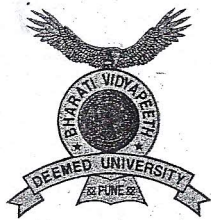
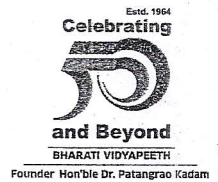




BVDU-RGITBT-M.Sc. mED.
Biotech.



Bharati Vidyapeeth (Deemed to be University) Pune, India.

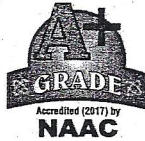


Hon'ble Dr. Patangrao Kadam
M.A., LL.B., Ph.D.
Chancellor

Prof. Dr. Shivajirao Kadam
M.Sc., Ph.D.
Pro Chancellor

Prof. M. M. Salunkhe
M.Sc., Ph.D., F.R.S.C.
Vice Chancellor

Accredited with 'A+' Grade (2017) by NAAC
'A' Grade University Status by MHRD, Govt. of India
Accredited (2004) & Reaccredited (2011) with 'A' Grade by NAAC



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NOTIFICATION NO. 894

It is hereby notified for the information of all concerned that the Academic Council, at its 55th meeting held on 26-3-2018, has resolved to approve the revised course structures, syllabi and rules of examinations of M.Sc. Biotechnology and M.Sc. Medical Biotechnology under Choice Based Credit System to be implemented from the academic year 2018-19.

Copies of revised course structures, syllabi and rules of examinations of M.Sc. Biotechnology and M.Sc. Medical Biotechnology under Choice Based Credit System are enclosed.

All the concerned may please note.

Ref. No. BVDU/2017-18/ 5333

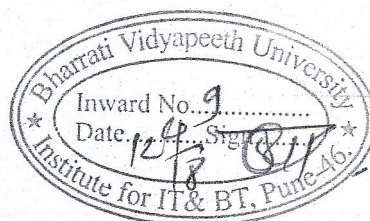
Date: April 10, 2018

G. Rajkumar
Registrar

To

1. The Dean, Faculty of Science, BVDU, Y. M. College, Pune 38
2. The Dean, Faculty of Interdisciplinary Studies, BVDU, College of Engineering, Pune 43
- ✓ 3. The Principal, BVDU Rajiv Gandhi Institute of IT and BT, Pune 43
4. The Controller of Examinations, BVDU.
5. The IT Cell for uploading in the Website.

Notification AC26-3-2018(55-5.7)



**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 to be 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 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 to be 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 Biotechnology Industry sector. 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.
5. The respective elective course will be implemented only if more than 10 students enroll for that course.
6. 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.
7. The teaching and evaluation for these courses will be combined for both disciplines.
8. The shared courses are coded as MBT&MedBT whereas the courses which are exclusive for M.Sc. Medical Biotechnology are coded as MedBT
9. All core courses will be evaluated by University Examination. The Elective courses will be assessed by Continuous Assessment.
10. 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
1	15	10	25
2	30	20	50
3	45	30	75
4	60	40	100

- The duration of 60 Marks UE theory paper will be 3.00 Hrs; for 45 Marks 2.00 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

1. 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

$$\sum Ck$$

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

$$\sum Ck$$

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 Number	Course Discription	Number of Credits	University Examination		IA/CA		Grade Point Average (GPA)	Result
			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.
 - li.
 - lii.
 - lv.
 - v.
 - vi.
 - vii.
 - viii.

- Q. 2** Attempt **Any Two** of the following (08)
- I.
 - ii.
 - lii.

SECTION II

- Q.3** Attempt **Any seven** of the following (07)
- I.
 - li.
 - lii.
 - lv.
 - v.
 - vi.
 - vii.
 - viii.

- Q. 4** Attempt **Any Two** of the following (07)
- I.
 - li
 - lii.

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	
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 Core Course - Practical	Immunology & Nanobiotechnology Lab	4	40	60	
MBT&MedBT 210 Elective Course I	Elective Bioentrepreneurship/ IPR I	2	Continuous Assessment		
					31

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	
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 protozoal pathogenesis 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, Lubert Stryer, 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. Gumport, 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	6
Structure of cell organelles: Endoplasmic reticulum, mitochondria, golgi apparatus, lysosomes, chloroplast, nucleus, cell wall. Comparison of prokaryotic and eukaryotic cells	
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:	7
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	
5 Specialized Cells (Muscle & Nerve cells):	4
Structure & functions of muscles (Straited, nonstraited and cardiac). Structure of neuron, Neurotransmitters and their receptors	
UNIT III	
6 Cell – Cell Interactions	3
Cell adhesion molecules, cadherins, Integrins, transmembrane proteoglycanc, Claudins and occludens, gap junctions, tight junctions, adherens, desmosomes and hemidesmosomes, plasmodesmata	
7 Cell Cycle	2
Molecular events of cell division and cell cycle, regulation of cell cycle events- Cyclins, Cyclin dependent kinases, inhibitors. Apoptosis and necrosis.	
8 Cell Signaling	6
General principles of cell signaling, signaling via G-protein coupled receptors, kinase receptors, role of secondary messengers.	
UNIT IV	
9 Developmental Biology	5
Gametogenesis (Spermatogenesis, Oogenesis), Meiosis and its significance, types of eggs, fertilization and implantation, types and patterns of cleavage, Blastulation	
10 Stages of fetal development	4
Gastrulation in Frog, Germ layer formation, fetal membranes, placenta formation in mammals	
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., Mastysdaira, P., Darnell, J. (2004). Molecular Cell Biology, Scientific American Books Inc. NY.
6. Matthews, C.A. (2003). Cellular physiology of nerve and muscle. 4th Edn. 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:	5
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.	
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:	3
Ultra structure of human chromosome, Classification of chromosomes, Sex chromosome, Origin of Y chromosome, SRY genes and its effects. Dosage compensation	
4 Human chromosomal Abnormalities: Aneuploidy and Structural, associated syndromes	4
5 Pedigree analysis of human:	2
X linked and autosomal disorders. Linkage maps, Lod scores to assess linkage in human pedigrees	
6 Diagnostics: Prenatal diagnosis, Karyotype analysis, FISH, Genetic counseling	3
UNIT III	
7 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.	5
8 Brain, Behavior and Evolution:	6
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.	
Unit IV	
9 Cancer genetics; genetic control of cell cycle, mutations that prevent normal checkpoints, inherited cancer syndromes, cancers acquired due to chromosomal abnormalities	6
10 Reproductive Technologies	5
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 Stranchan and A. Read. Garland Publishing, Taylor & Francis Group, NY, USA. 2010	
4. Human Genetics. A Gardner, T. Davies. 2 nd Ed. Springer Verlag Publ 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 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, 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 Verlag Publ 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. 5th Ed.
4. Essential genetics, A genomics perspective. Daniel L. Hartl. 6th Ed. Burlington, Mass Jones & Bartlett Learning Publ. USA, 2014
5. Human molecular genetics, 4th Ed. T Strachan and A. Read. Garland Publishing, Taylor & Francis Group, NY, USA. 2010
6. Human Genetics. A. Gardner, T. Davies. 2nd 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 differential 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 Microorganism 13theds, , Michael T.Madigan
2. Prescott's Microbiology, 9theds, 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 Dideoxy chain 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. Schalkhammer, 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	Total
Core Course – Theory; 3 Credits	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 class II molecules; the role of HLA typing in organ transplantation and disease susceptibility/resistance.	3
Unit IV : Clinical Immunology	
10 Clinical Immunology Hypersensitivity – Type I, II, III and IV- outline of mechanism with examples.	2
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, 3
General immune-suppressive therapy. Specific immune suppressive therapy.
Immune tolerance to allograft.
- 13 **Tumor immunology**- Malignant transformation of cells and immune responses. 3
Tumor antigens, Tumor evasion of the immune system, immuno-surveillance,
Cancer immune-therapy.
- 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 Louise 4th Ed. 2009
2. A Textbook of Microbiology & Immunology, Parija Subhash Chandra 2009
3. Immunology , Kuby, 7th edition, Richard A. Goldsby, T. J. Kindt and B. A. Osborna, WHfreeman and Co., New-York
4. Riott's essential Immunolgy, I. M. Riott, Evan M. riot and Peter J. Delves, 10th 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 Genomics Databases : 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, Expasy, 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 Andceas Baxevanis and B.F. Francis Ouellette. 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 + Business Media, LLC.

MBT&MedBT 205: Nanobiotechnology Core Course – Theory; 2 Credits	Total 30L
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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	Total
Core Course – Theory; 3 Credits	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, Gramene etc 	
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:

- Green and Sambrook, 4th edition (2012), Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press
- Molecular cloning: a laboratory manual, Volume 1, Joseph Sambrook, E. F. Fritsch, Tom Maniatis, Edition 2, Cold Spring Harbor Laboratory, ISBN 0879693096, 9780879693091.
- Guide to Human Genome Computing by Martin J. Bishop, Academic Press. ISBN 0-12-102051-7.
- From Genome to Therapy: Integrating new technologies with drug development by Novartis Foundation, John Wiley. ISBN 0-471-62744-5.
- Genome mapping and sequencing By Ian Dunham, Horizon, ISBN 1-898486-50-6.
- The Genome by Ram S. Verma, VCH, ISBN 1-56081-043-2.
- Bioinformatics - from genomes to drugs (vol. 1), basic technologies (vol.1) by Lengauer, T., Germany, Wiley-VCH, 2002.
- Principles of Genome Analysis And Genomics (3rd Ed.) by Primrose, S.B. & Twyman, R.M., UK. Blackwell Publishing Company, 2003.
- 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 | 5 |
| 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 |
| 5 | 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 |

- 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, Beedu Sasidhar 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 Augen Addison-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) Elective Course I – Theory; 2 Credits	Total 30L
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UNIT I

1 Introduction to Intellectual Property	15
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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. Geachart et. 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. 3rd Eds (2007) Stein *et. 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. Gordana Vunjak-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:	3
a) Disorders of amino acid metabolism- phenylketonuria, alkaptonuria, albinism.	
b) Disorders of nucleic acid metabolism- Disorders in purine/ pyrimidine metabolism.	
5 Biochemical aspects of hematology: Blood, composition, hemogram, hemoglobinopathies, thalassemias 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. Trough level monitoring and dosage adjustments. Drug delivery systems: sustained release, enteric coated formulations and liposome etc. Pharmacovigilance, Pharmacoeconomics, Pharmacogenetics	4
11 Drug regulations: Drugs and Cosmetics Act, Drug Price Control order, 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.	4
12 RNA interference and its applications in prevention of cancer, a Therapeutic genome editing- ZFN, CRISPR-Cas gene editing technology (HIV), TALENS (Leukaemia)	4
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 & syatemic 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-9 th edition	
2. A Text Book of Medical parasitology by CK Jayaram Panikar	
3. Medical parasitology- R. karyakarate-2 nd edi.	
4. Text book of Microbiology- Baveja C.P.	
5. Text book of Medical Mycology- Chander Jagdish, 3 rd edi.	
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- 13th edi.

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. Chandrakant Kokate Pramod H.J , 1st 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, ratio and discrete variable types	5
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-Whiteny 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. 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.	3
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 be 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 |
| 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 | Exercises: Creating PDF, PMF using Spread sheets | 2 |
| 15 | Numerical Exercises : 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 | Exercises : 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,
Exercises: Using SPSS or Data Analysis pack on spread sheets. | 7 |

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-2nd edi.
4. Text book of Microbiology- Baveja C.P.
5. Text book of Medical Mycology- Chander Jagdish, 3rd edi.
6. Principles & Practices of infectious diseases- Vol-1 & 2 by Mandell G 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- 13th edi.

10. Probability statistics, and reliability for engineers by Boca Raton, Ayyub B. M. & McCuen, R H, CRC Press, 1997.
11. Statistical methods in bioinformatics: an introduction by Ewens, W. J. & Grant, G. R., New York. Springer, 2001.
12. Handbook of computational statistics: concepts and methods by Gentle, J.E., Hardle, W. & Mori, Y., Berlin, Springer-Verlag, 2004.
13. Statistical design and analysis of industrial experiments by Ghosh, Subir, Ed., 1990.
14. Scan Statistics by Glaz, J., Naus, J. & Wallenstein S, New York, Springer, 2001.
15. Statistical design for research by Kish, L., Wiley series in probability and mathematical statistics, New York, John Wiley & Sons, 1987.
16. Introduction to probability and statistics by Lipschutz, S. & Schiller, J. J., New York. McGraw-Hill, 1999.
17. 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.
18. Mathematical and statistical methods for genetic analysis by Lange, K., 2nd 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, Beedu Sasidhar 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
UNIT II	
2 Technologies available for treatment of biomedical waste Conventional treatment technologies a) Wet thermal technology 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- Sushma Sahai	15

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, Pubchem BioAssay 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 studies	2
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, Vellerkad Viswanadhan, 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	5
	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.	
2	Types of patents	5
	Provisional and Complete specification; Contents of specification	
3	Introduction to Patent drafting	5
	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	
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.shtm	

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 TO BE 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, Bharati Vidyapeeth Deemed to be 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)

the Bharati Vidyapeeth Deemed to be University, Pune for the degree of Master of Science (M Sc.) in Medical Biotechnology under the Faculty of Interdisciplinary Science is

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 TO BE 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 TO BE 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:

BHARATI VIDYAPEETH DEEMED TO BE 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 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:

BHARATI VIDYAPEETH DEEMED TO BE 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 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):

BHARATI VIDYAPEETH DEEMED TO BE 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

Plan of Research Outline

(To be submitted to Principal, RGITBT, 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: