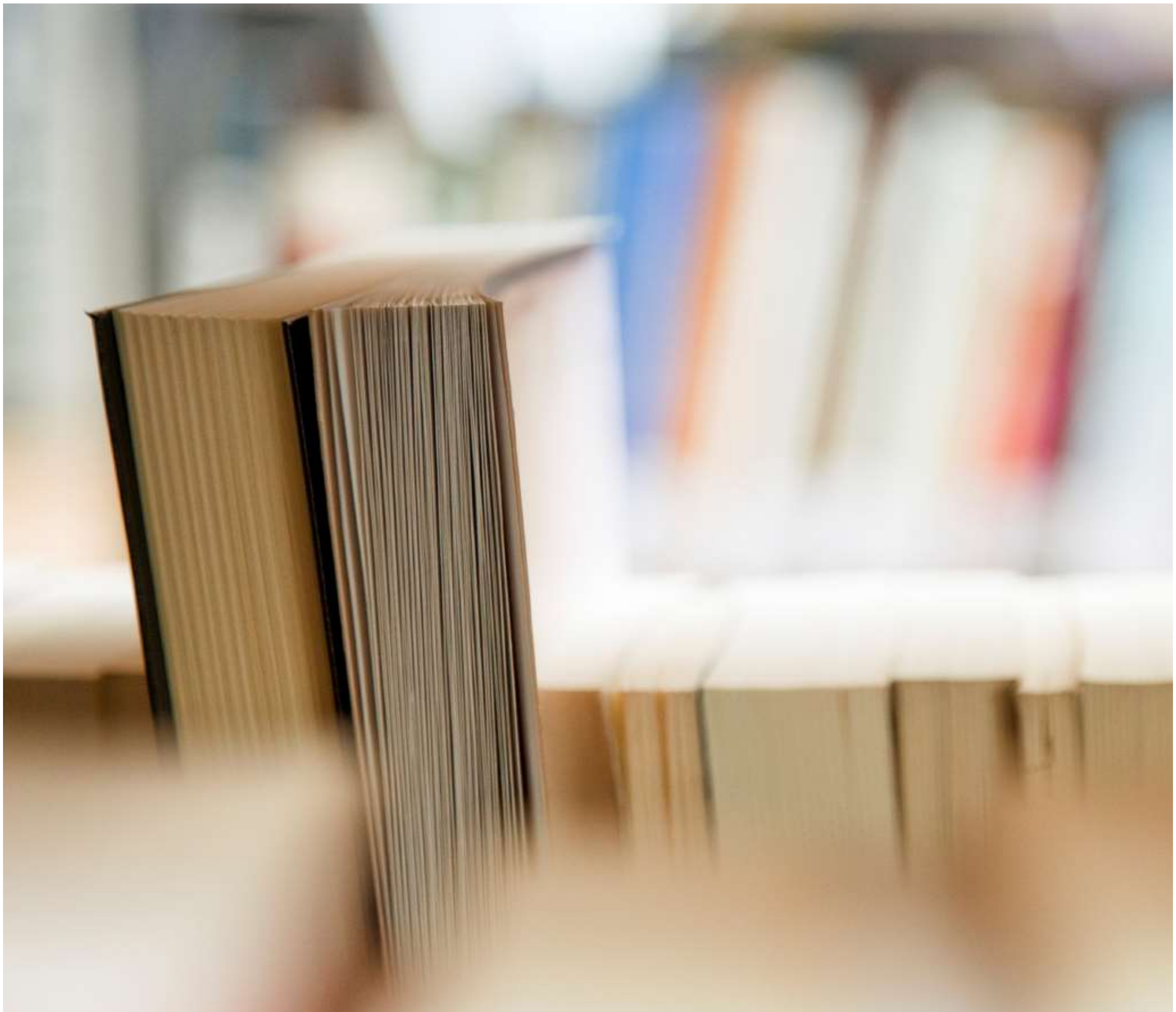

BVDU-RGITBT-M.Sc. Biotech.

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

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

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

A+ GRADE Accredited (2017) by NAAC

Estd. 1964 Celebrating 50 and Beyond BHARATI VIDYAPEETH
Founder Hon'ble Dr. Patangrao Kadam

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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.

G. Rajakumar
Registrar

Ref. No. BVDU/2017-18/ 5333
Date: April 10, 2018

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.

NotificationAC26-3-2018(55-5.7)

Bharati Vidyapeeth University * Institute for IT & BT, Pune-46. *
Inward No. 9
Date. 12/4/18 Sign.

BHARATI VIDYAPEETH DEEMED TO BE UNIVERSITY

PUNE

REVISED SYLLABUS FOR

MASTER OF SCIENCE

M.Sc. IN BIOTECHNOLOGY

UNDER

FACULTY OF SCIENCE

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 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 2005 and was designed to facilitate empowerment of students to face cutting edge technological applications in biotechnology sector. The main advantage of proposing this course was availability of the expertise in biotechnology, health and environment disciplines on the same campus. The course received very encouraging response from all its stakeholders. On its implementation for 13 years, the curriculum is being revised to embrace newer emerging disciplines and value added courses. The revised M.Sc. Biotechnology is a full time 102 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. Biotechnology Course

1. The candidate should have passed the Bachelors degree course in Biotechnology/ any branch of life science from the recognized university with minimum of 50% or 45% aggregate marks for open and SC / ST category respectively at graduate level university examination.
2. Subject to above conditions, the admission will be based on the merit at Entrance Examination conducted by Bharati Vidyapeeth Deemed 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 102 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.
5. The teaching schedule for the 3 credits and 2 credits theory courses will be 3 and 2 lectures per week respectively. All courses will have one tutorial forthnightly.
6. The respective elective course will be implemented only if more than 10 students enroll for that course.
7. Some of the core courses in Semester I and Semester II are common in two master's programmes; M.Sc. Biotechnology and M.Sc. Medical Biotechnology.
8. The teaching and evaluation for these courses will be combined for both disciplines.
9. The shared courses are coded as MBT&MedBT whereas the courses which are exclusive for M.Sc. Biotechnology are coded as MBT
10. All core courses will be evaluated by University Examination. The elective courses will be evaluated by Continuous Assessment.
11. Two extra credits will be awarded to students if there is any significant outcome of their dissertation study. The research outcome in terms of publication in indexed national/International journal; filing of patent; or commercialization of technology will be considered for the award of credits.

RULES FOR EXAMINATION

A: Nature of Examination:

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

Table 1: Evaluation pattern for one to four Credit Courses

Course Credits	Marks for UE (60% Weightage)	Marks for IE (40% weightage)	Total Marks for evaluation
1	15	10	25
2	30	20	50
3	45	30	75
4	60	40	100

3. 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.
4. 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.
5. 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-2 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-2: The grading system under CBCS

Range of Marks (out of 100)	Grade Point	Grade
$80 \le Marks \le 100$	10	O
$70 \le Marks \le 80$	9	A+
$60 \le Marks \le 70$	8	A
$55 \le Marks \le 60$	7	B+
$50 \le Marks \le 55$	6	B
$40 \le Marks \le 50$	5	C
$Marks < 40$	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-2) shall be the GPA for the course.
2. Two kinds of performance indicators, namely, the Semester Grade Point Average (SGPA) and the Cumulative Grade Point Average (CGPA) shall be computed at the end of each term. The SGPA measures the cumulative performance of a learner in all the courses in a particular semester, while the CGPA measures the cumulative performance in all courses up to and including the current semester. The CGPA of a student when he/she completes the programme is his/her final result.
3. The SGPA is calculated by the formula , $SGPA = \frac{\sum Ck \times GPAk}{\sum Ck}$ where *Ck* is the credit-value assigned to a course and *GPAk* is the GPA obtained by the student in the course. In the above, the sum is taken over all the courses that the student has undertaken for the study during the semester, including those in which he/she might have failed or those for which he/she remained absent. The SGPA shall be calculated up to two decimal place accuracy.
4. The CGPA is calculated by the formula , $CGPA = \frac{\sum Ck \times GPAk}{\sum Ck}$ where *Ck* is the credit-value assigned to a course and *GPAk* is the GPA obtained by the student in the course. In the above, the sum is taken over all the courses that the student has undertaken for the study from the time of his/her enrolment and also the during the semester for which CGPA is calculated, including those in which he/she might have failed or those for which he/she remained absent. The CGPA shall be calculated up to two decimal place accuracy.

5. The CGPA, calculated after the minimum credits specified for the programme are 'earned', will be the final result grace marks of 1, 2 or 3 may be awarded to a candidate at UE as per the university rules. B: Standards of Passing and ATKT rules:

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

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

OR

(b) If he/she fails in IA, then also the learner passes in the course, provided that a minimum of 25% is obtained in IA and GPA for the course is at least 6.0 (50%marks) in aggregate. The GPA for a course will be calculated only if the learner passes in that course.

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

C: AWARD OF HONOURS:

1. A student who has completed the minimum credits specified for the programme shall be declared to have passed in the programme. The final result will be in terms of letter grade and CGPA only and is based on the CGPA of all courses studied and passed. The criteria for the award of honours are given in Table 3.

Table 3: 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 ≤ *CGPA*≤ 10.00	O	Outstanding	80 ≤ *Marks* ≤ 100
9.00 ≤ *CGPA*≤ 9.49	A+	Excellent	70 ≤ *Marks* ≤ 80
8.00 ≤ *CGPA*≤ 8.99	A	Very Good	60 ≤ *Marks* ≤ 70
7.00 ≤ *CGPA*≤ 7.99	B+	Good	55 ≤ *Marks* ≤ 60
6.00 ≤ *CGPA*≤ 6.99	B	Average	50 ≤ *Marks* ≤ 55
5.00 ≤ *CGPA*≤ 5.99	C	Satisfactory	40 ≤ *Marks* ≤ 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 Description	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. <u>For 3 credit course</u>, 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 <u>3 Credit Course</u> of university theory examination of M.Sc. 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

Question Paper Pattern for 2 Credits Theory Course at University Examination

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. 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)

a
b
c
d
e
f
g
h

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

a
b
c

SECTION II

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

a
b
c
d

e
f
g
h

Q. 4 Attempt Any Two of the following (08)

a
b
c

D: Pattern for question paper of University Practical Examination of M.Sc. 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 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	
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	25

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	
MBT 206 Core Course -Theory	Animal Tissue Culture	2	40	60	
MBT&MedBT 207 Core Course –Practical	Genetic Engineering and Genomics Lab	4	40	60	
MBT&MedBT 208 Core Course –Practical	Analytical Techniques and Proteomics Lab	4	40	60	
MBT&MedBT 209 Core Course - Practical	Immunology & Nanotechnology Lab	4	40	60	
MBT&MedBT 210 Elective Course I	Bioentrepreneurship/ IPR I	2	Continuous Assessment		30

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
MBT 301 Core Course –Theory	Environmental Biotechnology	3	40	60	
MBT 302 Core Course –Theory	Plant Biotechnology	3	40	60	
MBT 303 Core Course –Theory	Microbial Technology	3	40	60	
MBT 304 Core Course –Theory	Food Biotechnology	2	40	60	
MBT&MedBT 305 Core Course-Theory	Biostatistics	2	40	60	
MBT&MedBT 306 Core Course-Theory	Research Methodology	2	40	60	
MBT 307 Core Course-Practical	Environment &Plant Biotech Lab	4	40	60	
MBT 308 Core Course-Practical	Microbial & Food Biotech Lab	4	40	60	
MBT 309 Core Course-Practical	Biostatistics Lab	2	40	60	
MBT&MedBT 310 Elective Course II	Biomedical Waste Management/ Drug designing/ IPR II	2	Continuous Assessment		27

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 401 Core Course	Research Project	20	40	60	20

Total Credits Offered: 25 C,Sem I+ 30 C, Sem II +27 C,Sem III+ 20C,Sem IV = 102 C

SEMESTER I

MBT&MedBT 101: Microbiology Core Course – Theory; 3 Credits		Total 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 inhumans	5
9	Microbial pathogenesis: Host-microbe interactions; Bacterial, fungal and protozoalpathogenesis in humans.	4
UNIT IV		
10	Effect of Antimicrobial drugs: on bacterial, fungal and viral pathogens	4
11	Virology: Diversity, Classification of virus, Cytopathic effect of virus	3
12	Taxonomy, Molecular methods, Bergey's manual of systematic bacteriology.	4

References

1. Brock Biology of Microorganismsm 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).

MBT&MedBT 102: Biochemistry Core Course – Theory; 3 Credits		Total 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 Structure of cell organelles: Endoplasmic reticulum, mitochondria, golgi apparatus, lysosomes, chloroplast, nucleus, cell wall. Comparison of prokaryotic and eukaryotic cells	6
2	Cytoskeleton: Organization and functions cytoskeleton, Actin filaments, actin binding proteins, Intermediate filaments, Microtubules, Structure and functions of cilia and flagella.	5

UNIT II

4	Plasma Membrane: Plasma membrane structure and functions, membrane models, Transport across membrane- passive diffusion, osmosis, active transport, Ion Channels, Na+ and K+ pump, Ca2+ ATPase pump, co-transport, symport, antiport, endocytosis and exocytosis. Membrane vesicle trafficking	7
5	Specialized Cells (Muscle & Nerve cells): Structure & functions of muscles (Straited, nonstraited and cardiac). Structure of neuron, Neurotransmitters and their receptors	4

UNIT III

6	Cell – Cell Interactions Cell adhesion molecules, cadherins, Integrins, transmembrane proteoglycanc, Claudins and occludens, gap junctions, tight junctions, adherens, desmosomes and hemidesmosomes, plasmodesmata	3
7	Cell Cycle Molecular events of cell division and cell cycle, regulation of cell cycle events- Cyclins, Cyclin dependent kinases, inhibitors. Apoptosis and necrosis.	2
8	Cell Signaling General principles of cell signaling, signaling via G-protein coupled receptors, kinase receptors, role of secondary messengers.	6

UNIT IV

9	Developmental Biology Gametogenesis (Spermatogenesis, Oogenesis), Meiosis and its significance, types of eggs, fertilization and implantation, types and patterns of cleavage, Blastulation	5
10	Stages of fetal development Gastrulation in Frog, Germ layer formation, fetal membranes, placenta formation in mammals	4
11	Concept of dedifferentiation, redifferentiation, transdifferentiation and regeneration	3

References

1. Alberts, B., Bray, D., Lewis, J., Raf, M., Roberts, K., Watson, J.D. (1994). Molecular Biology of the Cell
2. Cooper, G.M. (1997).The Cell: A molecular approach, ASM Press, USA.
3. Hallwell, B., Gutteridge, J.M.C. (2002). Free Radicals Biology and Medicine. Oxford Press.UK.

4. Karp, G. (1996). Cell and Molecular Biology concepts and experiments, John Wiley and Sons Inc. NY.
5. Lodish, H., Baltimore, D., Berk, A., Zipursky, B.L., Mastsydaira, P., Darnell, J. (2004). Molecular Cell Biology, Scientific American Books Inc. NY.
6. Matthews, C.A. (2003). Cellular physiology of nerve and muscle. 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 Core Course – Theory; 3 Credits		Total 45L
UNIT I		
1	**Overview of genetics:** Genes and Expression, Allele, multiple alleles, pseudoallele, complementation tests, Genetic variation, Molecular basis of allelic variation. Methodologies used in genetic studies, Model organisms. Genes-Environment interaction.	5
2	**Modes of inheritance:** Mendelian and Non Mendelian Inheritance: Lethal alleles, Epistasis, Penetrance and expressivity, Pleiotropy, Phenocopies, mitochondrial inheritance	6
UNIT II		
3	**Structure and function of human chromosome:** Ultra structure of human chromosome, Classification of chromosomes, Sex chromosome, Origin of Y chromosome, SRY genes and its effects. Dosage compensation	3
4	**Human chromosomal Abnormalities**: Aneuploidy and Structural, associated syndromes	4
5	**Pedigree analysis of human:** X linked and autosomal disorders. Linkage maps,Lod scores to assess linkage in human pedigrees	2
6	**Diagnostics:** Prenatal diagnosis, Karyotype analysis, FISH, Genetic counseling	3
UNIT III		
7	**Population genetics:** Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law;concepts and rate of change in gene frequency through natural selection, migration andrandom genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.	5L
8	**Brain, Behavior and Evolution:** Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality;Mating systems, Parental investment and Reproductive success; Parental care;Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientationand navigation; Domestication and behavioral changes.	6L
Unit IV		
9	**Cancer genetics;** genetic control of cell cycle, mutations that prevent normal checkpoints, inherited cancer syndromes, cancers acquired due to chromosomal abnormalities	6L
10	**Reproductive Technologies**	5L

References:

1. Human genetics: Concepts and applications. Ricky Lewis. 11th Ed. Mc Graw – Hill Higher Education IncPubl 2015

2. Essential genetics, A genomics perspective. Daniel L. Hartl. 6th Ed. Burlington, Mass Jones & Bartlett Learning Publ. USA, 2014

3. Human molecular genetics, 4th Ed. T Stranchan and A. Read. Garland Publishing, Taylor & Francis Group, NY, USA. 2010

4. Human Genetics. A Gardner, T. Davies. 2nd Ed. Springer Verlag Publ 2010.

MBT&Med BT 105: Molecular Biology Core Course – Theory; 3 Credits		Total 45L
UNIT I		
1	Genomes and its content 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	8
UNIT II		
2	DNA replication & repair DNA polymerases, mechanism of replication in prokaryotes and eukaryotes, DNA damage, Mechanisms of DNA repair in prokaryotes and eukaryotes,	6
3	Homologous and site specific recombination	4
	Insertion elements	3
UNIT III		
4	Transcription and posttranscriptional mechanisms 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	12
Unit IV		
5	Translation Mechanism of translation in prokaryotes and eukaryotes, post translational modifications, transport of proteins, role of chaperons	7
6	Gene regulation Operon, Induction and repression, positive and negative regulation, attenuation, lactose, arabinose and tryptophan operon, Eukaryotic transcription regulation	5
7	Epigenetic effects Heterochromatin nucleation, Chromatin remodeling, epigenetic inheritance, genomic imprinting.	2

References:

1. Human genetics: Concepts and applications. Ricky Lewis. 11th Ed. Mc Graw – Hill Higher Education IncPubl 2015
2. Essential genetics, A genomics perspective. Daniel L. Hartl. 6th Ed. Burlington, Mass Jones & Bartlett Learning Publ. USA, 2014
3. Human molecular genetics, 4th Ed. T Stranchan and A. Read. Garland Publishing, Taylor & Francis Group, NY, USA. 2010
4. Human Genetics. A Gardner, T. Davies. 2nd 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 Stranchan 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 microsopy)	3
3	Checking the purity of pharmaceutical samples.	3
4	Use of deferential media for isolation of various bacteria	2
5	Isolation of fungi from soil / clinical samples	2
6	Isolation of actinomycetes from soil/ water samples.	2
7	Cultivation of lactiobacillus under anaerobic condition	2
8	Antibiotic susceptibility testing	2
9	Ames test	2

References:

1. Brock Biology of Microorganismsm 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 Core course- Theory; 3 credits		Total 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 chaintermination 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., 7th edition (2016), Gene cloning and DNA analysis, Blackwell publishing, UK
2. Primrose S., Twyman R. M. , 8th 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 Core Course – Theory; 3 Credits		Total 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 Core Course – Theory; 3 Credits		Total 45L
UNIT I : Introduction		
1	**Immunity** – Types of Immunity, components of Innate and Acquired Immunity Cells and organs of immune system, Antigen presenting cells, endogenous and exogenous pathways of antigen presentation, presentation of non-peptide antigens	4
2	**Antigens** - Immunogenecity versus Antigenicity, Factors that influence immunogenecity, 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-ϒ 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 (αβ and γδ), 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, General immune-suppressive therapy. Specific immune suppressive therapy. Immune tolerance to allograft.	3
13	Tumor immunology- Malignant transformation of cells and immune responses. Tumor antigens, Tumor evasion of the immune system, immuno-surveillance, Cancer immune-therapy.	3
14	Immunotechniques: Immuniprecipitation, agglutination, RIA, ELISA, ELISPOT, Western blotting, fluorescence based imaging technique, HLA typing, Flow cytometry, and animal systems	

References:

1. Immunology and Serology in Laboratory Medicine Turgeon Mary Louise4th 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 Core Course – Theory; 3 Credits	Total 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

- 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

- 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

- 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 Ouellettee. John Wiley 2004.
8. Fogel, G.B. and Corne, D.W., Evolutionary Computation in Bioinformatics.
9. Patterson, B.K., Techniques in Quantification and Localization of Gene Expression.
10. Singer, M. and Barg, P. Exploring Genetic Mechanism.
11. Bowtell, D. and Sambrook, J. DNA Microarrays.
12. Fundamentals of Data Mining in Genomics and Proteomics, By Werner Dubitzky, Martin Granzow, Daniel P. Berrar, 2007, Springer Science + Bussiness Media, LLC.

MBT&MedBT 205: Nanobiotechnology
Core Course – Theory; 2 Credits

Total 30L

UNIT I

1	**Introduction to nanoscience**, properties of nanoparticles, Types of nanomaterial Carbon nanomaterials (fullerene, nanotube, nanofibres, nanowires) Quantum dots, magnetic nanoparticles	5
2	**Nanostructures:** Organic and Inorganic nanoparticles, Bionanostructures-protein, carbohydrate and lipid, DNA based	4
3	**Synthesis of nanoparticles,** Top down and Bottom up approach, Physical, Chemical and Biological methods of synthesis	5

UNIT II

4	**Characterization of nanoparticles:** Optical (UV-Vis, FTIR, Photoluminescence spectroscopy) X-ray diffraction, Microscopy (SEM,TEM,AFM,STM) Surface and composition (ECSA, EDAX), Particle size analysis and charge distribution analysis, Toxicity Evaluation of nanomaterials; Cyto-toxicity, Geno-toxicity In vivo tests/assays etc containment	7
5	**Applications of Nano-Materials in Biosystems;** Nanomedicines, Targeted Drug Delivery, Disease diagnosis at proteomic level, Biosensors (Nucleic acid based, protein based), Lab on Chip, Applications in Gene therapy, cancer Biology. Bionanomachines	5
6	**Application of nanobiotechnology in agriculture and environment:** desalination, monitoring water quality, detection of pollutants	4

References:

1. T. Pradeep, Nano, The Essentials, Understanding Nanoscience and Nanotechnology, Tata McGraw-Hill Limited, 2007
2. Tuan Vo, Dinh. Ed. Nanotechnology in Biology and Medicine: methods, device and applications. CRC Press, 2007
3. NANOBIOTECHNOLOGY 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

MBT 206: Animal Tissue Culture Core Course – Theory; 2 Credits		Total 30L
UNIT I		
1	Introduction to animal tissue culture: Overview of its applications in research, industry & therapeutics	1
2	Systems of tissue culture with distinguishing features, advantages and limitations	3
3	Growth characteristics of normal disploid and transformed cells growing in culture, anchorage dependent and independent cells	3
4	Aseptic techniques and its significance in ATC	2
5	Tissue culture media: role of balanced salt solution, individual constituents and serm; Serum free media	5
UNIT II		
6	Primary culture and routine maintenance: Disaggregation of tissue, techniques for primary culture, subculture and routine maintenance of cell lines, suspension culture,	3
7	Cryopreservation: Cryopreservation and revival of cell lines	6
8	Quantitation of cells: Estimation of viability,	2
9	Scale up: Scale up of anchorage independent and dependent cells, bioreactors, microcarriers, hollow fibers, perfused cultures	3
10	Applications of animal cell culture for *in vitro* testing of drugs, in production of monoclonal antibodies, viral vaccines and therapeutic proteins	2

References:

1. Ian Freshney, Culture of Animal cells (5th edition)2006, Wiley-Liss publication
2. Ed. John, Masters RW, Animal Cell Culture-Practical Approach, 2000, Oxford Press
3. Ed. Jenni, P Mather, David Barnes, Methods in Cell Biology, Vol 57, Animal cell culture methods. Academic Press 1998
4. R.Lanza, J. Geachart et. Al. (Eds.) Essentials of stem cell biology (2009), Elsevior Academic Press
5. R. Lanza, I Klimanskaya. Essential stem cell methods. (2009), Academic Press

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 *E.Coli*	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

- Sequence Similarity Search Tools: Dot Plot, BLAST, FASTA, ClustalW, ClustalX
- Explore Sequence analysis methods: AMAS, CINEMA, MaxAlign

2. Explore comparative genomics databases: — 5
- COG
- VirGen,
- CORG,
- HOBACGEN,
- Homophila,
- XREFdb,
- o Gramene etc

3. Explore Comparative genomics and it's applications Methods: — 5
- Genome Alignments: BLAST2, MUMmer , PipMaker , VISTA
- Comparison of Gene Order: GeneOrder , Gene synteny
- Comparative Genomics Databases : COG, VirGen, CORG, HOBACGEN, Homophila, XREFdb
- o
- Explore NGS data analysis methods: Bowtie, TopHat

References:

1. Green and Sambrook, 4th edition (2012), Molecular Cloning: A Laboratory Manual,Cold Spring Harbor Laboratory Press
2. Molecular cloning: a laboratory manual, Volume 1, Joseph Sambrook, E. F. Fritsch, Tom Maniatis, Edition2, Cold Spring Harbor Laboratory, ISBN0879693096, 9780879693091.
3. Guide to Human Genome Computing by Martin J. Bishop, Academic Press. ISBN 0-12-102051-7.
4. From Genome to Therapy: Integrating new technologies with drug development by Novartis Foundation, John Wiley. ISBN 0-471-62744-5.
5. Genome mapping and sequencing By Ian Dunham, Horizon, ISBN1-898486-50-6.
6. The Genome by Ram S. Verma, VCH, ISBN 1-56081-043-2.
7. Bioinformatics - from genomes to drugs (vol. 1), basic technologies (vol.1) by Lengauer, T., Germany, Wiley-VCH, 2002.
8. Principles of Genome Analysis And Genomics (3rd Ed.) by Primrose, S.B. & Twyman, R.M., UK. Blackwell Publishing Company, 2003.

9. Bioinformatics approach Guide to the analysis of genes and proteins by Andceas Baxevanis and B.F. Francis Ouellettee. 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 + Bussiness 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 biolomecules by size exclusion chromatography	2
5	Determination of pKa value of p-nitrophenol by using UV-visible spectrophometer	2
	Visit to research institute or Biotechnology Industry/institutes	2

Protein Analysis Lab

6 Explore Protein Primary Databases: Protein database on NCBI/ Protein database on EMBL, PIR-PSD, UniProt KB/SwissProt, Expasy, InterPro 5

7 To explore: 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

8 Explore Proteomics databases:

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

9 Explore Protein-Protein Interaction Networks, databases and software:

- 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

10 To explore:

- Structural databases: PDB, MMDB, SCOP, CATH.
- 3D structure visualization tools: Rasmol, Pymol, SPDBV, Cn3D

- Secondary structure prediction algorithms: Chou Fasman, Jpred, Psipred, GOR methods; analysis of results.
- 3D structure validation databases: PROSA, Ramchandran Plot, Procheck

3. 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 Elective Course I – Theory; 2 Credits		Total 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
UNIT I		
1	Introduction to Intellectual Property 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	15
UNIT II		
2	Types of IP Industries: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Plant variety andProtection of New GMOs	8
3	Concept of 'prior art' 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	7

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

MBT 301: Environmental Biotechnology Core Course- Theory; 3 Credits	Total 45L
UNIT I : Environment and Waste water treatment technology	
1 **Basic concepts,** Its ingredients – soil, water, air, biota and non-biota and its significance	3
2 **Environmental issues, Environmental pollution** - Types, measurement, effects on health & food, Air pollution and its control through Biotechnology, Water pollution and its control, Soil pollution sources, pesticides, heavy metals and agrochemical and its control, Noise pollution: effects and control, Degradation of Xenobiotic compounds in Environment	4
3 **Detection and control of micro-organisms** in environmental fresh water, in source and drinking water; Potable and non-potable water Biosensors - types and applications in environmental pollution detection and monitoring	4
UNIT II	
4 **Biological treatment:** stabilization pond, aerated lagoon, activated sludge process, trickling filter anaerobic treatment	2
5 Sewage and waste water treatments systems; Primary, secondary and tertiary treatments; Measurement of treatment efficiencies	3
6 Bioreactors for waste water treatments; Reactors types and design; Reactors in series; Development and optimization of membrane bioreactor process for use in sanitary and industrial sewage treatment	3
Biological treatment: stabilization pond, aerated lagoon, activated sludge process, trickling filter anaerobic treatment	2
UNIT III	
7 Global Environmental Issues Solid waste Management, physicochemical characters, hazardous and non hazardous wastes, bio-degradable and non-biodegradable wastes, collection and transport of solid waste, composting, vermin-composting and methane production.	4
8 Global warming: climate change, ozone depletion, UV- B and green house effects, acid rain, its effects	3
9 Biotechnological approaches for solid waste management	3
10 Carbon credit	1
Unit IV	
Biotechnological approach for improving the Environment:	
11 Characteristics of industrial effluents, Conventional treatments, kinetics of biodegradation of waste, Advances in aerobic and anaerobic treatments, genetically modified organisms for improving the environment, Techno-economic feasibility of conversion of waste into energy.	2

12	Environmental pollution control- Bioremediation, Bioaugmentation, Biostimulation and Phytoremediation	2
13	Desalination technique: Reverse osmosis, quality of input and output water, cost effectiveness, byproducts of desalination and industrial application	2
14	Biotechnological approach for improving the Environment:	2
15	Characteristics of industrial effluents, Conventional treatments, kinetics of biodegradation of waste, Advances in aerobic and anaerobic treatments, genetically modified organisms for improving the environment, Techno-economic feasibility of conversion of waste into energy.	2
16	Environmental pollution control- Bioremediation, Bioaugmentation, Biostimulation and Phytoremediation	2

References:

1. Rittamann B. E. and Mc Carty P. L. (2001), Environmental Biotechnology: Principles and Applications, International Edition, McGraw-Hill, New York
2. Methods of Air Sampling & Analysis (1977), 2nd Edition –APHA intersociety Committee APHA, Washington D.C
3. Standard Methods for the Examination of Water and Wastewater (1986) 15th Edition APHA-AWWA-WPCF
4. Brunner R.C., (1989), Hazardous Waste Incineration, McGraw Hill Inc.
5. Milton Wainwright, An Introduction to Environmental Biotechnology, Kluwer Academic Publishers, Boston. Hardbound, 1999.

Med BT 302: Plant Biotechnology Core Course – Theory; 3 Credits		Total 45L
UNIT I		
1	**Biodiversity hotspots in India**: Characterization of biodiversity through different biochemical and molecular methods (chemical printing of biodiversity),	3
2	**Conservation strategies of biodiversity**, threatened and extinct species	2
3	**Bio-prospecting** of biodiversity for product development	2
UNIT II		
4	**Plant tissue culture and micropropagation** Introduction, Different systems and stages in axillary shoot proliferation, organogenesis, somatic embryogenesis with examples..	4
5	**Cell culture technology** and its application for the production of artificial seeds and secondary metabolites..	4
6	**Homozygous plant production** through anther and pollen culture, Embryo rescue and embryo culture in rearing viable hybrid plants, Endosperm culture and production of triploids, Somaclonal and gametoclonal variations and their applications	4
7	**Protoplast technology** for the production of somatic hybrids and cybrids.Applications in crop improvement.	3
UNIT III		
8	**Transgenic Plants** Introduction, vertical versus horizontal gene transfer, vectors, reporter genes	3
9	**Direct and indirect methods for gene transformation,** plant cell and chloroplast transformation,	3
10	**Introduction to markers**, Marker – Assisted Crop Improvement, Genetic Markers and Linkage Maps	3
Unit IV		
10	**Applications of transgenic plants** Development of transgenes for the production of biofuels, single cell proteins, pigments, neutraceuticals, pharmaceuticals, biopesticides, pharmaceuticals, vaccines, plantibodies, value addition, bio-fortification.	3
11	**Selection and characterization of transformants** for biotic and abiotic stress tolerance, for increase in crop and timber productivity	3
12	**Marker Technology** in Crop Improvement	3

References:

1. Altman A, Hasegawa PM (Ed) (2012) – Plant Biotechnology and agriculture. Prospects for the 21st century (Academic press).
2. Bhojwani S S. &Razdan M K (1996). - Plant Tissue Culture : Theory and Practice (Elsevier)
3. Slater A, Scott NW, Fowler MR (2008) – Plant Biotechnology: the genetic manipulation of plants (Oxford Press)
4. Plant Molecular Breeding, (2009), Newbury HJ, John Wiley and Sons., USA.

MBT 303: Microbial Technology		Total
Core Course – Theory; 3 Credits		45L
UNIT I		
1	Introduction	
2	Microbial metabolites and recombinant products	1
3	Batch, continuous and fed batch culture , growth kinetics	2
4	Culture preservation methods	1
5	Improvement of industrial microorganisms	3
6	Fermentation media and media sterilization	2
7	Statistical designs	2
UNIT II		
6	Sterilization: Del factor, filter sterilization	2
7	Inoculum development: bacterial and fungal processes	1
8	Fermenter design	2
9	Types of fermenters e.g. air lift fermenter, packed tower fermenter	1
10	Aeration and agitation: Determination of K_La value and factors affecting K_La value	2
11	Measurement of Process variables: Temperature, pressure, foam, dissolved oxygen, pH, redox	2
12	Downstream processing	1
UNIT III		
13	Production of organic acids e.g. lactic acid	1
14	Microbial enzymes and applications	2
15	Production of antibiotics e.g penicillin	2
16	Production of vitamins e.g. vitamin B12	1
17	Biopolymers e.g xanthan, PHA	3
18	Biotransformation of sterols	2
Unit IV		
19	Plant growth promoting bacteria (PGPB): Nitrogen fixation and genetic engineering of nitrogenase gene cluster, Improved nitrogen fixation Nodulation,Hydrogenase	5
20	Microbial insecticides: *Bacillus thuringiensis* toxin, mode of action and genetic engineering of toxin genes	3
21	Biocontrol of pathogens: siderophorres, antifreeze proteins	2
22	Small biological molecules: indigo, lycopene	2

References:

1. L.E.J.R. Casida, 2nd edition (2016), Industrial Microbiology, New Age International Publishers
2. Glick B.R., Pasternack J.J., Patten C.L., 4th edition (2010), Molecular Biotechnology, ASM Press, Washington, DC

3. Peppler ans Periman , 2nd edition (2004), Microbial technology, Academic Press, New York
4. Barredo, José-Luis (Ed.), (2005),Microbial Processes and Products. Springer
5. Glare, Travis R., Moran-Diez, Maria E. (Eds.) (2016) Microbial-Based Biopesticides, Springer

MBT 304: Food Biotechnology Core Course – Theory; 2 Credits		Total 30L
UNIT I		
1	Introduction: Scope and importance of food processing: national and international perspectives	1
2	Food additives like preservatives, antioxidants, emulsifiers, sequesterants, humectants, stabilizers with respect to chemistry, food uses and functions in formulations.	4
3	Neutraceuticals, functional foods, fortified foods	4
4	Food reheology and texture	3
5	Nutrigenomics	3
UNIT II		
6	Fermented foods: Fermented milk products. cheese, cheese spread, Youghurt, dahi shrikhand and similar products Other fermented foods like beer, wine and vinegar, Traditional fermented foods like idli and dosa.	6
7	Mushroom cultivation: use of biotechnological methods to produce high quality mushrooms	3
8	Role of Biotechnology in food packaging	2
9	Natural food colours and flavors	2
10	Genetically modified foods: safety, risks and public concerns	2

References:

1. K. Shetty, G. Paliyath, A. Pometto, R. Levin (Eds), 2nd edition, (2006) Food Biotechnology, CRC Press
2. John E. Smith, Biotechnology , Fifth edition (2009), Cambridge University Press
3. S. Bielecki J. Polak J. Tramper (Eds), Food Biotechnology, Volume 171st Edition (2000), Elsevier
4. W.A. Gould , Fundamentals of Food Processing and Technology 1st edition, (1997), Woodhead Publishing
5. Toledo, Romeo T. (2007) Fundamentals of Food Process Engineering, Springer

MBT&Med BT 305: Biostatistics Core Course -Theory; 2 Credits,		Total 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 Core Course – Theory; 2 Credits	Total 30L

UNIT I

1	Basic concepts of Research Introduction, Definition and basic concepts, objectives of research, Research approaches, types of research, techniques of research, hypothesisation, literature survey, selection of topic, compiling records.	5
2	Research Design Important concepts in research design – basic principles of research design, need of research design, features of good research design.	5
3	Sampling and Data collection & Analysis Collection of primary and secondary data - parameters, techniques for data collection, methods of data presentations, classification and tabulation of data, graphical representation	5

UNIT II

6	Data Analysis Statistical methods of data analysis: Applications of statistics in research, measures of central tendency and dispersion	4
7	Testing hypothesis What is a Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Procedure for Hypothesis Testing, Flow Diagram for Hypothesis Testing, Measuring the Power of a Hypothesis Test, Tests of Hypotheses, Important Parametric Tests, Hypothesis Testing of Means	3
8	Technical Writing: Different types of scientific documents, review paper, book reviews, research paper, thesis, project reports (for the scientific community), Plagiarism, Research Ethics, Patents and IPR.	3

Objective:

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

Teaching – Learning Methodology:

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

Expected Learning Outcome:

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

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

References:

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

MBT 307: Environment & Plant Biotech Lab
Core Course – Practical; 4 Credits

Environmental Biotechnology Lab

1	Determination of particulate matter 10□ (PM) concentration from ambient air by high volume sampler	1
2	Determination of SOx and NOx concentration from ambient air by high volume sampler	1
3	Determination of equivalent noise level (Leq) of the surrounding air	1
4	Determination of dissolved oxygen (DO) in given water sample	1
5	Determination of biochemical oxygen demand (B.O.D) in given water sample	2
6	Determination of chemical oxygen demand (C.O.D) in given water sample	2
7	Determination of organic matter phosphate/ calcium / magnesium from given soil sample	2
8	Determination of sodium / potassium	2
9	Visit to waste water treatment plant(Industrial visit)	4
10	Determination of particulate matter 10□ (PM) concentration from ambient air by high volume sampler	4

Plant Biotech Lab

11	Nutrient media composition, preparation and sterilization	1
12	Micropropagation via adventitious shoot proliferation	1
13	Micropropagation via somatic embryogenesis	1
14	Anther/microspore/embryoculture	1
15	Protoplast isolation and culture	1
16	Histological and cytological techniques for plant cultures	1
17	*Agrobacterium*- mediated transformation studies	1
18	Extraction and quantification of secondary metabolites from callus	1
19	Visit to commercial Plant Biotechnology industry	1

References:

1. D.S. Ramtake and C. A. Moghe, Manual on water and waste water analysis, NEERI, Nagpur, 1988
2. Gabriel Bitton, Wastewater Microbiology, 2nd Edition. Wiley-Liss; 2nd Edition, 1999.
3. Trivedy,R.K. and Goel,P.K.(1987).Practical Methods in Ecology and Environmental Science,Environmental Publications, Karad.
4. Standard Methods for Waste and Water Analysis APHA 21st Edition
5. Gaurd.R.S. Gupta.G.D and Gukhade.S.B.2000. Practical Biotechnology: Nirali park Ashan Publishers. Pune
6. Tejovathi.G, Vimala.Y and Rekha Bhadauria, 1996. A practical manual for plant
7. Biotechnology. CBS publishers and distributors. New Delhi.

MBT 308: Microbial & Food Biotech Lab
Core Course: Practical 4 Credits
Microbial Technology Lab

1	Isolation, screening and optimization of conditions for production	1
2	Solid state fermentation: enzymes, alcohol	1
3	Submerged fermentation: enzymes, exopolysaccharide, organic acids	1
4	Estimation, recovery and purification of fermentation products-enzymes, antibiotics, organic acids, alcohol, exopolysaccharide	1
5	Influence of different parameters on immobilization of cells and enzymes	1
6	Isolation of probiotic culture from various sources • Evaluation and efficacy of probiotic culture	1
7	Production of fermented food and characterization of acidity, alkalinity and its microbial profile	1

Food Biotech Lab

11	Detection of siderophore production by *Azospirillum and Pseudomonas*	1
12	Analysis of milk , milk pasteurization and sterilization. Analysis of milk products	1
13	Preparation of cream, butter, cheese, paneer, milk sweets and ice cream. Visit to dairy plants.	1
14	Sensory analysis and hedonic rating of food.	1
15	Identification and ranking of food product attributes, sensory and instrumental methods for measuring food attributes.	1
16	Determination of food additives in foods.	1
17	Rheological properties of foods. Detection of adulteration of fats and oil.	1

References:

1. Joslyn, M.A. Ed. 1970. Methods in Food Analysis. Academic Press, New York.
2. King, R.D. Ed. 1978. Developments in Food Analysis Techniques-1. Applied Science Publishers Ltd., London.
3. Morris, C.J. and Morris, P. 1976. Separation Methods in Biochemistry 2nd Ed. Pitman Pub., London.
4. Raghuramulu, N., Madhavan Nair, K., and Kalyanasundaram, S. Ed. 1983. AManual of Laboratory Techniques. National Institute of Nutrition, ICMR, Hyderabad.
5. Aneja, K.R. Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology (2018), 5th edition

MBT 309: Biostatistics Lab
Core Course – Practical; 2 Credits
Biostatistics Lab:

1	Numerical Excercises: Elementary statistics using Spread sheets, Representation of Data using Charts	1
2	Scatter Plots,Curve fitting on Spread sheets , Add trendline Tool	1
3	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)	1
4	Excercises: Creating PDF, PMF using Spread sheets	1
5	Numerical Excercises : On spread sheet, data analysis tool-pack t,z - Tests for a single Mean Comparing Two Means ,t-tests: Paired – Unpaired Inference for Proportions	1
6	Excercises : 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, Excercises: Using SPSS or Data Analysis pack on spread sheets.	2

References:

1. Probability statistics, and reliability for engineers by Boca Raton, Ayyub B. M. & McCuen, R H, CRC Press, 1997.
2. Statistical methods in bioinformatics: an introduction by Ewens, W. J. & Grant, G. R., New York. Springer, 2001.
3. Handbook of computational statistics: concepts and methods by Gentle, J.E., Hardle, W. & Mori, Y., Berlin, Springer-Verlag, 2004.
4. Statistical design and analysis of industrial experiments by Ghosh, Subir, Ed., 1990.
5. Scan Statistics by Glaz, J., Naus, J. & Wallenstein S, New York, Springer, 2001.
6. Statistical design for research by Kish, L., Wiley series in probability and mathematical statistics, New York, John Wiley $ Sons, 1987.
7. Introduction to probability and statistics by Lipschutz, S. & Schiller, J. J., New York. McGraw-Hill, 1999.
8. Ian Freshney, Culture of Animal cells (5th edition)2006, Wiley-Liss publication.

MBT&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.	15

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

MBT &Med BT 310: Option II (310.2): Drug Designing Elective Course II – Theory; 2 Credits UNIT I		Total 30 L
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.	2
3	Modeling of target-small molecule interactions.	2
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.	3
6	Training data, test data and external validation data, applicability domain in QSAR, Cross validation techniques, Pubchem BioAssay data for QSAR studies.	3
UNIT II		
7	Pharmacophore features, Pharmacophore model, Receptor-based and ligand-based pharmacophore modeling.	3
8	Virtual screening based on pharmacophore model.	4
9	Receptor site, molecular docking study, flexible docking, rigid docking, molecular interactions.	4
10	Scoring functions, correlation between ligand-based and receptor-based studies	4

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.

MBT& Med BT 310: Option III (310.3) – Intellectual property rights II (IPR II) Elective Course II - Theory; 2 Credits		Total 30 L
UNIT I		
1	Basics of Patents Indian Patent Act 1970; Patent Rules, 2003; Recent Amendments; Definitions, non-patentable subject matter, patentability criteria, anticipation, infringement, opposition, biopiracy;Precautions before patenting-disclosure/non-disclosure.	5
2	Types of patents Provisional and Complete specification; Contents of specification	5
3	Introduction to Patent drafting National, PCT and Convention patent applications; PCT and Implications; Role of a Country Patent Office; Procedure for filing requirements Nationaland international Patent application, Forms, fees and timelines Cost and financial assistance for patenting, introduction to existing schemes	5
UNIT II		
4	Relevant case studies (3-4 cases) related to patentability criteria, anticipation, infringement, opposition, bio-piracy	12
5	Career opportunities in the field of IPR.	3

References:

1. Erbisch, Karim M. Maredia,Intellectual property rights in agricultural biotechnology By Frederic H. Biotechnology in Agriculture Series No 28,
2. David Castle, The role of intellectual property rights in biotechnology innovation, Edward Elgar Publishing
3. http://www.wipo.int/portal/index.html.en
4. http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
5. www.patentoffice.nic.in
6. www.iprlawindia.org/ - 31k - Cached - Similar page
7. http://www.cbd.int/biosafety/background.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 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 will have one Major Research Guide from the host organization (Preferably a Ph D. qualified scientist), however, a Co-Guide from RGIITBT 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, 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 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 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 'Biotechnology' under the faculty of Interdisciplinary Science has been carried out in the Department (laboratory) of……………., RGIITBT, BVDU (**Institute/ Private Lab, Govt Lab etc**) ……………, Pune (**OR Place**) during the period from …….to……, 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 Biotechnology under the Faculty of Interdisciplinary Science is original piece of work carried out by me under the supervision of _________ (Name of Guide) and ___________________ (Name of Co-guide (if any)). I further declare that it has not been submitted to 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, RGIITBT, 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:

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Proforma of Progress Report – II

(To be submitted to Principal, RGIITBT, 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:

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Proforma of Internal Evaluation Report

(To be submitted to Principal, RGIITBT, 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:

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Pune-Satara Rd, Katraj, Pune – 411 046

Proforma of Evaluation Report on Presentation

(To be submitted to Principal, RGIITBT, 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 (RGIITBT):

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Plan of Research Outline

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

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

Name & Place of Research Work :
Proposed Research Objectives :

Start Date of Research project :

Likely Date of Project Completion :

Significance of Research Project :

Name & Sign of Student

Approved by

1.Name of Research Guide with signature and seal:

Place & Date:

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

Place & Date: