their chosen topic of interest, develop research problem for their research project to be undertaken in the forthcoming semester.

Expected Learning Outcome:

Students are expected to learn key concepts in research methodology, data collection and data analysis, presentation of data, interpretation and technical write-up. It is expected that students will learn how different research methods are useful in developing working hypothesis, establish theories, models or concepts. It is expected that the students will practice reading and interpreting research papers, review articles, understanding key concepts of research approaches used by investigators, literature survey, data analysis, interpretation and presentation.

Through this course, it is expected that students should able to independently develop a research plan or research ideas in their areas of research interest for the forthcoming semester.

References:

1. Research Methodologies: Methods and Techniques. Kothari CK. 2004, 2nd Ed, New Age International, New Delhi
2. Research Methodologies, Paneerselvam R, 2004, Pentice Hall of India, New Delhi
3. Research Methodologies, Bulakh PM, Patki PS, Choudhary AS, 1st edition, Expert Trading Corporation, Mumbai
4. Introduction to Biostatistics and Research Methodology, 4th edition, Sunder Rao P.S.S, J.Richard
5. Fundamentals of statistics Gupta, S.C. (2013).Himalaya Publishing House.
6. The Role of IPR in Biotechnology Innovations by David Castle, Edward Elgar Publishing
7. Profits and plagiarism: The case of medical ghostwriting – Anekwe TD, Bioethics, 2010. 24(6): 267–272.

MedBT 307: ATC & Pharma Biotech Lab**Core Course – Practical; 4 Credits****Animal Tissue Culture Lab**

1	Sterilization and sterile handling techniques	1
2	Formulation of tissue culture medium	1
3	Subculturing of cell line	1
4	Cell counting and estimation of viability	1
5	Culture of lymphocytes	2
6	Primary culture of chick fibroblast using explant and cold trypsin method	2
7	Drug toxicity testing using MTT assay	2
8	Virus titration assay	2
9	Isolation and culture mesenchymal stem cells from rat bone marrow	4
10	Differentiation of mesenchymal stem cells	4

Pharma Biotech Lab

11	Minimum Inhibitory Concentration (MIC) of antibiotics	3
12	Bioassay of Penicillin	3
13	Phenol coefficient of a disinfectant	3
14	Sterility Testing of Pharmaceutical products	3

References:

1. Hugo and Russell's, 8th edition, Pharmaceutical Microbiology, Blackwell Scientific Publications
2. Glick B.R., Pasternack J.J., Patten C.L., 4th edition (2010), Molecular Biotechnology, ASM Press, Washington, DC
3. Gary Walsh, Pharmaceutical Biotechnology: Concepts and Applications (2007), Wiley Publications

MedBT 308: Infectious Diseases & Biostatistics Lab**Core Course – Practical; 4 Credits****Infectious Diseases Lab**

1	Isolation & identification of opportunistic pathogens – Escherichia coli, Klebsiella, Proteus, Pseudomonas & Staphylococci from clinical specimens.	5
2	Demonstration of Mycobacterium tuberculosis & Mycobacterium leprae in clinical specimens.	1
3	Acid-fast staining of sputum sample.	2
4	Isolation & identification of fungi from clinical specimens- Candida albicans.	2
5	Microscopic examination of pathogenic & opportunistic fungi.	2
6	Virology- demonstration of various routes of inoculation of chick-embryo.	2
7	Parasitology- demonstration of various cysts of pathogenic protozoa- EH, Giardia & eggs of cestodes & nematodes.	4
8	Study of haemo-parasites by blood films examination.	2

Biostatistics Lab

11	Numerical Exercises: Elementary statistics using Spread sheets, Representation of Data using Charts	2
12	Scatter Plots, Curve fitting on Spread sheets, Add trendline Tool	2

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|------------|--|----------|
| 13 | Outside Class room Activity: One sample survey (mini) using Google forms and inferencing - simple frequencies , means and std deviation (to be counted as a Practical) | 2 |
| 14 | Exercices: Creating PDF, PMF using Spread sheets | 2 |
| 15 | Numerical Exercices : On spread sheet, data analysis tool-pack
t,z - Tests for a single Mean
Comparing Two Means ,t-tests: Paired - Unpaired
Inference for Proportions | 2 |
| 16 | Exercices : One way ANOVA, Two way ANOVA (using Data Analysis pack on Spread sheet or On SPSS/PSPP), F-tests, and Use of Least significant differences,
Exercices: Using SPSS or Data Analysis pack on spread sheets.
References: | 7 |
| 4. | A Text Book of Microbiology by R Anantnarayan& CK Jayaram Panikar-9 th edition | |
| 5. | A Text Book of Medical parasitology by CK JayaramPanikar | |
| 6. | Medical parasitology- R. karyakarate-2 nd edi. | |
| 7. | Text book of Microbiology- Baveja C.P. | |
| 8. | Text book of Medical Mycology- ChanderJagdish, 3 rd edi. | |
| 9. | Principles & Practices of infectious diseases- Vol-1 &2 by MandellGGerald L. | |
| 10. | Gerald L. | |
| 11. | Diagnostic Medical Microbiology -colour atlas by StephenAllen,ElmerKonman . | |
| 12. | Diagnostic Microbiology by Bailey A.Forbes, Daniel Lehman & Alice S Weissfeld. | |
| 13. | Parasitology & Helminthology by K D Chatterjee- 13 th edi. | |
| 14. | Probability statistics, and reliability for engineers by Boca Raton, Ayyub B. M. &McCuen, R H, CRC Press, 1997. | |
| 15. | Statistical methods in bioinformatics: an introduction by Ewens, W. J. & Grant, G. R., New York. Springer, 2001. | |
| 16. | Handbook of computational statistics: concepts and methods by Gentle, J.E., Hardle, W. & Mori, Y., Berlin, Springer-Verlag, 2004. | |
| 17. | Statistical design and analysis of industrial experiments by Ghosh, Subir, Ed., 1990. | |
| 18. | Scan Statistics by Glaz, J., Naus, J. & Wallenstein S, New York, Springer, 2001. | |
| 19. | Statistical design for research by Kish, L., Wiley series in probability and mathematical statistics, New York, John Wiley \$ Sons, 1987. | |
| 20. | Introduction to probability and statistics by Lipschutz, S. & Schiller, J. J., New York. McGraw-Hill, 1999. | |
| 21. | Schaum's outline of theory and problems of statistics by Spiegel, M. R. & Stephens, L. J., Ed. 3, New Delhi, Tata McGraw-Hill Publishing Co. Ltd., 2001. | |
| 22. | Mathematical and statistical methods for genetic analysis by Lange, K., 2 nd Ed., New York. Springer-Verlag, 2002. | |

MedBT 309: Medical biochemistry and Drug discovery Lab**Core Course – Practical; 4 Credits**

1	Glucose tolerance test	2
2	Liver function tests- Estimation of Alkaline Phosphatase and Alanine Transferase	3
3	Renal Function tests- Estimation of blood creatinine	2
4	Studies of enzymes distribution in the cell	3
5	Experiments with hemoglobin	2
6	Analysis of normal and abnormal urine samples	2
7	Estimation of streptomycin/ penicillin by chemical assay method	2
8	Determination of LD50 & ED50 of selected drug	2
9	To perform the sterility test on injectables.	2
10	Pathology lab and animal house visit	2

References:

1. Introductory Practical biochemistry, S.K Sawhney&Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 195-303
2. Standard Methods of Biochemical Analysis, S.K Thimmaiah (ed), Kalayani Publishers, Ludhiana ISBN 81-7663-067-5, p12-18
3. Experimental Biochemistry: A Student companion, BeeduSasidhar Rao& Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p 13-17, p 49-72
4. Practical Biochemistry, R.C Gupta &Bhargava (eds) CBS Publishers and distributors, New Delhi, ISBN 81-239-0124-0, P 9-27
5. Practical Clinical Chemistry, Harold Varley, CBS Publishers and distributors, New Delhi.
6. Basic and Clinical Pharmacology, Prentice hall, International, Katzung, B.G.

Med BT 310: Option I (310.1) – Biomedical Waste Management**Total****Elective Course II – Theory; 2 Credits****30 L****UNIT I**

1	Introduction, definition, classification/ categories, composition and sources. Radioactive waste Health Impacts, direct and Indirect hazards Modern technology for handling biomedical waste Basic steps in waste management, segregation, collection and handling of waste On site pre-treatment of waste Mechanical treatment and chemical disinfections store and off-site transportation Common treatment facilities in-site and off-site Liquid waste treatment and different technologies, cost aspect	15
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UNIT II

2	Technologies available for treatment of biomedical waste Conventional treatment technologies a) Wet thermal technology	15
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b) Incineration - different models

Treatment of general/non-infectious waste

a) Composting, rotating jumbling system French composting

b) Vermi-composting

Disposal Technologies

a) Sharp disposal pit

b) Deep- burial pit

c) Secured land

Controls applied to waste management,

Environmental safety, risks & public issues,

Instrumentation and monitoring, Crematories,

Risk management in hospitals -Environment issues in hospitals -Risk analysis

Legislation and policies on health care waste management.

References:

1. Principles of Hospital Management - S. A. Tabish
2. Hospital Management - S. L. Goel
3. Hospital Administration - Francis
4. Bio-Medical Waste Act & Rules Govt. of India
5. Current Issues In BMW Waste Handling-ISHA, Bangalore
6. Management and Handling Rules for: municipal solid waste, biomedical waste, hazardous waste and radioactive wastes, Government of India Publications.
7. Bio-Medical Waste Management- SushmaSahai

Med BT 310: Option II (310.2): Drug Designing		Total
Elective Course II – Theory; 2Credits		30 L
UNIT I		
1	Drug discovery process, role of Bioinformatics in drug design.	2
2	Target identification and validation, lead optimization and validation. Structure-based drug design and ligand based drug design.	3
3	Modeling of target-small molecule interactions.	3
UNIT II		
4	Structure Activity Relationship:QSARs and QSPRs, QSAR Methodology.	3
5	Various descriptors used in QSARs: Electronics; Topology; Quantum Chemical based descriptors. 3D QSAR techniques: CoMFA and CoMSIA.	4
6	Training data, test data and external validation data, applicability domain in QSAR, Cross validation techniques, PubchemBioAssay data for QSAR studies.	4
UNIT III		
7	Pharmacophore features, Pharmacophore model, Receptor-based and ligand-based pharmacophore modeling.	2
8	Virtual screening based on pharmacophore model.	2
UNIT IV		
9	Receptor site, molecular docking study, flexible docking, rigid docking, molecular interactions.	1
10	Scoring functions, correlation between ligand-based and receptor-based	2

studies

References:

1. Computer-Aided Molecular Design: Theory and Applications by Jean-Pierre Doucet, J. P. Doucet, Jacques Weber, Elsevier Science & Technology Books.
2. Receptor-based Drug Design edited by Paul Leff, Marcel Dekker Inc., New York.
3. Advanced Drug Design and Development: A Medicinal Chemistry Approach by P. N. Kourounakis, 1994, Taylor & Francis.
4. Biopharmaceutical Drug Design and Development by Susanna Wu-Pong, Yon Rojanasakul, 2008, Humana Press.
5. Combinatorial Library Design and Evaluation: Principles, Software, Tools, and Applications in Drug Discovery by Arup Ghose, VellerkadViswanadhan, 2001.
6. Computer-Aided Drug Design and Delivery Systems by Ahindra Nag, Baishakhi De, 2010, McGraw-Hill Professional.

Med BT 310: Option III (310.3) – Intellectual property rights II (IPR II)		Elective	Total
Course II - Theory; 2 Credits			30 L
UNIT I			
1	Basics of Patents Indian Patent Act 1970; Patent Rules, 2003; Recent Amendments; Definitions, non-patentable subject matter, patentability criteria, anticipation, infringement, opposition, biopiracy; Precautions before patenting-disclosure/non-disclosure.		5
2	Types of patents Provisional and Complete specification; Contents of specification		5
3	Introduction to Patent drafting National, PCT and Convention patent applications; PCT and Implications; Role of a Country Patent Office; Procedure for filing requirements National and international Patent application, Forms, fees and timelines Cost and financial assistance for patenting, introduction to existing schemes		5
UNIT II			
4	Relevant case studies (3-4 cases) related to patentability criteria, anticipation, infringement, opposition, bio-piracy		12
5	Career opportunities in the field of IPR.		3
References:			
	1. Erbisch, Karim M. Maredia, Intellectual property rights in agricultural biotechnology By Frederic H. Biotechnology in Agriculture Series No 28,		
	2. David Castle, The role of intellectual property rights in biotechnology innovation, Edward Elgar Publishing		
	3. http://www.wipo.int/portal/index.html.en		
	4. http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html		
	5. www.patentoffice.nic.in		
	6. www.iprlawindia.org/ - 31k - Cached - Similar page		
	7. http://www.cbd.int/biosafety/background.shtml		

SEMESTER IV**MBT&MedBT 401: RESEARCH PROJECT****Core Course – 20 Credits****Guidelines for Research Project and Dissertation Submission during Sem IV for Master of Science (M. Sc.) in Medical Biotechnology****Eligibility:**

- If student fails to pay any of the pending dues before the beginning of the project date, he/ she will not be considered to be eligible to undertake research project.

Project Duration, Dissertation writing and Submission:

- The project duration will be from beginning till the end of Semester IV
- Students shall submit dissertation title, name of research guide, name of co-guide (for off-campus only), name & place of research work within 10 days after the start date of semester IV. (As per the format enclosed).
- Student must have to submit Two hard copies (copy of Library/ Co-Guide & Student's copy) and one soft copy (Guide) of Dissertation only in the prescribed format (read below), duly approved by Research Guide(s) on or before April 15th of every year. The dissertation will not be accepted for evaluation for those who submit after March 15th, their presentation will be taken along with the next year batch.
- Students must acknowledge all the figures, maps, tables, methods, texts, etc., that are used, taken from other sources for writing the dissertation, except for original work that they have carried out. Dissertation having more than 10 % of plagiarism found will not be considered for evaluation.
- Dissertation must be written in specified format only as mentioned below:
 - a. The paper used for printing shall be of A4 size;
 - b. Printing shall be in a standardized form (word size of 12, font in Times New Roman) on one side of the paper and in 1.5 line spacing;
 - c. A margin of 1.5 inches shall be on the left hand side, top, bottom and right hand margin shall be of 1 inch.
 - d. The card for cover shall not be more than 330 GSM.
 - e. The title of the dissertation, name of the candidate, degree, name of the guide, co-guide, place of research and the date, month and year of submission shall be printed on the title page and on the front cover.
 - f. The hard- bound thesis cover shall be of black color. Spine of the binding [side cover] should mention 'M Sc. Biotechnology or Medical Biotechnology or Bioinformatics dissertation on the top, name of the candidate and date, month and year.
- Student must follow following chapter scheme for Dissertation submission:

Chapter Scheme of Dissertation :

- ✓ Introduction
- ✓ Review of Literature
- ✓ Aims and Objectives
- ✓ Materials & Methods
- ✓ Observations and Results
- ✓ Discussion
- ✓ Summary
- ✓ Conclusions
- ✓ Bibliography –Reference etc.

Place of Research Project:

- Student may prefer to undertake his/ her research project in-house or off-campus. Students those preferring to pursue research at off-campus will have to undertake research work only in any of the Department of Scientific and Industrial research (DSIR), Government of India recognized laboratory (Government, State-Government, Private).

Research Guide(s):

- Students who are opting for off-campus they will have one Major Research Guide from the host organization (Preferably a Ph D. qualified scientist), however, a Co-Guide from RGITBT will be appointed.

Dissertation Evaluation:

- Students will have to submit **Two progress reports (45 days of Intervals) (Format Enclosed) and One evaluation report from Research Guide having 40 % weight age (Format Enclosed)** at the time of dissertation submission on the execution of research project duly signed by Guide / Co-Guide. The progress report will include, attendance percentage, review collection, research progress, sincerity, topic understanding, and systematic execution of research project, data collection and management. The evaluation report will include attendance, review work, project execution, critical thinking, originality of work, presentation of result, understanding of research and topic, dissertation write-up, presentation of tables, figures, maps, references, etc.
- Student will have to give 20 min presentation on the work done in the presence of expert committee (between **April 21 to May 5 of every year**). (Note only working dates will be considered). The power point presentation format shall contain project title, name of candidate, place of research work, name of Guide/ Co-Guide, introduction, review, objectives, significance of the work, methodology, results & discussion, conclusion, references and acknowledgement. The presentation shall be of 12-15 min with 5-8 minutes of discussion.
- The presentation will carry **60 % of weight age** based on the following consideration. The overall understanding of the research project, objectives, methodology. The

outcome of research work, data analysis and statistics, clarity in presentation and question – answer session (**Format Enclosed**).

- Student will be assigned a grade as per the Rules mentioned.



RAJIV GANDHI INSTITUTE OF IT AND BIOTECHNOLOGY

“Write here **approved title** of the Dissertation in all upper-case (capital letters) with a 'centre' alignment. Place this title on the upper central part of the cover with sufficient margin from top and both sides. Use font size suitable to length of the title”

A DISSERTATION SUBMITTED TO

**RAJIV GANDHI INSTITUTE OF I.T. AND BIOTECHNOLOGY,
BHARATI VIDYAPEETH DEEMED UNIVERSITY, PUNE**

FOR AWARD OF DEGREE OF
MASTER OF SCIENCE in MEDICAL BIOTECHNOLOGY

SUBMITTED BY

.....

UNDER THE GUIDANCE OF

.....

.....

Name of Co-Guide

Name of Guide

RESEARCH CENTRE

.....

.....

.....

WRITE HERE DATE, MONTH & YEAR OF SUBMISSION

CERTIFICATE

This is to certify that the work incorporated in the dissertation entitled “.....” for the degree of ‘Master of Science’ in the subject of Medical Biotechnology under the faculty of Interdisciplinary Science has been carried out by Mr/ Mrs..... Rajiv Gandhi Institute of I.T and Biotechnology, BharatiVidyapeeth Deemed University, Dhankawadi, Pune (OR NAME OF THE LABORATORY, PLACE OF THE WORK) during the period from to.....under the guidance of Dr.....

Place: Pune

(Signature of Head of the Institute with seal)

Date :

Principal / Director
Seal

CERTIFICATION OF GUIDE

This is to certify that the work incorporated in the dissertation entitled
 “
 ”

Submitted by..... for the degree of ‘Master of Science’ in the subject of
 ‘Medical Biotechnology’ under the faculty of Interdisciplinary Science has been
 carried out in the Department (laboratory) of....., RGITBT, BVDU
 (**Institute/ Private Lab, Govt Lab etc**), Pune (**OR Place**) during
 the period fromto....., under my direct supervision/ guidance.

Place : (Signature of Research Guide)

Date : (Name & Designation)

Place : Pune (Signature of Research Co-Guide)

Date : (Name & Designation)

DECLARATION BY THE CANDIDATE

I hereby declare that the dissertation entitled “
”
_____ submitted by me to
(Title of thesis)

theBharatiVidyapeeth University, Pune for the degree of Master of Science (M Sc.) in
Medical Biotechnology under the Faculty of Interdisciplinary Sciences
original piece of work carried out by me under the supervision of _____
(Name of Guide) and _____. I further declare that it has not been
submitted to
(Name of Co-guide (if any))

this or any other university or Institution for the award of any degree or Diploma.

I also confirm that all the material which I have borrowed from other sources and
incorporated in this dissertation is duly acknowledged. If any material is not duly
acknowledged and found incorporated in this dissertation, it is entirely my
responsibility. I am fully aware of the implications of any such act which might have
been committed by me advertently or inadvertently.

Place :
Date : / /

Name & signature of
Research Student

BHARATI VIDYAPEETH DEEMED UNIVERSITY

(Re-accredited with **A grade** by NAAC in 2011, Accredited with **A⁺ Grade** by NAAC in 2017)

Rajiv Gandhi Institute of Information Technology and Biotechnology
Pune-Satara Rd, Katraj, Pune – 411 046

Proforma of Progress Report – I

(To be submitted to Principal, RGITBT, BVDU., Pune)

Name of the Student :
 Registration Number of the Student :
 Degree Program :
 Project Title :
 Name of the Research Guide :
 Name of Internal Guide (Co-Guide) :
 (Only in case of off-campus student)
 Period under report : Dec 1 – Jan 15

Name & Place of Research Work :

Objectives of Research Work : 1)
 2)
 3)

(Tick mark, wherever applicable)

	Very Good	Good	Poor	Special Remark, if any
Percent Attendance				
Getting well acquainted with colleague and laboratory procedures, sincerity				
Technical Aspects: Understanding research topic, review collection, systematic execution of research project, research progress, data collection and management				
Overall Performance				

Name of Research Guide with signature and seal:

Place & Date:

BHARATI VIDYAPEETH DEEMED UNIVERSITY

(Re-accredited with **A grade** by NAAC in 2011, Accredited with **A⁺ Grade** by NAAC in 2017)

Rajiv Gandhi Institute of Information Technology and Biotechnology
Pune-Satara Rd, Katraj, Pune – 411 046

Proforma of Progress Report – II

(To be submitted to Principal, RGITBT, BVDU., Pune)

Name of the Student :
 Registration Number of the Student :
 Degree Program :
 Project Title :
 Name of the Research Guide :
 Name of Internal Guide (Co-Guide) :
 (Only in case of off-campus student)
 Period under report : Jan 16 – Feb 28

Name & Place of Research Work :

Objectives of Research Work: 1)
 2)
 3)

(Tick mark, wherever applicable)

	Very Good	Good	Poor	Special Remark, if any
Percent Attendance				
Getting well acquainted with colleague and laboratory procedures, sincerity				
Technical Aspects: Understanding research topic, review collection, systematic execution of research project, research progress, data collection and management				
Overall Performance				

Name of Research Guide with signature and seal:

Place & Date:

(Re-accredited with **A grade** by NAAC in 2011, Accredited with **A+ Grade** by NAAC in 2017)

Rajiv Gandhi Institute of Information Technology and Biotechnology
Pune-Satara Rd, Katraj, Pune – 411 046

Proforma of Internal Evaluation Report

(To be submitted to Principal, RGITBT, BVDU., Pune)

Name of the Student :
 Registration Number of the Student :
 Degree Program :
 Project Title :
 Name of the Research Guide :
 Name of Internal Guide (Co-Guide) :
 (Only in case of off-campus student)

Name & Place of Research Work :
 Completion of Research Objectives : (Yes / No)

(of 40 % weight age)

	Out of	Marks obtained
Percent Attendance	10	
Getting well acquainted with colleague and laboratory procedures, sincerity	5	
Technical Aspects: Understanding research topic, review collection, systematic execution of research project, research progress, data collection and management	20	
Overall Performance	5	
Total		

1. Name of Research Guide with signature and seal:

2. Name of Research Guide:

Place & Date:

(Re-accredited with A grade by NAAC in 2011, Accredited with A+ Grade by NAAC in 2017)

Rajiv Gandhi Institute of Information Technology and Biotechnology
Pune-Satara Rd, Katraj, Pune – 411 046

Proforma of Evaluation Report on Presentation

(To be submitted to Principal, RGITBT, BVDU., Pune)

Name of the Student :
Registration Number of the Student :
Degree Program :
Project Title :
Name of the Research Guide :
Name of Internal Guide (Co-Guide) :
(Only in case of off-campus student)

Name & Place of Research Work :
Completion of Research Objectives : (Yes / No)

(of 60 % weight age)

	Out of	Marks obtained
Overall understanding of the research project - Research Objectives	10	
Significance of Research / Review	10	
Results – Data presentation, statistical analysis, Softwares used, Result Interpretation	15	
Presentation – Clarity, power point slides, communication skills, question – answer session.	15	
Significant outcome – Technical abstract, Seminar, etc.	10	
Total		

Name & Signature of Expert Pane - 1. (External):

- 2. (Internal):

- 3. (Internal):

Signature of Principal (RGITBT):

(Re-accredited with A grade by NAAC in 2011, Accredited with A+ Grade by NAAC in 2017)

Rajiv Gandhi Institute of Information Technology and Biotechnology
Pune-Satara Rd, Katraj, Pune – 411 046

Plan of Research Outline

(To be submitted to Principal, RGIITBT, BVDU., Pune)

Name of the Student :
Registration Number of the Student :
Degree Program :
Proposed Project Title :
Name of the Research Guide :
Name of Internal Guide (Co-Guide) :
(Only in case of off-campus student)

Name & Place of Research Work :
Proposed Research Objectives :

Start Date of Research project :

Likely Date of Project Completion :

Significance of Research Project :

Name & Sign of Student

Approved by

1. Name of Research Guide with signature and seal:

Place & Date:

2. Name of Research Guide (Co-Guide) with signature and seal:

Place & Date:



**BHARATI VIDYAPEETH
(DEEMED TO BE UNIVERSITY), PUNE**

**FACULTY OF INTERDISCIPLINARY STUDIES
M.Sc. - Medical Biotechnology
Old Syllabus**



**BHARATI VIDYAPEETH DEEMED UNIVERSITY,
PUNE**

FACULTY OF INTERDISCIPLINARY STUDIES

**MASTER OF SCIENCE IN
MEDICAL BIOTECHNOLOGY
PROGRAMME**

**COURSE STRUCTURE AND DETAILED SYLLABUS
OF
SEMESTERS I, II, III and IV
(UNDER CREDIT SYSTEM)
TO BE EFFECTIVE FROM 2012 -13 AT SEMESTER I**

BHARATI VIDYAPEETH DEEMED UNIVERSITY
FACULTY OF INTERDISCIPLINARY STUDIES
Course Structure of Master of Science in Medical Biotechnology Program
(Under Credit System)
To be effective from 2012 – 13 at Semester I

INTRODUCTION

The Master of Science in Medical Biotechnology (M.Sc. MedBT) is a full time 100 Credits course offered by Bharati Vidyapeeth Deemed University (BVDU) in its constitutive unit Rajiv Gandhi Institute of IT and Biotechnology, Pune. The Institute is approved by UGC to conduct graduate and post graduate courses in Biotechnology and the University itself is reaccredited by NAAC with prestigious 'A' grade. The Institute has excellent infrastructure, faculty, state-of-art laboratories, and library to provide appropriate learning facilities and environment. The prospects of the Biotechnology in industry and research in health sector are envisaged while designing the M.Sc. Medical Biotechnology curriculum. The feedback of students, faculty, employers and parents has a substantial contribution in designing this curriculum.

OBJECTIVE

Biotechnology is application of technological advances in life sciences for the benefit of mankind and the associated plant and animal life. The discipline of biotechnology encompasses almost all branches of life science like biochemistry, microbiology, molecular biology, crop and plant improvement, animal husbandry, bioinstrumentation, bioinformatics etc. Although, the M.Sc. biotechnology course covers most of the above areas, the advances in every sector make it difficult to provide 'state of art' information in these subjects to students. Several institutions have therefore given thrust to specific areas of Biotechnology such as agriculture, molecular biology, immunology, genetics, virology etc. Medical science appears to be a favored choice because of the incredible advances made in this area. Medical Biotechnology is a field that deals with the technologies related to health care. Recent research in this discipline has revolutionized patient care in terms of :

1. Biological reagents such as engineered monoclonal antibodies have substantially improved laboratory diagnostics. Improved diagnosis using molecular techniques to amplify DNA, RNA and identification of chromosomal changes at molecular level with FISH and SKY technique.
2. Improvement in vaccine technology has reduced infant mortality by 90% in western world and more than 60% in India.
3. Improved therapeutics such as a) humanized monoclonal antibodies, genetically engineered cytokines like interferons, hormones and growth factors, b) Newer drugs along with newer methods of assessment of drug efficacy and genetic manipulations to bypass multidrug resistance have gone a long way in reducing deaths due to communicable as well as non-communicable diseases.
4. Management of non-communicable diseases such as cancer, endocrine and neurological disorders, allergies, autoimmune diseases and immunodeficiency diseases has benefited to a great extent by discoveries in biotechnology.
5. Success in organ transplantation today is entirely attributed to improvement in immunosuppressive drugs and immune interventions – the products of modern biotechnology research.

6. The areas of gene therapy, tissue engineering, the use of stem cells for regenerative medicine and cell replacement therapy, use of biosensors for diagnosis purposes, development of non-invasive imaging instrumentation are the thrust areas in the future and the main opportunities in Medical Biotechnology will lie in these areas.

Due to the ample thrust imparted globally to the discipline of Medical Biotechnology, Bharati Vidyapeeth Deemed University proposes to start 2 years masters (M.Sc.) degree course in its constitutive unit RGITBT. The main advantage in proposing such a course is the excellent trained staff and the availability of the expertise of medical fraternity and the hospital on the same campus. The course will be singular of its kind perhaps in the state of Maharashtra.

ELIGIBILITY FOR ADMISSION TO THE COURSE

Admission to the course is open to any graduate of any recognized university satisfying the following conditions

- i. The candidate should have obtained the Bachelors degree in Biotechnology/ Biochemistry/ Zoology/ Microbiology/ Botany/ Chemistry/ Pharmacy/ Medicine including homeopathy and Ayurveda / veterinary.
- ii. The candidate should have secured at least 50% (45% for SC/ST) in aggregate at graduate level university examination

DURATION OF THE COURSE

The duration of this course is two years consisting of four semesters. The medium of instruction and examination will be only English.

RULES AND REGULATIONS

1. The entire Course is of 100 credits and will be executed in 4 semesters.
2. One credit is equivalent to 15 hrs of interaction of student with facilitator for theory, while one credit for practical course is equivalent to 40 hrs of practical work.
3. About 27 & 28 credits are offered in Semester I & II respectively. Whereas 25 and 20 credits are offered in Semester III & IV respectively.
4. The student will undertake dissertation in Semester IV for which 10 credits are allotted. One hundred marks are allotted for the assessment of this dissertation work. The distribution of these marks is as follows;
 - I. 25 Marks for updated literature survey and framing of Aims & Objectives of the selected dissertation topic.
 - II. 25 Marks for progress of work (based on day – to – day work)
 - III. 25 Marks for fulfillment of objectives
 - IV. 25 Marks for presentation/ Viva (External evaluation)
5. The field/ industrial/ academic institute visits will be organized for demonstration of advance experimental techniques wherever necessary along with the practical courses.
6. A student must have minimum 70% attendance to fulfill the term. A student who does not have the required attendance may not be allowed to appear for the university term.

Rules for Examination

1. Examination for the theory and practical courses will be conducted at the end of each respective semester.
2. The weightage allotted for internal assessment is 40%. Thus 40 marks out of 100 will be allotted for internal assessment which will be conducted throughout the semester in the form of tests/tutorials/seminars/oral presentations etc.
3. The university shall conduct an examination for 60 marks.
4. The elective courses and general courses will be evaluated by the instructor on the basis of continuous assessment.

STANDARD OF PASSING

1. The 10–point scale would be used to convert marks out of 100 to grades and grade points according to the following table.

Marks as percentage	Grade	Grade point
[75, 100]	O	10.0
[70, 74.9]	A+	9.0
[65, 69.9]	A	8.0
[60, 64.9]	B+	7.0
[55, 59.9]	B	6.0
[50, 54.9]	C+	5.5
[45, 49.9]	C	5.0
[40, 44.9]	D	4.5
[00, 39.9]	F	0.0

2. For courses which have University Examination (UE) and Internal Assessment (IA) In order to pass at the University Examination, a student must obtain at least 'D' grade at the university examination and a minimum GPI of 4.0 in aggregate of UE and IA. There will be a separate grade assigned for performance in IA. There is no minimum grade for passing in IA. The grade point index (GPI) will be calculated for a course as and when the student passes in the UE by combining UE and IA percent marks with weights 60% and 40%. A student who fails in a course, must clear the course by re-appearing at UE only as a backlog candidate.
3. For courses which have no University Examination:
For some courses, there is no UE. The respective institutes conduct 'continuous assessment' and report the grade. For such courses the corresponding grade point would be the GPI. In order to pass in such courses the student must obtain a minimum GPI of 4.0.
4. At the end of each semester, a cumulative grade point average (CGPI) will be calculated as a weighted average of the GPI of all courses in which the student have passed till that semester.
5. A student who passes in all the courses will be declared to have passed the entire M.Sc. program with the following honours.
CGPI in [0.00, 3.99] -- Fail

CGPI in [4.00, 4.99] -- Pass Class

CGPI in [5.00, 5.49] -- Second Class

CGPI in [5.49, 5.99] -- Higher Second Class

CGPI in [6.00, 7.99] -- First Class

CGPI in [8.00, 10.00] -- Distinction
6. The percent marks equivalent a CGPA/SGPA is calculated by the formula:

$$\left| 10 * CGPA \right. \quad \text{if CGPA is in } [4.00, 6.00],$$

$\%Marks = \begin{cases} 5 * CGPA + 30 & \text{if } CGPA \text{ is in } [6.00, 9.00], \\ 25 * CGPA - 150 & \text{if } CGPA \text{ is in } [9.00, 10.00] \end{cases}$

SEMESTER-WISE COURSE INFORMATION

SEMESTER I

Course Number	Course Title	Credit Value	# Lec.	# Tut.	# Lab	Weightage for EoTE/IA	EoTM
MedBT 101	Medical Biochemistry	4	3	2	-	0.6/0.4	Univ.
MedBT 102	Human Physiology	4	3	2	-	0.6/0.4	Univ.
MedBT 103	Medical Microbiology	4	3	2	-	0.6/0.4	Univ.
MedBT 104	Molecular Biology	4	3	2	-	0.6/0.4	Univ.
MedBT 105	Medical Biochemistry & Physiology Lab	3	-	-	4	0.6/0.4	Univ.
MedBT 106	Medical Microbiology Lab	3	-	-	4	0.6/0.4	Univ.
MedBT 107	Molecular Biology Lab	3	-	-	4	0.6/0.4	Univ.
MedBT 108	General Course 1 Communication skills and Personality Development	2	2	-	-	Continuous Assessment	Institute

Total Credits offered in Sem I: 27

SEMESTER II

Course Number	Course Title	Credit Value	# Lec.	#Tut.	#Lab	Weightage for EoTE/IA	EoTM
MedBT 201	Immunology	4	3	2	-	0.6/0.4	Univ.
MedBT 202	Medical Genetics	4	3	2	-	0.6/0.4	Univ.
MedBT 203	rDNA in Medicine	4	3	2	-	0.6/0.4	Univ.
MedBT 204	Infectious Diseases	4	3	2	-	0.6/0.4	Univ.
MedBT 205	Immunology Lab	3	-	-	4	0.6/0.4	Univ.
MedBT 206	Medical Genetics Lab	3	-	-	4	0.6/0.4	Univ.
MedBT 207	rDNA in Medicine Lab	3	-	-	4	0.6/0.4	Univ.
MedBT 208	Infectious Diseases Lab	3	-	-	4	0.6/0.4	Univ.

Total Credits offered in Sem II: 28

SEMSTER III

Course Number	Course Title	Credit Value	# Lec.	# Tut.	# Lab	Weightage for EoTE/IA	EoTM
MedBT 301	Animal Tissue Culture	4	3	2	-	0.6/0.4	Univ.
MedBT 302	Non communicable diseases	2	1	2	-	0.6/0.4	Univ.
MedBT 303	Vaccines, antibiotics & therapeutics	4	3	2	-	0.6/0.4	Univ.
MedBT 304	Genomics & Proteomics	4	3	2	-	0.6/0.4	Univ.
MedBT 305	Biostatistics	2	2	-	-	0.6/0.4	Univ.
MedBT 306	Animal Tissue Culture Lab	3	-	-	4	0.6/0.4	Univ.
MedBT 307	Vaccines, antibiotics & therapeutics Lab	3	-	-	4	0.6/0.4	Univ.
MedBT 308	Genomics & Proteomics Lab	3	-	-	4	0.6/0.4	Univ.

Total Credits offered in Sem III: 25

SEMSTER IV

Course Number	Course Title	Credit Value	# Lec.	#Tut.	#Lab	Weightage for EoTE/IA	EoTM
MedBT 401	IPR and Bio-safety	2	2	-	-	Continuous assessment	Institute
MedBT 402	Medical Informatics	2	2	-	-	Continuous assessment	Institute
MedBT 403	Biomedical waste and environment	2	2	-	-	0.6/0.4	Univ.
MedBT 404	Nanotechnology in Medicine	2	2	-	-	0.6/0.4	Univ.
MedBT 405	General Course II Research Methodologies	2	2	-	-	-	Institute
MedBT 406	Dissertation	10	-	-	-	-	Univ.

Total Credits offered in Sem IV: 20

Total Credits offered in all four semesters: 100

MASTER OF SCIENCE IN MEDICAL BIOTECHNOLOGY (MedBT) PROGRAMME
Course-wise Syllabus
SEMESTER I

COURSE MedBT101: Medical Biochemistry
(4 Credits, 3L + 1T)

Unit 1
15L

1. Carbohydrates: Regulation of Blood Sugar, Insulin and Diabetes Mellitus:

Regulation of blood glucose, Determination of glucose, Glucose tolerance test, Impaired glucose tolerance. Impaired fasting glycemia, Gestational diabetes mellitus, Alimentary glucosuria, Renal Glucosuria, Reducing substances in urine, Glycosuria, Insulin, Glucagon, Diabetes mellitus, Clinical presentation, Diabetic keto acidosis, Hyperosmolar nonetotic coma, Lactic acidosis, Chronic complications, Glycated haemoglobin.

2. Lipids:

Introduction and overview, Beta oxidation, Energetics, Metabolism of adipose tissue, Hormone sensitive lipase, Liver adipose tissue axis, Obesity, Fatty liver, Lipotropic factors, Ketone bodies, Ketogenesis, Ketolysis, Ketosis, Steroids, Structure of cholesterol, Biosynthesis of cholesterol, Hypercholesterolemia, Lipid profile, Plasma cholesterol, Atherosclerosis, Coronary artery disease, Bile salts, Steroid hormones.

Unit 2

15L

1. Proteins: Overview, Fates of amino acids and overview of metabolism, Transamination, deamination, decarboxylation, formation & fates of ammonia, urea cycle, fates of glycine, tryptophan, metabolism of tyrosine, metabolism of sulphur containing amino acids (methionine), excretion of sulphur, phenylketoneuria, Albinism, Alkaptonuria, Creatinine metabolism.

2. Plasma Proteins:

Serum electrophoretic pattern in normal and abnormal states, Albumin, Transport proteins, Polymorphism, Acute phase proteins, Ceruloplasmin, Alpha-1-anti-trypsin, Alpha-2-macroglobulin, Alpha-1-acid glycoprotein, Negative acute phase proteins, Clotting factors, Anticoagulants, fibrinolysis, Hemophillia.

3. Hemoglobin:

Structure of hemoglobin, Transport of gases, Oxygen dissociation curve, Haemoglobin interaction, Effect of 2,3-BPG, Types of normal hemoglobin- A, A₂E, F, glycosylated, abnormal hemoglobin, HbS, HbM Fetal haemoglobin (HbF), Haemoglobin variants, Sickle cell haemoglobin (HbS), Thalassemias, Myoglobin, Anemias, Bilirubin Metabolism, Jaundice.

Unit 3

15L

1. Enzymology: Iso-enzymes and Clinical Enzymology:

Iso-enzymes, Enzyme units, Lactate dehydrogenase, Creatine kinase, Cardiac troponins, Aspartate amino transferase, Alanine amino transferase, Alakaline phosphatase, Nucleotide phosphatase, Gamma glutamyl

transferase, Acid phosphatase, Cholinesterase, Glucose-6phosphate dehydrogenase, Enzymes as therapeutic agents, Enzymes used for diagnosis.

2. Vitamins:

Definition and classification, water soluble vitamins- thiamine, riboflavin, niacin, pyridoxine, folic acid, cobalamin, biotin, pantothenic acid, ascorbic acid: Their common food sources, active metabolic role, deficiency problems.

Unit 4

15L

1. Detoxification (Metabolism of Xenobiotics)

Mechanism of Detoxification of Xenobiotics, Phase I Reactions, Phase II Reactions

2. Acid-Base Balance:

Acids, Bases and Buffers, Normal pH of the Body Fluids, Regulation of Blood pH, Acidosis and Alkalosis, Anion Gap

3. Electrolyte Balance And Water Metabolism

4. Radioisotopes In Medicine

Concept of radioactivity, Use of Radioisotopes in Medicine, Radiation Hazards, Radiation Health Safety and Protection

5. Free Radicals And Antioxidants:

Free Radicals and Reactive Oxygen Species (ROs), Antioxidants, Oxidative Stress

6. Techniques in biochemistry: Principles and application of: Chromatography, Electrophoresis, Spectrophotometry, Auto analysers.

References

1. Nelson and Cox (2008), Principles of Biochemistry by A. Lehninger, W.H. Freeman and Company, New York, USA.
2. Berg Jeremy M., Tymoczko J. L. and Stryer L. (2003), Biochemistry, W.H. Freeman and Company, New York, USA.
3. Biotechnology U Satyanarayana (2009), Books And Allied (p) Ltd.

**COURSE MedBT102: Human Physiology
(4 Credits, 3L + 1T)**

Unit 1 **15L**

- 1. Muscle:**
 - a) Classification of Muscle
 - b) Structure of Skeletal Muscle
 - c) Mechanism of Muscle Contraction
 - d) Muscle Disorders
- 2. Connective Tissue:**
 - a) Basic Components Tissue
 - b) Collagen
 - c) Elastin
 - d) Disorders of Connective Tissue
- 3. Brain and neurobiology:**
 - a) Overview of the Brain and nervous system
 - b) Classification of Neurotransmitters
 - c) Mechanism of Release of Neurotransmitters
 - d) Regulation Action of Neurotransmitters
 - e) Different Common Neurotransmitters

Unit 2 **15L**

- 4. Heart and Blood circulation, blood clotting**
- 5. Digestive system, reproductive system, nervous system and respiratory system.**

Unit 3 **15L**

- 5. Hormones:**

Classification, Mechanism of action of Hormones, G.Proteins Cyclic AMP., Steroid hormones, Thyroid hormones.
- 6. Body fluids**

Fluid balance, parenteral solutions, renal physiology
- 7. Clinical Biochemistry:**

Pre analytical Variable, Collection of blood, Collection of Urine, Anti coagulants, Quality Control Programme, Liver Function Tests, Renal Function Tests, Thyroid Function Tests, Lipid Profile Tests

Unit 4 **15L**

Nutrition:

- 8. Principle of Human Nutrition**

Introduction: The relationship between nutrition, health and disease, Proximate principles, Balance Diet, Energy Metabolism, Water, Minerals including trace elements, Vitamins, Recommended dietary allowances, Nutrition throughout life cycle, Malnutrition and Chronic Energy Deficit, Micronutrient disorders, Maternal and child nutrition, Method of promoting dietary change.
- 9. Nutrigenomics and nutrient gene interaction**

References:

1. 1.Clinical Biochemistry Second Ed., Godkar, P. B. and Godkar, D. B., Bhalani Publishing House, Mumbai 2003
2. Principles and Techniques of Biochemistry and Molecular Biology, Wilson K. and Walker J. Cambridge Univ. Press, New York. 2005

3. Advanced textbook on food and Nutrition: Dr. M Swaminathan, The Bangalore Publishing Co. Ltd. Bangalore, 1974
4. Nutrition for Developing Countries: E. Savage King, Oxford University Press, Oxford, 1992.
5. Nutrition problems and Programmes in South East Asia: Dr. C. Gopalan, World Health Organization, New Delhi, 1987.
6. Perspective in Nutrition: Gordon M. Wardlaw, Paul M. Injel, Time/Mosby College Publishing, St. Louis, 1990.
7. Fundamental of food and Nutrition: Sumati R. Mudambi, M.V. Rajagopal, V.R. Damodharan, Wiley Eastern Ltd. New Delhi, 1982.
8. Clinical Dietetics and Nutrition, F.P. Antia, Oxford University Press, Delhi, 1993.

**COURSE MedBT 103: Medical Microbiology
(4 Credits, 3L + 1T)**

Unit 1	15
L	
1. Classification of microorganisms Bacteria, Fungi, Viruses, Parasites	
2. Morphology and physiology of bacteria Microscopy: compound microscope, DGI, Electron microscope, Immunofluorescence microscope Size and shape of bacteria Bacterial anatomy, growth and multiplication of bacteria Bacterial nutrition	
3. Sterilization and disinfection Physical agents, Chemical agents, Testing of disinfectants	
Unit 2	
15 L	
1. Culture media Types of culture media : used for isolation and identification of microorganisms	
2. Culture methods Methods of isolating pure cultures of pathogens Anaerobic culture methods	
3. Identification of bacteria-systemic study Microscopic examination Cultural characteristics Resistance (antibiotic susceptibility testing) Metabolism Fermentation and other biochemical properties Rapid identification methods	
Unit 3	15 L
1. Infection	
2. Sources of infection	
3. Methods of transmission of infection	
4. Factors predisposing to microbial pathogenicity	
5. Types of infectious diseases	
Unit 4	15 L
1. Diagnostic methods for identification of fungi Microscopy, culture and specific tests	
2. Diagnostic methods for identification of viruses Microscopy, culture and serological tests	
3. Diagnostic methods for identification of parasites Microscopic examination of stool, blood and other body fluids	
4. Diagnostic methods in clinical microbiology Sample collection and processing	
5. Recent advances in diagnostic techniques in clinical microbiology	

New diagnostic techniques-nucleic acid base methods, immunoassays, miscellaneous tests with examples

References:

1. Textbook of Microbiology Ananthanarayan R, 8th Ed. – 2009
2. Textbook of Microbiology Baveja C. P. 3rd Ed. – 2009
3. Textbook of Diagnostic Microbiology Mohan Connie R. 3rd Ed. – 2007
4. Prescott, Harley and Kleins Microbiology, WILEY, 7th Ed. – 2008
5. Mckie and McCartney Practical Medical Microbiology, College J.G., 14th Ed. – 2008
6. Bailey & Scott's Diagnostic Microbiology, Forbes Betty A, 12th Ed. – 2007
7. Schaechter's Mechanism of Microbial Diseases, Engleberg N. Carey, 4th Ed. – 2007
8. Mims Medical Microbiology, 4th Ed. 2007
9. Parasitology Protozoology and Helminthology, Chatterjee K.D, 13th Ed. 2009
10. A text book of Microbiology, Arora D. R. 3rd Ed. 2008
11. Jawets Melnick & Adelberg's Medical Microbiology, B.R., 24th Ed. 2007
12. Principles and Practice of Infectious Diseases Vol.I Mandell Gerald L. 7th Ed.
13. Principles and Practice of Infectious Diseases Vol.II Mandell Gerald L. 7th Ed.
14. Textbook of Medical Mycology, Chader Jagdish, 3rd Ed. 2011

COURSE MedBT 104: Molecular Biology

(4 Credits, 3L + 1T)

Unit 1

15L

1. Genomes and its content

Genome sizes of different organisms, C Value

Genome mapping

Repetitive and nonrepetitive DNA sequences

Clusters, repeats, satellite, minisatellites DNA sequences

Gene numbers, distribution of genes and other sequences in the genome

Number of expressed genes and its evaluation Genome evolution

Unit 2

15L

1. Organization of prokaryotic and eukaryotic genome

Organization of chromatin, chromosome structure and role, chromosome banding

2. DNA replication, repair and recombination

DNA polymerases, mechanism of replication in prokaryotes and eukaryotes,

DNA damage, repair and recombination

Unit 3

15L

1. Transcription and posttranscriptional mechanisms

RNA polymerase and mechanism of prokaryotic transcription

Eukaryotic RNA polymerases and their promoters, activating transcription, role of enhancers, post transcriptional modifications, RNA splicing reactions, catalytic RNA

Unit 4

15L

1. Translation

Mechanism of translation in prokaryotes and eukaryotes, post translational modifications, transport of proteins

2. Gene regulation

Operon, Induction and repression, positive and negative regulation, attenuation, lactose, arabinose and tryptophan operon, Eukaryotic transcription regulation

3. Epigenetic effects

Definition, Biochemistry, Inheritance; Meiotic and mitotic, DNA methylation, histone modifications, Methods for DNA methylation measurements
Role of epigenetics in regulation of gene expression, genomic imprinting.

4. Role of epigenetics in human diseases

5. Fetal programming of adult diseases

References:

1. Lewin's GENES X. Krebs J.E., Goldstein E.S., Kilpatrick S.T. (2011) Jones and Bartlett Publishers, MA, USA, 01776
2. Watson J. and Stephen (2004) Molecular Biology of the Gene, Dorling Kindersley(India) pvt ltd, New delhi. Taylor and Francis group, New York.
3. Cooper G.M. and Hausman R.E. (2004) The Cell: A molecular approach, Sinauer Associates, Inc., ASM Press, Washington DC.

Course MedBT 105: Medical Biochemistry Physiology Lab (Practical Course)

(3 Credits, 2P, 6.00 Hr)

- 1 Estimation of Blood Sugar
- 2 Estimation of Blood Urea
- 3 Estimation of Serum Creatinine
- 4 Estimation of Serum Proteins
- 5 Estimation of Serum Cholesterol
- 6 Estimation of Alkaline Phosphatase
- 7 Estimation of Alanine Transferase
- 8 Estimation of Aspartate Transferase
- 9 Estimation of Lactic Dehydrogenase
- 10 Urine Analysis
- 11 CSF Analysis
- 12 Determination of k_m value of Alkaline Phosphatase and effect of substrate concentration on k_m value.
- 13 Separation of Serum proteins by electrophoresis
- 14 Separation of LDH isoenzymes by PAGE
- 15 Separation of Sugars and Amino acids by chromatography
- 16 Determination of blood pH by Acid-base analyser.
- 17 Estimation of electrolytes by flame photometer.

Reference:

1. A practical clinical biochemistry, methods and interpretations; R. Chawala, Jaypee Brothers Medical Publishers Ltd.
2. A manual of laboratory techniques, National Institute of Nutrition, Raghulamulu N, Nair K. M., Kalyanasundarm S
3. Manipal manual of clinical Biochemistry, Shivananda Nayak, Jaypee Brothers Medical Publishers Ltd. 3rd Edition.
4. Nelson and Cox (2008), Principles of Biochemistry by A. Lehninger, W.H. Freeman and Company, New York, USA.
5. Biotechnology U Satyanarayana (2009), Books And Allied (p) Ltd

Course MedBT 106: Medical Microbiology Lab (Practical Course)

(3 Credits, 2P, 6.00 Hr)

- 1. Microscopy:** **2P**
Study of compound microscope with its use and care, uses of DGI, Phase contrast, electron microscope and fluorescence microscope. Uses of Microme
- 2. Morphology-1**
2P
Grams staining of bacteria
Demonstration of various shapes and arrangements of bacteria
- 3. Morphology-2** **2P**
ZN-staining of acid-fast bacteria
Demonstration of special morphological features of bacteria-spore, capsule, metachromatic granules
- 4. Sterilization** **2P**
Study of various instruments used for sterilization
- 5. Culture media**
2P
Study of different types of culture media with their preparation and uses
- 6. Systemic study of bacteria**
2P
Various methods used of isolation and identification of bacteria by biochemical tests and antibiotic susceptibility testing
- 7. Serological tests** **2P**
Agglutination, precipitation, ELISA, VDRL

References:

1. Laboratory Practices in Tropical Countries Part I and II, Monica Chesbrough, 2nd Ed
2. Diagnostic Microbiology (Bailey & Scott's), Betty A. Fobes, Daviel F. Sahm & Alice S. Weissfeld, 11th Edition
3. Textbook of Diagnostics Microbiology, Connie R. Mahon, Donald C. Lehman, 3rd Ed
4. Color Atlas and Textbook of Diagnostic microbiology, Gorge Munusetis, Washington Winn Jr. Stephan Allen, William J. , Elmer Konneman and Gary Procop, 6th Ed

COURSE MedBT107: Molecular Biology Lab (Practical Course)

(3 Credits, 2P, 6.00 Hr)

1. Isolation and analysis of DNA from bacteria/ cells/blood/plant **6P**
2. Isolation and estimation of mRNA from bacteria/yeast/eukaryotic cells **6P**
3. Determination of T_m and % (G+C) of DNA **2P**
4. Southern blotting **3P**
5. Demonstration of DNA amplification by PCR, **2P**
6. Evaluation of gene expression using Real Time PCR **1D**
7. DNA sequencing (Demonstration) **1D**
8. Study of phases of mitosis and meiosis **2P**

References:

1. Sambrook J and Russell D. (2001) Molecular cloning A Laboratory Manual, Cold spring harbor laboratory press, New York.
2. Wilson K. and Walker J. (2005) Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, New York.

COURSE Med BT 108: General Course I: Communication skills and personality development

Objectives: In addition to sound technical knowledge, today's youth are expected to acquire soft skills in order to compete in the global market. Because of the importance of these skills in the employability of students, the Medical Biotechnology curriculum includes courses that will develop soft skills of students. The above course is aimed at developing the writing and presentation skill of students which are essential in industry as well as research careers. The course will train the students to:

- Communicate ideas effectively
- Make effective oral presentations, both formally and informally
- Understand and offer constructive critiques of the presentations to the others
- Have a pleasant demeanor as they work with people, either in person or by phone
- Write appropriate electronic communications (including email, blogs, instant messages etc.)

The communication skill development program will include formal lectures and demonstrations for improving writing and oral communication in a way that emphasizes both speaking and active listening skills.

SEMESTER II

COURSE MedBT 201: Immunology (4 Credits, 3L + 1T)

Unit 1

15L

1. Introduction to basic immunology

Immunology overview, Innate immunity, adaptive immunity, Humoral Immune response and Cells mediated immune response

Organs of the immune system, Antigens, Antibodies, Antigen presenting cells, antigen processing and presentation

Unit 2

15L

1. Lymphocyte ontology and molecular immunology

B cell maturation, activation and differentiation, Ig gene rearrangement

T cell maturation, activation and differentiation, T cell receptor, Major histocompatibility complex, Complement system, Cytokines, Chemokines and their receptors, Cell signalling and trafficking

Unit 3

15L

1. Immunochemistry

Antigen-antibody interactions: Preparation of polyclonal antibodies, Immunoglobulin separation techniques, production of monoclonal antibodies and genetically engineered antibodies, assessment of antibodies by: precipitation, agglutination, complement fixation, viral neutralisation, ELISA, RIA, Immunofluorescence, immunoperoxidase, western blotting.

Separation of immune cells, Identification of lymphocytes, lymphocyte transformation, Mixed lymphocyte reaction, generation of cytotoxic T cells, Measurement of cytotoxicity of T and NK cells, ADCC, Enumeration of cells secreting specific proteins (Elispot)

Unit 4

15L

1. Clinical immunology

Immunology of bacterial diseases with special reference to Tuberculosis, leprosy, Immunology of viral diseases with special reference to influenza and AIDS, Immunology of parasitic diseases with special reference to malaria,

2. Immunodeficiency diseases

Primary immunodeficiency, disorders of complement, disorders of phagocytosis
Secondary immunodeficiency

References:

1. Primary immunodeficiency, disorders of complement, disorders of phagocytosis
Secondary immunodeficiency

2. Immunology and Serology in Laboratory Medicine Turgeon Mary Louise 4th Ed. 2009
3. A Textbook of Microbiology & Immunology, Parija Subhash Chandra 2009
4. Immunology , Kuby, 4th edition, Richard A. Goldsby, T. J. Kindt and B. A. Osborn, WHfreeman and Co., New-York
5. Riott's essential Immunolgy, I. M. Riott, Evan M. riot and Peter J. Delves, 10th edition

COURSE MedBT 202: Medical genetics

(4 Credits, 3L + 1T)

Unit 1

15L

1. Overview of genetics, cell division and development

Transmission genetics; Mendel' laws of inheritance, concepts of alleles, dominance, recessiveness, codominance, epistasis, pleiotrophy and multiple alleles.

Extension of Mendelian genetic principles

ABO and Rh blood group systems.

Genetic linkage, sex determination in human and role of Y chromosome, dosage compensation, mitochondrial genome-extrachromosomal inheritance.

Molecular basis of mutations, types of mutations,

Unit 2

15L

1. Structure of human chromosome, chromosomal abnormalities, numerical abnormalities, structural abnormalities, spontaneous abortion, birth defects.

Sex chromosomes, sexual differentiation, X chromosome inactivation, disorders of sex chromosomes, Klienfelter syndrome, XYY syndrome, Turner syndrome, X-linked mental retardation, Fragile X, X-autosome translocations

Unit 3

15L

1. Autosomal abnormalities

Diseases exhibiting Mendelian pattern of inheritance-sickle cell anemia, X-linked diseases-haemophilia, cystic fibrosis, diseases associated with syndrome, Edward's syndrome, Patau's syndrome, Jacobe syndrome, inborn errors of amino acids, carbohydrate and lipid metabolism, mitochondrial genetic defects.

2. Cancer genetics; genetic control of cell cycle, mutations that prevent normal checkpoints, inherited cancer syndromes, cancers acquired due to chromosomal abnormalities

Unit 4

15L

1. Genetic testing and treatment; karyotyping, FISH, prenatal diagnosis, molecular methods, genetic counseling, treatment, gene therapy

References

1. Human molecular genetics. Peter Sudbery, 2nd Ed, 2002. Pearson education limited Publ, Edinberg UK.
2. Essential genetics, A genomics perspective. Daniel L. Hartl, Elizabeth W. Jones. 4th Ed. 2006 Jones Bartlett Publ. USA
3. Human genetics: Concepts and applications. Ricky Lewis. Mc Graw – Hill Higher Education Inc Publ 2007

4. Human molecular genetics 3. T Strachan and A. Read. Garland Publishing. 2004
5. Genetics: Analysis of genes and genomes. D.L. Hartl and E. W. Jones, Jones and Bartlett. 2001
6. Emery's elements of medical genetics. 2nd Edn. R. Mueller and I. Young. Churchill Livingstone 2001.
7. Human Genetics. A. Gardner, R. T. Howell and T. Davies. Viva Book Publ

**COURSE MedBT 203: rDNA in Medicine
(4 Credits, 3L + 1T)**

Unit 1

15 L

1. Tools and techniques in recombinant DNA Technology

General introduction to the concepts of genetic engineering
Use of various enzymes in recombinant DNA work: nucleases; Restriction Enzymes: DNA ligase Klenow enzymes, T4 DNA polymerases, Polynucleotide kinase, alkaline phosphatase
Cohesive and blunt end ligation; Homopolymeric tailing
Labelling of DNA: Nick translation, random priming, radioactive and non-radioactive probes
Hybridization: Northern, Southern and Colony hybridisation, fluorescence in situ hybridization
Chromatin immunoprecipitation
DNA-protein Interactions
Electromobility shift assay, DNase I footprinting, methyl interference assay

Unit 2

15 L

1. Vectors, libraries and screening

Vectors: cloning vectors: plasmids, bacteriophages, M13 mp vectors, PUC 19 and blue script vectors, phagemids, lambda vectors, shuttle vectors, selectable markers, insertion and replacement vectors, EMBL, cosmids, artificial chromosome vectors (YAC's, BAC's), animal derived vectors-SV 40, vaccinia /baculo & retroviral vectors, expression vectors, Protein purification, His-tag, GST-tag etc, intein based vectors, inclusion bodies, methodologies to reduce formation of inclusion bodies, Baculovirus and pichia vector systems, yeast vectors
Insertion of foreign DNA into host cells, Identification and characterization of insert DNA fragments, transcript analysis, Restriction mapping, transformation, construction of libraries genomic and cDNA), isolation of mRNA and total RNA

Shotgun cloning and cDNA cloning techniques, expression cloning, southwestern and far western cloning, protein-protein interactive cloning and yeast two hybrid system, phage display, principles in maximizing gene expression
Selection of recombinant DNA clones.

Unit 3

15 L

1. Sequencing and PCR based techniques

RFLP and other uses of cloned sequences.
PCR-based analysis, RFLP, DNA fingerprinting.
Site-directed mutagenesis and molecular chimeras
PCR: primer design, fidelity of thermostable enzymes, DNA polymerases, types of PCR-multiplex, nested, reverse transcriptase, RT PCR, touchdown PCR, hot start PCR, colony PCR,
Cloning of PCR products, T vectors, proof reading enzymes, PCR in gene recombination, deletion, addition, overlap extension and SOEing, site specific mutagenesis, mutation detection, SSCP, DGGE, RFLP, Oligo Ligation Assay,

MCC (Mismatch Chemical Cleavage), ASA (Allele Specific Amplification) PTT (protein Truncation Test)

Sequencing methods, Enzymatic DNA sequencing, Chemical sequencing of DNA, Automated DNA sequencing, Next generation sequencing, RNA sequencing

Unit 4

15 L

1. Nucleic acid based therapeutics

Chemical synthesis of oligonucleotides, introduction of DNA into mammalian cells, transfection techniques, gene silencing techniques, introduction to siRNA, siRNA technology, MicroRNA, Construction of siRNA vectors, principle and applications of gene silencing, gene knockouts and gene therapy, creation of knockout mice, disease models, somatic and germ line therapy in-vivo and ex-vivo, suicide gene therapy, gene replacement, gene targeting, transgenics, cDNA and intragenic arrays, differential gene expression and protein array.

References:

1. Primrose S., Twyumon R. M. And Old R. W., 7th edition (2008), Principles of gene manipulation, Blackwell Publishing, UK
2. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
3. Brown T. A., 5th edition(2006), Gene cloning and DNA analysis , Blackwell Publishing, UK
4. Nicholl D. S. T. ,2nd edition (2002), Introduction to genetic engineering, Cambridge University Press, UK
5. Channarayappa (2006), Molecular Biotechnology: Principles and Practices, University Press, New Delhi, India
6. Watson J. and Stephen (2004), Molecular Biology of the gene, Dorling Kindersley Pvt. Ltd., New Delhi, India
7. Benjamin Lewin, (2004) Genes VIII , Pearson Education Inc. Nj.
8. Bernhard Palsson and Sangeeta N Bhatia, Tissue Engineering, 2nd Edition, Prentice Hall, 2004
9. Pamela Greenwell, Michelle McCulley, Molecular Therapeutics: 21st century medicine, 1st Edition, Springer, 2008.

**COURSE MedBT 204: Infectious Diseases
(4 Credits, 3L + 1T)**

**Unit 1
15L**

Etiology, pathogenesis, laboratory diagnosis, treatment and prophylaxis

National disease control programmes for Vector Control, Tuberculosis, AIDS, Diarrheal Disease, Leprosy, and Other National Disease Programmes.

- 1. Diseases caused by Gram positive cocci**
 - a) *Staphylococci*
 - b) *Streptococci*
 - c) *Pneumococci*
- 2. Diseases caused by Gram negative cocci**
 - a) *Nisseria species*
- 3. Diseases caused by Gram Positive bacilli**
 - a) *Corynebacterium species*
 - b) *Bacillus anthracis*
 - c) *Clostridium species*
- 4. Diseases caused by Non sporing anaerobes**

**Unit 2
15L**

- 1. Diseases caused by**
 - a) Enterobacteriaceae-1 *E. coli, Klebsiella, Proteus*
 - b) Enterobacteriaceae-2: *Shigella*
 - c) Enterobacteriaceae-3 : *Salmonella*
 - d) *Vibrio*
 - e) *Pseudomonas*
 - f) *Yersinia, Haemophilus, Bordetella, Brucella*
 - g) *Mycobacterium tuberculosis*
 - h) Non-tuberculous mycobacteria
 - i) *Mycobacterium leprae*
 - j) *Spirochaetes-Treponema, Borrelia, Leptospira*

**Unit 3
15L**

- 1. Diseases caused by**
 - a) Pox viruses-variola, vaccinia, small pox, other pox viruses
 - b) Herpes viruses-Herpes simplex, VZ, HZ, Cytomegalo, E-B viruses
 - c) Adeno viruses
 - d) Picorna viruses- polio,
 - e) Orthomyxo viruses: Influenza viruses
 - f) Arbo viruses: Rabies viruses
 - g) Hepatitis viruses: Type-A, B, C, D, E, G
 - h) Miscellaneous viruses: Rubella, SARS, Rota-viruses

- i) Oncogenic viruses: DNA viruses, RNAviruses
- j) Human immunodeficiency virus: AIDS. Transmission, Natural course of the disease, Laboratory analysis, Virus, Replication, HIV genes, Immunology of AIDS, Anti-HIV drugs, Prevention.

Unit 4

15L

1. Diseases caused by fungi

- a) Superficial mycoses: surface infections, cutaneous infections, Dermatophytoses, Candidiosis
- b) Deep mycoses: Subcutaneous mycoses, Systemic mycoses
- c) Opportunistic systemic mycoses
- d) Diseases caused by parasite
- e) Protozoal infections caused by-Amoeba, Flagillates, Malarial parasites,
- f) Helminthic infections caused by-Cestodes, Nematodes and trematodes

References:

1. Textbook of Microbiology Ananthanarayan R, 8th Ed. – 2009
2. Textbook of Microbiology Baveja C. P. 3rd Ed. – 2009
3. Textbook of Diagnostic Microbiology Mohan Connie R. 3rd Ed. – 2007
4. Prescott, Harley and Kleins Microbiology, WILEY, 7th Ed. – 2008
5. Mckie and McCartney Practical Medical Microbiology, College J.G., 14th Ed. – 2008
6. Bailey & Scott's Diagnostic Microbiology, Forbes Betty A, 12th Ed. – 2007
7. Schaechter's Mechanism of Microbial Diseases, Engleberg N. Carey, 4th Ed. – 2007
8. Mims Medical Microbiology, 4th Ed. 2007
9. Parasitology Protozoology and Helminthology, Chatterjee K.D, 13th Ed. 2009
10. A text book of Microbiology, Arora D. R. 3rd Ed. 2008
11. Jawets Melnick & Adelberg's Medical Microbiology, B.R., 24th Ed. 2007
12. Principles and Practice of Infectious Diseases Vol.I Mandell Gerald L. 7th Ed.
13. Principles and Practice of Infectious Diseases Vol.II Mandell Gerald L. 7th Ed.
14. Textbook of Medical Mycology, Chader Jagdish, 3rd Ed. 2011

COURSE MedBT 205 Immunology Lab (Practical Course)

(3 Credits, 2P, 6 Hr)

- | | |
|--|----|
| 1. Ouchterlony double diffusion | 2P |
| 2. Radial immunodiffusion | 2P |
| 3. Lymphocyte separation from peripheral blood | 2P |
| 4. Lymphocyte transformation | 2P |
| 5. T and B cell identification by E and EAC rosettes | 4P |
| 6. ELISA | 2P |
| 7. Immunoperoxidase staining | 2P |

References:

1. Goldsby A., Thomus J.K., Barbara A. O. and Kuby J. Immunology, 5th eds.
2. Deives P.J., Seamus J.M. and Raoitt E. M. (2006) Essential Immunology, 11th eds. Blackwell Publ.
3. Jaeway C. Travers, Walport and Shlomchik Immunobiology 6th eds. Garland Sc. Publ.

COURSE MedBT206: Medical Genetics Lab (Practical Course)
(3 Credits, 2P, 6.00 Hr)

- | | | |
|----|---|----|
| 1. | Planting of blood culture | 1P |
| 2. | Preparation of chromosome spreads from lymphocyte culture | 3P |
| 3. | Banding of metaphase slides | 2P |
| 4. | Karyotyping and analysis | 2P |
| 5. | Preparation of chromosome spreads from amniotic fluid | 3P |
| 6. | Primary culture of cells from chorionic villus sample | 2P |
| 7. | Preparation of chromosome spreads from chorionic villus cells | 4P |
| 8. | Visit to the cytogenetic laboratory | 2P |

References

1. Chromosome analysis protocols (Methods in molecular biology) Ernstjan Speel, A.H.N. Hopman. Humana Press Inc., U.S.; 2nd Edn 2005
2. Human cytogenetics: Malignancy and acquired abnormalities, A practical approach. 3rd Edn. D. E. Rooney, ed., Oxford University Press 2001
3. Human cytogenetics: Constitutional analysis: A practical approach. D. E. Rooney, ed., OUP Oxford; 3rd Edn. 2001

**COURSE MedBT 207 rDNA in Medicine Lab (Practical Course)
(3 Credits, 2P, 6 Hr)**

- | | |
|---|-----------|
| 1. Plasmid isolation, restriction digestion , ligation | 3P |
| 2. Competent cell preparation and cloning in <i>E. coli</i> | 3P |
| 3. mRNA isolation & cDNA synthesis | 3P |
| 4. Denaturing agarose gel electrophoresis | 2P |
| 5. Restriction mapping | 2P |
| 6. RFLP analysis | 3P |
| 7. Visit | 1P |

References:

1. Primrose S., Twyumon R. M. And Old R. W., 7th edition (2008), Principles of gene manipulation, Blackwell Publishing, UK
2. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.

COURSE MedBT 208: Infectious Diseases Lab (Practical course)
(3 Credits, 2P, 6 Hr)

1. Sample collection, microscopic examination, isolation and identification, ABST, serodiagnosis of
 - a) *Staphylococci* 1P
 - b) *Streptococci and Pneumococci* 1P
 - c) *Nesseria* 1P
 - d) *E. Coli, Klebsiella, Proteus* 1P
 - e) *Shigella* 1P
 - f) *Salmonella* 1P
 - g) *Vibrio, Pseudomonas* 1P
 - h) Gram negative coccobacilli- *Brucella, Heamphilus, Bordetella, Yersinia* 1P
 - i) *Mycobacterium- M tuberculosis, M leprae* 1P
 - j) *Corynebacteria* 1P
 - k) *Clostridia and Bacillus* 1P
 - l) *Spirochaetes - Treponema* 1P
 - m) Viruses – Methods of cultivation, diagnostic tests used 1P

References:

1. Laboratory Practices in Tropical Countries Part I and II, Monica Chesbrouch, 2nd Ed
2. Diagnostic Microbiology (Bailey & Scott's), Betty A. Fobes, Daviel F. Sahn & Alice S. Weissfeld, 11th Edition
3. Textbook of Diagnostics Microbiology, Connie R. Mahon, Donald C. Lehman, 3rd Ed
4. Color Atlas and Textbook of Diagnostic microbiology, Gorge Munusetis, Washington Winn Jr. Stephan Allen, Willium J. , Elmer Konneman and Gary Procop, 6th Ed.

SEMESTER III

COURSE MedBT 301: Animal Tissue Culture (4 Credits, 3L, 2T)

Unit1 15L

1. Overview of animal tissue culture system. Advantages and limitations
2. Structure and organization of tissues
Epithelial, connective, vascular, lymph
3. Cell matrix and cell interactions
4. Growth characteristics of cells growing in culture, molecular basis of cell adhesion, anchorage dependent and independent cells
5. Tissue culture media, role of serum, serum free media
6. Techniques for disaggregation of cells and routine maintenance of cell lines, quantitation of cells and estimation of viability

Unit 2 15L

1. Organ culture: Advantages and limitations, techniques, spheroid cultures
2. Characterization of cells
3. Cell based assays for screening of drugs – Viability, survival, metabolic assays, transformation and mutagenesis, testing for carcinogenicity and inflammation
4. Scale up of anchorage independent and dependent cells, bioreactors, microcarriers, perfused monolayer cultures,

Unit 3 15L

1. Applications of cell cultures in biotechnology industry – Production of monoclonal antibodies, vaccines, interferons and biologicals
2. Introduction to tissue engineering – Basic definition, current scope of development, use in therapeutics and *in vitro* testing
3. Hormone and growth factor signaling – Growth factor delivery in tissue engineering, applications of growth factors, VEGF/ angiogenesis
4. Scaffolds – Basic properties, different scaffolds used for tissue engineering

Unit 4 15L

1. Stem cells – Introduction, types, embryonic, fetal, adult, plasticity, sources of cells for tissue engineering
2. Technique – Propagation, characterization, differentiation.
3. Transplantation of engineered cells and tissues – Basic transplantation immunology
4. Bioconstructs of skin, bone, cartilage, tendon, ligament, liver and applications
5. Other applications of engineered tissues

References

1. Bernhard Palsson, Sangeeta Bhatia, *Tissue Engineering*, Pearson Prentice Hall, 2003
2. Robert. P.Lanza, Robert Langer & William L. Chick, *Principles of tissue engineering*, Academic press, 1997

3. Gordana Vunjak-Novakovic, R. Ian Freshney, *Culture of Cells for Tissue Engineering*, WIS, 2006
4. B. Palsson, J.A. Hubbell, R. Plonsey & J.D. Bronzino, *Tissue Engineering*, CRC-Taylor & Francis
5. Joseph D., Bronzino *The Biomedical Engineering –Handbook*, CRC; 3rd edition, 2006

COURSE MedBT 302: Non Communicable Diseases

(2 Credits, 1L, 1T)

Unit 1

15L

Overview and introduction to Pathophysiology, including Biochemical and genetic parameters, clinical and diagnostic features, Epidemiology, risk factors, global profile and predictions prevention and control of Asthama, Cardiovascular diseases and mental disorders.

Unit 2

15L

1. Overview and introduction to Pathophysiology, including Biochemical and genetic parameters, clinical and diagnostic features, Epidemiology, risk factors, global profile and predictions prevention and control of Chronic rheumatic diseases, Diabetes and Cancer

References:

1. Immunology, 2006, – Kuby Thomas J. Kindt, Richard A. Goldsby, Barbara Anne Osborne, Janis Kuby. W.H.Freeman Publ.
2. Drug discovery and evaluation, 2008, Hans Gerhard Vogel 3rd eds. Springer
3. Janeway's Immunobiology,2007, Ken Murphy, Paul Travers, Mark Walport. Garland Science Publ.
4. Molecular Biology of the Cell, 4th edition 2002, Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. Garland Science Publ.

**COURSE MedBT 303: Vaccines, Antibiotics and Therapeutics
(4 Credits, 3L, 2T)**

Unit 1

15L

Antimicrobial chemotherapy

1. Types of antimicrobial agents,
2. Concept of Bioassay,
3. Therapeutic index,
4. MIC and LD₅₀.
5. Mechanism of action, antibacterial spectrum and adverse drug effect of antibiotics acting on cell wall, cell membrane, protein synthesis and nucleic acids.
6. Antifungal and antiviral drugs,
7. Acquisition of drug resistance, MDR
8. Microbial production of antibiotics (β Lactam , Streptomycin)
9. Cloning of Antibiotic- biosynthesis genes by Complementation and other methods
10. Improving Antibiotic production

Unit 2

15L

Vaccine technology

1. Conventional vaccines (Inactivated, Attenuated bacterial and viral vaccines)
2. Manufacturing procedure and in-process control of Traditional Bacterial and Viral vaccines, Toxoids and sera
 - Recombinant polypeptide vaccines,
 - Purified antigen vaccines,
 - DNA vaccines,
 - Edible Vaccines,
 - Strategies and Development (Vaccinia virus recombinants, Baculo virus expression, Vector Vaccines, Vaccines for HIV and cancer, recombinant veterinary vaccines).

Unit 3

15L

Therapeutics

1. Sources of biopharmaceuticals
 - a) *E-coli* as a source of recombinant therapeutic proteins
 - b) Additional product systems (Yeast, fungi, transgenic animals)
 - c) Phytochemical production and applications
2. Cytokines
 - a) Interferons
 - b) Interleukins
3. Monoclonal Antibody
 - a) Advance techniques
 - b) Different systems and vectors used in medicine
4. Haematopoietic Growth Factors
5. Therapeutic Hormones
 - a) Insulin
 - b) Human Growth hormones
3. Recombinant Blood Products
 - a) Factor VIII
 - b) Stretokinase
 - c) Urokinase
4. Therapeutic enzymes
 - a) Asparaginase
 - b) DNase

Unit 4

15L

Product analysis, Quality Assurance and Validation

1. Protein based contaminants
2. Immunological approaches to detect contaminants
3. Endotoxin and pyrogen contaminants
4. Regulatory aspects of QC, QA, and QM.
5. GMP, GLP and CMP in Pharmaceutical Industry (ISO, WHO, USFDA certification)
6. Microbial limit test of pharmaceutical products,
7. Sterility testing.

References

- 1 Pharmaceutical Biotechnology Concepts and Applications by Gary Walsh, (2007), Wiley Publication
- 2 Pharmaceutical Biotechnology by S. P. Vyas & V.K. Dixit (2000) CBS publishers & distributors, New Delhi.
- 3 Quality control in the Pharmaceutical industry - Edited by Murray S. Cooper Vol. 2, Academic Press New York (1972).
- 4 Biotechnology- Edited by H.J. Rhem & Reed, vol 4 VCH publications, Federal Republic of Germany.
- 5 Hugo and Russell's pharmaceutical microbiology, Stephen P. Denyer, Norman A. Hodges, Sean P.Gorman, Seventh Edition 2009, Blackwell Scientific Publications

- 6 Chanock etc(Eds) Vaccines 87.Modern approaches to new vaccines including prevention of AIDS 1987 Cold Spring harbour Lab,N.Y.
- 7 Murray Moo-Young (Ed)-Comprehensive biotechnology Vol.3.2004(Permagon Press) Drug discovery and design AP publisher
- 8 Pharmaceutical biotechnology edition2 by Crommel

**COURSE MedBT 304: Genomics and Proteomics
(4 Credits, 3L + 1T)**

Unit 1 15 L

1. Genome map

Types and their uses: high and low resolution map, map elements, polymorphic markers, Line, sine, RFLP, SNP; types: cytogenetic (linkage map, transcript map), physical map (comparative map, integrated map); map repositories: GDB genome database, NCBI-Enterz- Human genome map viewer, OMIN, NGI/MGD-mouse genome initiative database, mouse genome expression database; Linkage map resources: CEPH reference pedigree, CHLC, radiation hybrid map resources, STS content maps, single chromosome and regional maps; Practical uses of genome maps.

Unit 2 15 L

1. Human genome and genome analysis

Size, features, comparison and characteristics of human genome, sequence repeats, transposable elements, gene structure, pseudo genes.
Genome analysis: gene order, chromosome rearrangement, compositional analysis, clustering of genes, composite genes.

2. Transcriptomics, RNA chips and Microarray

Unit 3 15 L

1. Comparative genomics

Purpose and methods of comparison: comparison at nucleotide level, mibreakpoints level, gene cluster level, ontological comparison, phylogenetic comparison; tools for genomic comparison, applications of comparative genomics.

Protein structure comparison and classification: architecture, Blocks, Class and domains, fold, motif, PSSM, profile, principles of classification, CATH, SCOP, FSSP, MMDB, SARF.

2. Functional proteomics

Integrated proteome analysis: phage antibody as tool, protein expression analysis, high throughput analysis for proteomics; Automation of proteomic analysis: organ comparison, spatio temporal comparison, cross species, intra species comparison. Applications of Proteomics: clinical and biomedical.

Reference:

1. Andreas D Baxevanis and B F Francis Ouellette. Bioinformatics, A practical guide to the analysis of genes and proteins. A John Wiley & Sons, Inc publications.
2. David Mount, 2001 Bioinformatics, Sequence and genome analysis.
3. Malcolm J Gardner et al 2002. Genome sequence of the human malaria parasite, *Plasmodium falciparum*. Nature, 419: 498-511.

4. Peter D Karp et al, 1996. EcoCyc: encyclopedia of E coli genes and metabolism. Nucleic acids research, 10: 86-90
5. Shanmughavel, P. 2005. Principles of Bioinformatics, Pointer Publishers, Jaipur, India.
6. Shanmughavel, P. 2006. Trends in Bioinformatics, Pointer Publishers, Jaipur, India.
7. Ann Gibbons, 1998. Comparative genetics, Science, 281: 1432-1434.
8. Attwood & Parry-smith. Introduction to bioinformatics.
9. Rastogi et al., Bioinformatics, Methods and applications. Prentice-Hall of India Pvt.
10. Pennigton S R. and M.J. Dunn. Proteomics, 2002.
11. Kris Gevaret et al., 2000. Protein identification methods in proteomics.
12. Electrophoresis, 21: 1145-54.
13. Wilkins M R et al., Proteome research: New frontiers in functional genomics. Springer.
14. Andreas D Baxevanis and B F Francis Ouellette. Bioinformatics, A practical guide to the analysis of genes and proteins. A John Wiley & Sons, Inc publications.

**Course MedBT 305: Biostatistics
(2 Credits, 1L, 1T)**

Unit 1

15L

1. Introduction to Biostatistics, Common terms, notions and Applications; . Statistical population and Sampling Methods
2. Types of variables; Independent and dependant variables; Nominal, Ordinal, ratio and discrete variable types
3. Classification and tabulation of Data, Diagrammatic and graphical presentation; Frequency Distribution, Measures of central value;

Unit 2

15L

1. Descriptive Statistics; Measures of variability; Standard deviation, standard Error, Range, Mean, Deviation, Coefficient of variation, Analysis of variance
2. Inferential Statistics; Statistical power; Hypothesis testing, Test of significance; t-test, chi-square test;
3. Regression; Basic of regression, regression analysis, Estimation, Testing, Prediction, checking
4. Non-parametric statistical methods; Man-Whiteny U test, Wilcoxon test; Kruskal-Wallis test.

Reference Books:

1. An Introduction to computational Biochemistry by C Stan T Sai
2. Statistics for Agricultural Sciences by Nageswara Rao
3. Fundamental of Statistics by Goon et al 1962
4. Methods in Biostatistics by B.K. Mahajan
5. Statistical Methods by S P Gupta
6. Statistical Methods by G W Snedecor and W G Cochran

7. Fundamental of Artificial Neural Networks, Prentice-Hall of India, New Delhi

Course MedBT 306: Animal Tissue Culture Lab (Practical Course)
(3 Credits, 2P, 6 Hr)

1. Understanding of tissue culture laboratory requirements, equipments, and sterilization procedures **2P**
2. Preparation of reagents, formulation of tissue culture medium and membrane filtration **2P**
3. Subculturing and routine maintenance of cell lines **4P**
4. Cell counting and estimate of viability **1P**
5. Fixation and staining of cells **1P**
6. Determination of growth curve and population doubling time of cell line **4P**
7. Preparation of metaphase chromosomes from cultured cells **2P**
8. Drug toxicity testing using MTT/ SRB/ cell viability assay **4P**
9. Virus titration/ neutralization assay **3P**
10. Visit to industry/ research laboratory

References:

1. Bernhard Palsson, Sangeeta Bhatia, *Tissue Engineering*, Pearson Prentice Hall, 2003
2. Robert. P.Lanza, Robert Langer & William L. Chick, *Principles of tissue engineering*, Academic press, 1997
3. Gordana Vunjak-Novakovic, R. Ian Freshney, *Culture of Cells for Tissue Engineering*, WIS, 2006
4. B. Palsson, J.A. Hubbell, R.Plonsey & J.D. Bronzino, *Tissue Engineering*, CRC-Taylor & Francis
5. Joseph D., Bronzino *The Biomedical Engineering –Handbook*, CRC; 3rd edition, 2006

Course MedBT 307: Vaccines, antibiotics & therapeutics Lab (Practical course)
(3 Credits, 2P, 6 Hr)

1. Microbial production and Bioassay of Penicillin. **3P**
2. Determination of MIC and LD50 of Ampicillin / Streptomycin. **3P**
3. Sterility testing by using *B. sterothermophilus*/ *B. subtilis*. **2P**
4. Screening, Production and assay of therapeutic enzymes (Glucose Oxidase, beta lactamase) **4P**
5. Visit **1P**

References:

1. Biotechnology- Edited by H.J. Rhem & Reed, vol 4 VCH publications, Federal Republic of Germany.

2. Hugo and Russell's pharmaceutical microbiology, Stephen P. Denyer, Norman A. Hodges, Sean P.Gorman, Seventh Edition 2009, Blackwell Scientific Publications
3. Chanock etc(Eds) Vaccines 87.Modern approaches to new vaccines including prevention of AIDS 1987 Cold Spring harbour Lab,N.Y.
4. Murray Moo-Young (Ed)-Comprehensive biotechnology Vol.3.2004(Permagon Press) Drug discovery and design AP publisher
5. Pharmaceutical biotechnology edition2 by Crommel

COURSE MedBT 208: Genomics & Proteomics Lab (Practical Course)
(3 Credits, 2P, 6 Hr)

1. Visualizing different genomes using UCSC genome browsers
2. Finding and annotating SNPS in human genome
3. Finding and annotating indels in the human genome
4. Compare genomes using Dot-plots.
5. Analysing microarray data for finding differentially expressed genes in disease condition.
6. Assembly of genomes: Reference assembly and De Novo assembly
7. RNA-Seq mapping methods
8. Chip-Seq analysis to find transcription factor binding sites
9. Finding ORFs and predicting genes in the genome
10. Functional annotation of the genes.

Reference:

1. Andreas D Baxevanis and B F Francis Ouellette. Bioinformatics, A practical guide to the analysis of genes and proteins. A John Wiley & Sons, Inc publications.
2. David Mount, 2001 Bioinformatics, Sequence and genome analysis.
3. Malcolm J Gardner et al 2002. Genome sequence of the human malarial parasite, *Plasmodium falciparum*. Nature, 419: 498-511.
4. Peter D Karp et al, 1996. EcoCyc: encyclopedia of E coli genes and metabolism. Nucleic acids research, 10: 86-90
5. Shanmughavel, P. 2005. Principles of Bioinformatics, Pointer Publishers, Jaipur, India.
6. Shanmughavel, P. 2006. Trends in Bioinformatics, Pointer Publishers, Jaipur, India.
7. Ann Gibbons, 1998. Comparative genetics, Science, 281: 1432-1434.
8. Attwood & Parry-smith. Introduction to bioinformatics.
9. Rastogi et al., Bioinformatics, Methods and applications. Prentice-Hall of India Pvt.
10. Pennigton S R. and M.J. Dunn. Proteomics, 2002.
11. Kris Gevaret et al., 2000. Protein identification methods in proteomics. Electrophoresis, 21: 1145-54.
12. Wilkins M R et al., Proteome research: New frontiers in functional genomics. Springer.

SEMESTER IV

COURSE MedBT: 401 IPR, Bio-Safety
(2 Credits, 1L, 1 T)

Unit 1

15L

1. Introduction to Intellectual Property

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP; IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of GATT, WTO, WIPO and TRIPS

2. Concept of 'prior art'

Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, India etc.); Analysis and report formation

3. Basics of Patents

Types of patents; Indian Patent Act 1970; Recent Amendments; Precautions before patenting-disclosure/non-disclosure; WIPO Treaties; Budapest Treaty; PCT and Implications; Role of a Country Patent Office; Procedure for filing a PCT application.

Unit 2

15L

1. Patent filing and Infringement

Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures and costs; financial assistance for patenting-introduction to existing schemes;

Patent infringement- meaning, scope, litigation, case studies and examples

2. Biosafety

Introduction; Historical Background; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Bioethics; Concepts; Philosophical considerations; Epistemology of Science; Ethical Terms; Principles & Theories; Relevance to Biotechnology;

3. Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

Important Links

1. Intellectual property rights in agricultural biotechnology By Frederic H. Erbisch, Karim M. Maredia, Biotechnology in Agriculture Series No 28,
2. The role of intellectual property rights in biotechnology innovation By David Castle, Edward Elgar Publishing
3. <http://www.wipo.int/portal/index.html.en>

4. http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
5. www.patentoffice.nic.in
6. www.iprlawindia.org/ - 31k - Cached - Similar page
7. <http://www.cbd.int/biosafety/background.shtml>

COURSE MedBT402: Medical Informatics

(2 Credits, 1L, 1 T)

Unit 1

15L

1. Introduction and Overview of hospital information system. Patient history taking mechanisms.
2. Patient Data Processing, Database Management, Communication of Medical data across different hospital units. Networking and Integration of patient data.
3. Data from Patients, Coding and Classification, The Patient Record, Biosignal Analysis, Medical Imaging, Image Processing and Analysis.
4. Patient-Centred Information Systems ,Primary Care, Clinical Departmental Systems, Clinical Support Systems,
5. Nursing Information Systems.
6. Medical Knowledge and Decision Support, Methods for Decision Support, Clinical Decision-Support Systems,
7. Strategies for Medical Knowledge Acquisition, Predictive Tools for Clinical Decision Support.

Unit 2

15L

1. Institutional Information Systems, Modeling of Health Care for Information Systems Development, Hospital Information Systems: Clinical Use, Technical Choices, Health Information Resources.
2. Methodology for Information Processing, Logical Operations, Modelling for Decision Support, Structuring the Computer-based Patient Record, Evaluation of Clinical Information Systems.
3. Methodology for Information Systems: Human-Computer Interaction in Health Care Costs and Benefits of Information
4. Systems, Security in Medical Information Systems, Standards in Health-care Informatics and Telematics, Project Management,

References:

1. Bommel, J.Van; Musen, M.A. Handbook of Medical Informatics 1st ed. 1997.
2. R.D.Lele , Computers in Medicine Tata McGraw Hill, 2005.
3. Davidson, P., Best Practice Series: Healthcare Information Systems, Auerbach Publications, 2000

COURSE Med BT 403: Biomedical waste and environment

(2 Credits, 1L, 1 T)

Unit 1

15 L

1. Classification of Environment, Environmental Biochemistry, Environmental Pollution,
2. Metabolic Responses or Adaptations to an Altered Environmental Temperature, Heat Stress, Cold Stress

Unit 2

15 L

Biomedical waste

1. Introduction, definition, classification/ categories, composition and sources.
2. Radioactive waste

3. Health Impacts, direct and Indirect hazards
4. Legislation and policies on health care waste management
5. Modern technology for handling biomedical waste
6. Basic steps in waste management-segregation, collection and handling of waste
7. On site pre-treatment of waste
8. Mechanical treatment and chemical disinfections
9. store and off-site transportation
10. Common treatment facilities in-site and off-site
11. Liquid waste treatment and different technologies, cost aspect
12. Technologies available for treatment of biomedical waste
13. Conventional treatment technologies
 - a) Wet thermal technology
 - b) Incineration - different models
14. Disposal Technologies
 - a) Sharp disposal pit, Deep- burial pit, Secured land fill

References:

1. Principles of Hospital Management - S. A. Tabish
2. Hospital Management - S. L. Goel
3. Hospital Administration - Francis
4. Bio-Medical Waste Act & Rules Govt. of India
5. Current Issues In BMW Waste Handling-ISHA, Bangalore
6. Management and Handling Rules for: municipal solid waste, biomedical waste, hazardous waste and radioactive wastes, Government of India Publications.
7. Bio-Medical Waste Management- Sushma Sahai
8. A text book on Environmental Pollution & Control by Dr. H.S. Bhatia Publisher Galgotia Pvt. Ltd., 1st Edition, 1998
9. Dey, A. K. - Environmental chemistry
10. Burton. I, Kates. R.W and White. G.F, 1993, Environment as Hazard Guilford Press.

**COURSE Med BT: Nanotechnology in Medicine
(2 Credits, 1L, 1 T)**

Unit 1

15 L

1. Introduction to nanotechnology, History and scope, interdisciplinary nature
2. Nano medicine
3. Drug delivery, protein and peptide delivery, Applications in cancer biology
4. Site- Specific Delivery of Chemotherapeutic Agents Using Nanoparticles, Increasing Bioavailability of a Compound , Active Targeting, Magnetically Directed Targeting to Tumor Tissue , Ligand-Directed Active Targeting, Targeted Drug Delivery Using Magnetic Nanoparticles, Controlled Delivery of Chemotherapeutic Drugs Using Nanoparticles, anti-AIDS drugs, General medicine to personalized medicine,
5. Nanomaterials characterization
Electron microscopy – SEM, TEM, EDAX, X-ray diffraction atomic force microscopy, confocal microscopy, UV-Visible spectroscopy, photoluminescence spectroscopy, FTIR spectroscopy, UV and X-ray photoelectron spectroscopy, particle size analysis, charge distribution analysis (charge on the surface, estimation).

Unit 2

15 L

1. Gene therapy
2. Nanobiosensors:
 - a) Electrochemical
 - b) Optical
 - c) Mass and acoustic
 - d) Proteins: enzymes, antibiotics based biosensors
 - e) Nucleic acids: DNA, RNA based biosensors
3. Lab on a Chip

References

1. Biosensors and Biodetection, Editor(s): Avraham Rasooly, Keith E. Herold, Springer Protocol.
2. Microdevices in Biology and Medicine, Yaakov Nahmias, Sangeeta N. Bhatia Eds. Artech House 2009.
3. Biosensors, A Practical Approach, John Cooper and Tony Cass, Oxford University Press, 2003.
4. Bionanotechnology- Proteins to Nanodevices, Springer. V. Renugopalakrishnan and R. V. Lewis Eds.
5. Bionanotechnology- Lessons from Nature D. S. Goodsell, John Wiley & Sons, Inc. Handbook of nanotechnology Bhushan Ed., Springer.
6. Micro and Nano Manipulations for Biomedical Applications A. C. Yih and I. Talpasanu Eds.
7. Nanotechnology in Biology and Medicine: methods, device and applications. Tuan Vo-Dinh. Ed. CRC Press.

COURSE Med BT 405: General Course II: Research Methodology

This course will enhance the students' knowledge of data analysis techniques. The main objectives of this course are to give students practice in the quantitative methods used by researchers as well as to expose them to statistical packages. Other objectives include

1. To read and understand scientific research papers
2. To formulate a research question and translate it into step by step approach for working with data
3. To practice the presentation of statistical data.
4. To achieve this goal this course will use a combination of lectures and assignments.
5. The course contents will make the students familiar with
6. Principles of theory/ model building and case selection
7. How to distinguish probabilistic from deterministic explanation
8. The role of comparison in controlling variation
9. The benefits and draw backs of different methodologies
10. Identification and interpretation of data
11. Preparation and execution of feasible research project.
12. Elimination of alternative explanations.
13. Plagiarism- antiplagiarism strategies for research papers

Course Contents

1. Introduction
2. Study design
3. Protocol writing format
4. Data collection and statistical analysis
5. Scientific writing
6. Financial aspects of research and resources

References:

1. Research methodologies, Bulakh PM, Patki PS and Chaudhary AS, 1st Eds. 2010, Expert Trading Corporation, Mumbai.
2. Research Methodologies: Methods and Techniques, Kothari CK, 2004, 2nd Eds. New Age International, New Delhi.
3. Research Methodologies, Panneerselvam R, Prentice Hall of India, New Delhi, 2004.

**COURSE Med BT 406: Dissertation
(10 Credits)**

The student will undertake a project preferably in the specialization subject. The student will conduct literature review, plan of work and will conduct the project under the guidance of assigned guide. About 10 credits are allotted for the project. The dissertation will be assessed for 100 marks. The distribution of these marks will be as follows;

1. 25 Marks for literature survey and framing of Aims & Objectives of the selected dissertation topic.
2. 25 Marks for progress of work (based on day – to – day work)
3. 25 Marks for fulfillment of objectives
4. 25 Marks for presentation/ Viva (External evaluation)