PRAVARA INSTITUTE OF MEDICAL SCIENCES
(DEEMED TO BE UNIVERSITY)
Centre for Biotechnology
Loni- 413736, Dist. Ahmednagar, Maharashtra, India
NAAC Reaccredited with 'A' Grade (CGPA 3.17)

Regulations Governing Post Graduate Programme in Medical Biotechnology

(I to IV Semesters)

Under Credit Based System

Effective From: 2020-2021

Draft Regulations prepared by:

1. Dr. Y.M. Jayaraj
2. Dr. S. N. Jangle
3. Dr. Sonali Das

Regulations governing Postgraduate Studies and programmes under Credit based system, as per the provisions UGC CBCS Regulations & Pravara Institute of Medical Sciences –Deemed to be University, Loni.

1.0 Title: These Regulations shall be entitled as "Regulations governing postgraduate programme M. Sc. in Medical Biotechnology offered by Centre for Biotechnology of Pravara Institute of Medical Sciences -DU offered from time to time.

2.0 Commencement: These regulations come into force from the date of the approval by the statutory bodies of Pravara Institute of Medical Sciences -DU.

3.0 Definitions: The definitions of the term and abbreviations used in the said regulations shall be as under.

a. **Board of Studies (BOS):** Means Postgraduate Board of Studies in the respective subjects of the PIMS-DU, constituted as per the provisions of the statutes and regulations of UGC & PIMS-DU Regulations 2019.

b. **Academic Council (AC)**: Means the Academic Council of Pravara Institute of Medical Sciences -DU, constituted as per the provisions of UGC and PIMS-DU regulations.

c. **Board of Management (BOM):** Means the Governing Body of Pravara Institute of Medical Sciences -DU constituted as per the provisions of statutes & regulations of UGC & Pravara Institute of Medical Sciences -DU Regulations 2019.

d. **Degree:** Means undergraduate degree awarded by PIMS-DU, Loni, or any other recognised universities of India & abroad considered as equivalent to the UG degree of PIMS-DU. Postgraduate Degree means the postgraduate degree awarded by PIMS-DU, Loni or any other recognised university of India & abroad.

e. **PG Programme:** Means the Post graduate programme offered by Centre for Biotechnology, PIMS-DU, under semesterised CBS System.

f. **Structure of the PG Programme**: Means the structure of the PG degree of Centre for Biotechnology, PIMS-DU, Loni. It is of 4 semesters- spread over 2 academic years. Each semester will be of a minimum of 15 to 16 working weeks comprises of a minimum of 90 working days.

g. **Course**: Means a designed curriculum (Theory or practical or project work) designated by a number code & title offered to the registered students for the award of postgraduate degree.
Compulsory courses means, the fundamental /basic/hardcore courses which are mandatory for a student for the award of postgraduate degree.

h. **Specialization courses**: Means the applied / supportive/ soft-core courses to be studied by a postgraduate student for successful completion of PG programme in a given subject, offered from time to time.

i. **A Course** may comprise of theory, practical, projects and any other components decided by BOS as per the provisions of the course structure form time to time. Each course shall have a weightage as per the number of credits assigned to a particular course.

j. **Credit means:** The weightage given to a course in a given semester in terms of instructional hours assigned.
1 hour of theory teaching work or 2 hours of practical work per course per week for duration of one semester of 15 -16 weeks is considered as one credit.
Further, each credit may be assigned 25% of marks for a given course
(1 credit = 1hr. Theory/2 hrs practical/week – 25% marks)

k. **Grade Point (G.P):** Is an index to indicate the performance of the students in their respective courses. These grades are calculated by converting the marks into grade point for each course & 10% of the marks scored out of 100 as Grade Point.

l. **Credit point (GP):** Credit point means the Grade Point multiplied by the number of credits of the respective course.

m. **Grade Point Average (GPA)** means the indicator of the performance of the student in each semester based on the number of total credit points divided by total number of credits studied by student in a said semester.

n. **Commutative Grade Point Average (CGPA)**: Means the weightage of the grade points average of all semesters calculated as per the details given in the annexure to regulations.

o. **Student:** Means a registered student for the Master of Science programme on full time basis leading to successful completion and award of postgraduate degree in a given subject.

p. **Parent University**: Means, Pravara Institute of Medical Sciences-DU to which the CBT is a constitute college.

q. Salient features of CBCS CGPA

1 **Credit** : 1 hour theory teaching / week/semester of 16 weeks is one credit

(16 hour/Semester or

: 2 hours practical / FW week / Semester of 16 weeks. (32hrs/Sem.)

Grade point (GP)

- Absolute Grade Point is followed.
  (Not to follow the normalisation of GP based on the fixed range of marks scored)
- If 10 percent of marks scored out of maximum marks of 100 in a given course (T/P/D).
- Formula for the calculation of Grade Point (GP)

$$GP = \frac{\text{10\% of the marks scored in a given course x 100}}{\text{Maximum marks for the said given course}}$$

- Examples / Illustrations

Sr. No.	For a given course					
1.	Maximum marks allotted	100	50	150	200	100
2.	Marks Scored	60	30	90	120	70
3.	Ten percent of marks scored	6.0	3.0	9.0	12.00	7.0
4.	Formula for Calculation GP	$\frac{6x100}{100}$	$\frac{3x100}{50}$	$\frac{9x100}{150}$	$\frac{12x100}{200}$	$\frac{7x100}{100}$
5.	GP	6.0	6.00	6.00	6.00	7.0

Credit point:

Grade point of a given course multiplies by the total marks & credits of a given course is equivalent to Credit Point.

GP of a given course x no. of credits of a course= CP

Illustrations marks scored	60/100 or 30/50	70/100 or 35/50	80/100 or 40/50	90/100 or 45/50						
GP of a Course	6.0	7.0	8.0	9.0	9.5	6	7	8	9	9.5
Credits of a course	4.0	4.0	4.0	4.0	4.0	2	2	2	2	2
Credit point of a course	24.00	28.00	32.00	36.00	38.00	12	14	16	18	19

SGPA: Total of all credit points of all the courses of a semester divided by total credits of the semester

Total CPs of semester = X, Total credits of semester= Y, then

Example: SGPA: X/Y

CGPA: It is the aggregation of all the SGPA of a given programme.

It can be calculated by adding the CPs of all course & all the semesters of programme divided by total number of credits of the entire programme.

It is equivalent to the addition of all the SGPA of VI semester & divided by marks of semester.

Note: Credits earned and marks scored for credit audit courses, if any shall not be counted for calculating SGPA & CGPA, award of grade & class. However successful completions of mandatory credit audit courses are a must for the award of the Degree.

4.0 . Eligibility for Admission:

4.1. A candidate who has passed Bachelor Degree in Science of the Parent University or any other recognised University shall be eligible for admission to the postgraduate programme of the College, subject to the fulfilment of the conditions of eligibility as prescribed by the Parent University from time to time and adopted and notified by the University.

Normally, the student must have passed any one or two subjects as major / core of B. Sc. i.e., Biotechnology, Microbiology, Biochemistry, Botany, Zoology, Chemistry, Genetics, Molecular Biology, Life Sciences or MBBS/BDS/MVSc. /B. Sc Agriculture. The successful UG student of the Centre for Biotechnology are eligible to directly move over to M. Sc program & will get M. Sc as M. Sc (Integrated). UG students eligible for admission from other college / university will pursue M. Sc after selection & will get M. Sc. in Medical Biotechnology.

4.2 . Transfer of students from other Institutions:

The provisions of the Parent University governing admission of students from other Institutions / Universities on transfer shall be followed by the Institution. Hence, the Institution shall constitute an Equivalence Committee to consider such transfer cases. The Head of the Institution, Chairman BOS, Controller of Examination, a member of academic council nominated by Parent University & two senior staff members of post graduate department, shall be the members.

5.0. Duration of the Programme:

The PG programme shall be of four semesters spread over two academic years. Each semester comprises of minimum of 90 working days. A student once admitted has to complete the programme normally within 2 years and within a maximum of 4 years from the date of registration, subject to the approval of the authorities of the College.

A student once registered shall not pursue any other regular programme.

5.1. Academic calendar:

The institution shall notify Academic Calendar of Events for an academic year / semester. It shall include the dates of reopening of the college, departments, calendar for admissions, commencement of classes, last working day & dates of commencement of examinations & vacations. It shall also include the probable dates for declaration of results.

6.0 Medium of Instructions: The medium of Instructions & Examination shall be in English.

7.0 Programme structure: The structure of the programme indicating the course number, credits, total marks, minimum marks for passing & other details are given in the **Annexure 1- 4**.

The teaching and learning components for each of the course shall be well defined by the concerned BOS from time to time. As a normal practice, each course of theory shall have

work load of around minimum of 60 hrs and maximum of 64 hrs. The workload for practical course shall be of 60 - 64 hrs. Thus the theory workload for student per course shall not exceed 64 hrs. The BOS while preparing the content of the syllabus shall undertake unitization of the syllabus per course. There shall be 4 units per theory course, each unit with a workload of around 15 hrs. The BOS shall also list the number of practicals for practical course covering the essential components befitting to the course content & programme. For each course – Paper, the BOS shall give objectives and expectations and develop PO and COs (Programme Outcome and Course Outcomes).

7.1 The BOS in the concerned subject shall prepare the syllabus as per the provisions of the course structure to be approved by the statutory bodies of the university & notified from time to time. The BOS shall prepare pattern of question paper for semester end examination, scheme of evaluation and scheme of practical examination.

7.2 . There shall be two categories of courses namely compulsory & electives or specialization courses.

7.3 . Summary of the Structure of M. Sc. Medical Biotechnology. Semester wise and of entire programme of 2 years -4 semesters in a given table.

Summary for each semester & total of 4 semesters						
		I	II	III	IV	Total of 4 semester
1.	Total Theory Courses	4	4	4	4	16*
2.	Total Practical Courses	2	2	2	2	08**
3.	Total Courses (T+P)	6	6	6	6	24
4.	Total Credits (4 Credit / Course) (T:P)	24 (16:8)	24 (16:8)	24 (16:8)	24 (16:8)	96 (64:32)
5.	Total Maximum marks (Max Marks per course = 100 (T:P))	600 (400+200)	600 (400+200)	600 (400+200)	600 (400+200)	2400 (1600+800)

* of the 16 Theory courses, 14 are core / compulsory courses + one course on electives + one course on Dissertation – Project.

** of the 8 practical courses, 7 are core and one is a combination of practical course on elective & Dissertation practicals.

7.4 . In all a student shall complete 96 credits (Theory = 60 credits for 1500 marks & Practical = 32 credits for 800, dissertation will have 04 credits for 100 marks) to be eligible to the award of P.G. Degree. Student can go for 4 credit audit courses by participating in co-curricular activities as per the list published by the institute time to time in the span of 4 semesters.

7.5 . In each postgraduate programme, there will be 14 compulsory courses in theory + one elective course & one Dissertation course. Accordingly there shall be 7 compulsory practical courses and one on practicals of elective & Dissertation course.

7.6 . Each postgraduate programme shall have elective courses (theory as well as Practicals). The number of elective courses offered by the department may depend upon the expertise & facilities available in the department. However, there shall be at least two elective courses in theory and 2 elective courses in practicals.

8.0. Attendance: A student registered for a programme has to register a minimum of 75% of attendance for each course of the semester.

About 10 percent of shortage of attendance may be condoned as per the directions of the Parent University from time to time. (Applicable to students of NSS, NCC, Sports or any other events).

However, the institution may arrange for special classes to make up the shortage of attendance of maximum 10% student fulfilling the provision of attendance only shall be eligible to appear for concerned examination.

The Head of the institution shall monitor and maintain the records, the attendance of the student from time to time & inform the concerned accordingly.

9.0. Examinations:

9.1. Each course shall have two components:

i) Continuous Internal Assessment (CIA)

ii) Semester End Examination (SEE)

9.2. The continuous internal assessment may consist of 2 internal tests of 20 marks and compulsory seminar (05 marks) & field report / assignment for 05 marks. The CIA shall be carried out by

the concerned department & the marks secured by the students shall be submitted to the examination section within a week after conducting the tests. The tests shall be conducted as per the calendar of events for CIA announced by COE. There shall be a gap of at least 30days between two tests.

9.3. The weightage for CIA shall be 30% & SEE shall be 70% as followed by Parent University.

9.4. There shall be a semester end examinations for each of the course after completion of respective semester.

There shall be a minimum of a gap of 15 days duration between last working day and examination to for student to prepare for the semester end examinations.

Each semester end examinations of a theory course shall be of 3 hrs duration comprising of 70 marks out of 100marks.

Each practical examination per course may be of 5 - 8 hrs as prescribed by the concerned BOS.

9.5. The institution shall announce the calendar of events for examination indicating the date of submission of application form through a proper channel & by payment of prescribed fees. The student shall offer themselves to take examination in the respective ongoing semesters.

9.6. The Controller of Examination shall follow the manual for the entire process of examination. It shall include registration of candidates, eligibility, and schedule of examinations, constitution of BOAE & other processes of examination, results, issue of marks list/cards, and maintenance of records as on.

9.7. There shall be a full carryover system. However, a student has to appear for the respective semester as per the calendar of events and as when the examination for courses as per semester is notified. `

There shall be a Board of Examiners (BOE) of the university & Board of Appointment of Examiners (BOAE) of the University to be constituted by the university. The BOAE shall comprise of Head of the University, Controller of Examination, Dean of the Faculty & Chairman BOS of the concerned subject.

The University BOE shall constitute Board of Examinations (BOE) for respective subject. The BOE of the subject shall comprise of Chairman BOS, one or two internal members and one or two external members, selected from the approved Panel of Examiners.

The Chairman of BOE of the subject shall allot the setting of theory question papers amongst the members of BOE of the subject from the Panel of Examiners prepared by BOS & approved by BOE & BOAE of the University. Each paper setter shall set preferably one paper and not more than two theory papers per programme. Each paper setter shall set assigned question paper in two sets as per the format provided. He / She shall ensure that proper weightage is given to each unit and that the questions are within the syllabus.

The Chairman of BOE of the subject shall allot at least 50% of the papers to be set by external examiners.

External examiners shall be either the faculty of PG departments of University/ Colleges. Not more than one examiner per semester can be from a research institution, in case of need.

- The Chairman BOE of the subject shall act as a moderator & securitize the question papers set and modify accordingly as per need or set fresh sets of question papers, with appropriate remarks. The securitized question papers in three sets per course be sent to the office of controller of examination, in sealed covers.
- The Controller of Examination shall follow a well defined procedure as per the manual to choose one set per course as a question paper for the given semester end examination.
- The Controller shall arrange to prepare the schedule for semester end examination issue of hall tickets, printing of question paper, conduct of examinations, coding of answer scripts, evaluation, decoding, tabulation & announcement of results as well as preparation and issue of marks cards, ledgers and other related records. He shall consult the Vice Chancellor, Dean of the Faculty & Chairman of BOS while preparing calendar of events and other examination process.
- There shall be double valuation of answer script of semester end examination for theory courses (one internal & one external). The average of the two evaluations can be considered as marks secured by the students per course per semester. However, if the difference of marks between two valuators exceeds 15% & above, there shall be third valuation of the same. The average of the nearest two evaluations shall be taken as marks secured.
- If the total number of script for 3rd valuation exceeds 20% of the total number of scripts in a given paper. Then, such answer scripts shall be valued by of Board of Examiners on specified dates & marks allotted by the BOE shall be final.
- Each practical examination of the Practical courses shall be conducted and evaluated jointly by both internal and external examiners and marks awarded there on shall be final.

- In case of project work the same may be evaluated separately by internal and external examiners or the BOS may prescribe presentation & viva voce for the same & joint valuation/ internal and external /BOE
- The Controller of Examination in consultation with Chairman BOS shall work out and notify the procedure for conducting of 2 internal tests the seminar / assignment / field work. The same shall be included in the manual of examination.

11. Performance appraisal: Tabulation and declaration of results.

11.1. The minimum for pass shall be 50% of the total marks (including both CIA and SEE), for each head of passing in each course.

Further, the candidate shall obtain at least 50% of marks in semester end examination. However, there is no minimum for passing with respect to IA marks.

- The candidate shall secure a minimum of 50% in aggregate of all the courses in all semester of a programme for the successful completion of all course for the award of degree.
- After the completion of tabulation of marks for each course, grade points, credit points for each course is calculated, only in case of successful candidates
  Then the SGPA of the semester and CGPA of the semesters are calculated. The procedure for the calculation of CP, GP, SGPA & CGPA are given in the **Annexure -5**.
- The specimen of the marks card is given in the **Annexure – 1-4**.

12. Award of Class / CGPA / Letter Grade.

The class / CGPA / Letter Grade shall be awarded to successful candidates based on CGPA of all the four semesters as specified below.

For successful candidates, Class shall be awarded based on the CGPA

Cumulative Grade Point Average (CGPA)	Total Percentage of Marks	Class to be awarded	Letter grade
7.5 to 10.0	> 75%	First class with Distinction	A +
6.0 and above but below 7.5	60 – 74.9%	First Class	A
5.5 and above but below 6.0	55 – 59.9 %	High Second Class	B +
5.0 and above but below 5.5	50 – 54.9 %	Second Class	B
Below 5.0	-	Fail	F

- Ranks shall be assigned in the order of merit of only those candidates who have successfully completed each semester in first attempt & completed the programme within 2 academic years.

- A candidate who is desirous of improvement of results may appear for any specified semester or more than one semester or all the semesters. However, he shall complete the improvement within 4 years from the date of registration. He has to appear for only the semester end examination as per the regular schedule. Internal Assessment marks shall be carried, forward for tabulation and announcement of results.
  In case of no improvement the candidate may retain the original results.

13. Miscellaneous Provisions: With the approval and notification of the above mentioned regulations, any earlier regulations governing postgraduate programme of the college shall stand repealed. These regulations shall be in force till the next notification.

- The Academic Council with the approval of the Board of Management may delete, add or modify the provisions of said regulations from time to time with suitable justifications.

14. Savings clause: The said regulations shall come into force from the day of its notification and shall be in force till the date of repealing of the same.

In case of any inconsistency or ambiguity or difficulty brought in, to will be modified accordingly through suitable amendments & notifications, unfore seen problems & difficulties while interpreting the provisions of the regulations may be resolved by the Head of the University in consultation & concurrence with the experts suggested by BOM & AC from time to time.

14.1 Result Review:

There shall be a Result Review by BOS & BOE. The report of the review shall be submitted to AC & BOM for information & perusal.

The BOS / BOE shall review the examination results and record their opinion on the satisfactory compliance of the process or as per the manual.

The minutes of the meeting will be kept as record.

14.2 Unfair Means Committee:

There shall be a committee for prevention of malpractice and adjudicated malpractice cases of students, teachers and officials. The composition & function of the committee will be as per the provisions of PIMS-DU.

14.3. Each Post Graduate student shall undergo facilitation and training in at least four credit audit course, each of 1 credit during the span of two academic years to be eligible for recommendation for the award of degree by the parent university. The college may

constitute committee for extra mural studies to offer this audit course to be chosen by on his aptitude. The student may complete four credit audit course during the span of their 2 years programs.

14.4. There shall be a Graduation Day ceremony to be arranged for successful candidates. The procedure for the same be worked and by the Institution. The Graduation Day shall be conducted only after the approved of the list of successful candidates by Parent University. Successful candidates will be awarded degree certificate at convocation ceremony as per the University convocation notification.

14.5. **Saving clause**:

In case of any difficulty in the implementation of the provisions of these Regulations. The decision of Vice chancellor shall be final. The Vice Chancellor will request this action taken to Academic Council in its next meeting for information.

PRAVARA INSTITUTE OF MEDICAL SCIENCES
(DEEMED TO BE UNIVERSITY)

Centre for Biotechnology

Loni 413736, Ahmednagar District, Maharashtra State, India

PG Program in M. Sc. in Medical Biotechnology & Pattern of Marks statement
[4 Semesters + Credit & Grade based system]

Semester: I

Month & Year: _____ Name of the Student:_____ Reg. No: _____

	Course number & code T or P	Title of course (to be given by BOS)	Core or Elective C or E	Credits	Internal Assessment marks		Semester End Exam.			Total Marks			GP	CP
					Max.	Secured	Max.	Min. for pass	Marks secured	Max.	Min. for pass	Secured		
	MBTT 101	Theory	C	4	30		70	35		100	50			
	MBTT 102	Theory	C	4	30		70	35		100	50			
	MBTT 103	Theory	C	4	30		70	35		100	50			
	MBTT 104	Theory	C	4	30		70	35		100	50			
	MBTP105	Practical Course (Based on MBTT 101 & MBTT 102)	C	4	30		70	35		100	50			
	MBTP106	Practical Course (Based on MBTT 103 & MBTT 104)	C	4	30		70	35		100	50			
Grand Total	4T+2P	4T + 2P		24	180		420			600				

MBT = Medical Biotechnology
T = Theory
P = Practical
101 = Semester I x Course No.01
C = Core or compulsory paper / practical

$$\text{S.G.P.A of I Semester} = \frac{\text{CP of I Semester}}{\text{Total Credits of I Semester}}$$

PRAVARA INSTITUTE OF MEDICAL SCIENCES

(DEEMED TO BE UNIVERSITY)

Centre for Biotechnology

Loni 413736, Ahmednagar District, Maharashtra State, India

PG Program in M. Sc. in Medical Biotechnology & Pattern of Marks statement
[4 Semesters + Credit & Grade based system]

Semester: II

Month & Year: _____ Name of the Student:_____ Reg. No: _____

	Course number & code T or P	Title of course (to be given by BOS)	Core or Elective C or E	Credits	Internal Assessment marks		Semester End Exam.			Total Marks			GP	CP
					Max.	Secured	Max.	Min. for pass	Marks secured	Max.	Min. for pass	Secured		
	MBTT 201	Theory	C	4	30		70	35		100	50			
	MBTT 202	Theory	C	4	30		70	35		100	50			
	MBTT 203	Theory	C	4	30		70	35		100	50			
	MBTT 204	Theory	C	4	30		70	35		100	50			
	MBTP205	Practical Course (Based on MBTT 201 & MBTT 202)	C	4	30		70	80		100	50			
	MBTP 206	Practical Course (Based on MBTT 203 & MBTT 204)	C	4	30		70	80		100	50			
Grand Total	4T+2P	4T + 2P		24	180		420			600				

MBT = Medical Biotechnology

T = Theory
P = Practical
201 = Semester II x Course No.01
C = Core or compulsory paper / practical

$$\text{S.G.P.A of II Semester} = \frac{\text{CP of II Semester}}{\text{Credits of II Semester}}$$

$$\text{CGPA of I \& II Semester} = \frac{\text{CP: of II Sem + GP of II Sem}}{\text{Credit of I Sem + Credit of II Sem}}$$

PRAVARA INSTITUTE OF MEDICAL SCIENCES
(DEEMED TO BE UNIVERSITY)

Centre for Biotechnology

Loni 413736, Ahmednagar District, Maharashtra State, India

PG Program in M. Sc. in Medical Biotechnology & Pattern of Marks statement
[4 Semesters + Credit & Grade based system]

Semester: III

Month & Year: _____ Name of the Student:_____ Reg. No: _____

	Course number & code T or P	Title of course (to be given by BOS)	Core or Elective C or E	Credits	Internal Assessment marks		Semester End Exam.			Total Marks			GP	CP
					Max	Secured	Max	Min. for pass	Marks secured	Max.	Min. for pass	Secured		
	MBTT 301	Theory	C	4	30		70	35		100	50			
	MBTT 302	Theory	C	4	30		70	35		100	50			
	MBTT 303	Theory	C	4	30		70	35		100	50			
	MBTT 304	Theory	C	4	30		70	35		100	50			
	MBTP 305	Practical Course (Based on MBTT 301 & MBTT 302)	C	4	30		70	35		100	50			
Grand Total	MBTP 306	Practical Course (Based on MBTT 303 & MBTT 304)	C	4	30		70	35		100	50			
	4T+2P	4T + 2P		24	180		420			600				

MBT = Medical Biotechnology
T = Theory
P = Practical
301 = Semester III x Course No.01
C = Core or compulsory paper / practical

$$\text{S.G.P.A of III Semester} = \frac{\text{CP of III Semester}}{\text{Credits of III Semester}}$$

$$\text{CGPA of II \& III Semester} = \frac{\text{CP of I+CP of II + CP of III Sem}}{\text{Credit of I +II+III Sem}}$$

Annexure - 4

PRAVARA INSTITUTE OF MEDICAL SCIENCES
(DEEMED TO BE UNIVERSITY)

Centre for Biotechnology

Loni 413736, Ahmednagar District, Maharashtra State, India

PG Program in M. Sc. in Medical Biotechnology & Pattern of Marks statement
[4 Semesters + Credit & Grade based system]

Semester: IV

Month & Year: _____ Name of the Student:_____ Reg. No: _____

	Course number & code T or P	Title of course (to be given by BOS)	Core or Elective C or E	Credits	Internal Assessment marks		Semester End Exam.			Total Marks			GP
					Max	Secured	Max	Min. For pass	Marks secured	Max.	Min. for pass	Secured	
	MBTT 401	Theory	C	4	30		70	35		100	50		
	MBTT 402	Theory	C	4	30		70	35		100	50		
	MBTT 403 A MBTT 403 B	**Any one of the electives offered** - Theory	E	4	30		70	35		100	50		
	MBTD 404	Project work / Dissertation	C	4	30	-	70	35		100	50		
	MBTP 405	Practical Course (Based on MBTT 401 & MBTT 402)	C	4	30		70	35		100	50		
	MBTP 406	Practical Course (Based on MBTT 403A or MBTT403B & MBTD 404*)	C	4	30		70	35		100	50		
Grand Total	3T+2P+1D	3T+2P+1D		24	180		420			600			

* Practical Exam based on Dissertation practical + PPT presentation of Dissertation + Viva voce based on dissertation

MBT = Medical Biotechnology
T = Theory
D = Dissertation
401 =Referred to semester IV x Course No.01
C = Core or compulsory paper / practical
E = Elective

S.G.P.A of IV Semester = $\frac{\text{CP of IV Semester}}{\text{Credits of IV Semester}}$

CGPA of I, II & III Semester = $\frac{\text{CP of I+CP of II + CPIII+CPIV of IV Sem}}{\text{Credit of I +II+III +IV Sem}}$

Class awarded

Annexure - 5

Calculation of SGPA and CGPA

SGPA for IV semester = CP (IV Sem) / Credits (IV Sem)

SGPA for I Semester = CP (I Sem) / Credits (I Sem)

SGPA for I Semester = SGPA for I Semester

$$\text{CGPA for I and II Sem} = \frac{\text{CP(I Sem)} + \text{CP(II Sem)}}{\text{Credits(I Sem)} + \text{Credits(II Sem)}}$$

$$\text{CGPA for I,II and III Sem} = \frac{\text{CP(I Sem)} + \text{CP(II Sem)} + \text{CP(III Sem)}}{\text{Credits (I Sem)} + \text{Credits (II Sem)} + \text{Credits (III Sem)}}$$

$$\text{CGPA for I,II,III \& IV Sem of the Programme} = \frac{\text{CP(I Sem)} + \text{CP(II Sem)} + \text{CP(III Sem)} + \text{CP(IV Sem)}}{\text{Credits(I Sem)} + \text{Credits(II Sem)} + \text{Credits(III Sem)} + \text{Credits(IV Sem)}}$$

PRAVARA INSTITUTE OF MEDICAL SCIENCES

(Deemed to be University)

Loni Bk. 413 736, Tal. Rahata, Dist. Ahmednagar, (MS)

Centre for Biotechnology

Proposed Course Structure & Syllabus of

M. Sc. (Medical Biotechnology)

To be implemented from Academic Year 2020-21

M. Sc Medical Biotechnology

SEMESTER I

CELL BIOLOGY (MBTT 101)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT101	Core	Cell Biology	4	0	4	60	4+2=**6**

Objective:

The objective of the course is to familiarize the students with the fundamentals of cell biology.

Outcome:

At the end of the course, the students will be familiar with cell science and cell-cell interaction. This would help him to take further courses in biotechnology in the subsequent semesters.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Cell Structure	Introduction to Prokaryotes and eukaryotes Prokaryotic cell structure Eukaryotic cell structure	8
Unit II	Cytoskeleton	Overview of the Major Functions of Cytoskeleton. Microtubules: Structure and Composition. MAPs: Functions- Role in Mitosis, Structural Support and Cytoskeleton Intracellular Motility. Motor Proteins: Kinesins, Dynein; MTOCs. Dynamic Properties of Microtubules. Microtubules in Cilia and Flagella. Microfilaments: Structure, Composition, Assembly and Disassembly. Motor Protein: Myosin. Muscle Contractility: Sliding Filament Model. Actin Binding Proteins: Examples of NonMuscle Motility. Intermediate Filaments: Structure and Composition; Assembly and Disassembly; Types and Functions.	12
Unit III	Cell Differentiation and tissues maintenance	Tissues with permanent cells: Renewal by simple duplication, Renewal by stem cells- epidermis, Renewal by pluripotent stem cells- blood cell formation Quiescent stem cells – skeletal muscle, Soft cells and tough matrix – growth turnover and repair in skeletal connective tissue	10
Unit IV	Cell cycle & Signaling	Mitosis and meiosis, chromosomes- structure and organization, nucleosomes organization karyotypes and ideograms. Cytological, genetical and evolutionary significance of Mitosis and Meiosis. Molecular events and regulation of cell cycle in eukaryotes. Check points, Cyclins and protein kinases, MPF (maturation promoting factor). Types of Cell signaling, Signaling molecules and their receptors, functions, pathways of intracellular signal transduction	14
Unit V	Cell –Cell Communication	Cell adhesion & cell junctions Cell –cell interaction & cell matrix interaction Extracellular matrix	6

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit VI	Cancer Biology	Cellular and genetic basis of cancer, apoptosis, carcinogens, environmental and diet factors in cancer.	10

METHODOLOGY

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

Books recommended:

Cell and Molecular Biology by De Robertis.
Molecular Biology of Cell by Bruce Alberts 2002.
The Cell by Cooper 2000
Cell Biology, Genetics, Molecular Biology, Evolution and
Ecology by P. S Verma and VK Agarwal. Publisher S. Chand and Comp. 2005
Cell Biology by Powar
Cell and Molecular Biology Garald Karp J. Wiley & Sons, NY
Harvey Lodish- Molecular Cell biology, 5th edition (2003), Freeman W. H. and company
Gerald Karp- Cell & molecular Biology 6th Edition 2010
Alberts- Essential Cell Biology 4th Edition 2014

PRACTICAL IN CELL BIOLOGY (4 hrs per week)

LIST OF EXPERIMENTS

1. Microscopes- Compound microscopes
2. Observation of prokaryotic and eukaryotic cells with the help of light micrographs
3. Arrest and observation of chromosomes after colchicine treatment in onion roots.
4. Different stages of Meiosis.
5. Cell fractionation
6. Buccal smear – Identification of Barr Body
7. Isolation of Mitochondria/chloroplast
8. Counting of cells using Haemocytometer

REFERENCE: Becker WM Kleinsmit, LJ, Hardin J, and Bertoni GP, 2009. The World of the Cell, seventh edition. Pearson/Benjamin-Cummings, Boston, MA.

MOLECULAR BIOLOGY (MBTT 102)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT 102	Core	Molecular Biology	4	0	4	60	4+2=**6**

Objective:

The objective of the course is to familiarize the student with the fundamentals concepts and technique in molecular biology and its use in the medical research.

Outcome:

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

Sr. No.	Topic	Detail of syllabus	Hrs
Unit I	Introduction	History and scope of molecular biology- Discovery of DNA- evidence for DNA as the genetic material. The genomes of bacteria, viruses, plasmids, mitochondria and chloroplast	4
Unit II	Structure and maintenance of genome	Structure of DNA, types and alternatives forms of DNA. Structure of RNA. Organisation of eukaryotic genome- components of eukaryotic chromatinchromatin and chromosome structure- DNA-supercoiling -linking number- satellite DNA	7
Unit III	DNA Replication	Replication of DNA in prokaryotes-, Origin of replication, types of DNA polymerases, details of DNA synthesis process Eukaryotic DNA replication- multiple replicons, eukaryotic DNA polymerases, ARS in yeast, Origin Recognition Complex (ORC), regulation of replication	10
Unit IV	DNA damage, repair and mutation	Different types of DNA damages Mutation, types of mutation, spontaneous and induced mutation, Detecting mutation Nucleotide excision repair, Base excision repair, mismatch repair, recombination, repair, SOS operon, Double strand break repair, transcription coupled repair	7
Unit V	Recombination	Homologous and site specific recombination, Models for homologous recombination Proteins involved in recombination: RecA, B, C, D, Ruv A, B, C Gene conversion	8
Unit VI	Mobile DNA elements	General features of Transposable elements, Transposable elements in prokaryotes-IS element, Retroviruses Retrotransposons- Ty elements in yeasts, SINES and LINES	5
Unit VII	Transcription	Transcription in Prokaryotes: RNA polymerase, sigma factor, Initiation, elongation, termination, Transcription in Eukaryotes: RNA polymerases, transcription of protein coding sequences by RNA polymerase-II, post-transcriptional modification, R NA	7

Sr. No.	Topic	Detail of syllabus	Hrs
		splicing and RNA editing, CpG Island and Epigenetic - Overview	
Unit VIII	Translation	Genetic code, Translation in Prokaryotes and eukaryotes, post translational process- protein translocation	7
Unit IX	Control of Gene Expression	Gene regulation in Prokaryotes, Operon model, Gene regulation in eukaryotes, gene activators, enhancers and silencers	5

METHODOLOGY

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

Books Recommended:

1. Benjamin Lewin. (2010) Genes X, Jones and Bartelett Publishers Inc.
2. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James D. Watson (2004), Molecular Biology of the Cell, 4th Edition, Garland Publishing
3. Raff, Keith Roberts, Peter Walter, (2003) Essential Cell Biology, 2nd Edition, Garland Publishing
4. Watson James D., Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick (2004) Molecular Biology of the Gene, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc.
5. Weaver R., (2007) Molecular Biology, 4th Edition, McGrew Hill Science.
6. Molecular Biology and Biotechnology, 3rd edition– J M Walker & E B Gingold, Panima publishing corporation, 1999.
7. Elliot, Biochemistry & Molecular Biology
8. Kleinsmith, L. J. & Kish, V.M. 1995. Principles of Cell and Molecular Biology. 2nd edn., McLaughlin, S., Trost, K., Mac Elree, E. (eds.)., Harper Collins Publishers, New York.

PRACTICAL IN MOLECULAR BIOLOGY (4 hrs per week)

LIST OF EXPERIMENTS

1. Isolation of Genomic DNA from Bacterial & Blood Samples
2. Quantitative analysis of DNA by UV Spectrophotometer
3. Qualitative analysis of DNA through Agarose Gel Electrophoresis
4. Total isolation of RNA from bacterial cells
5. Quantitative analysis of RNA by UV Spectrophotometer

REFERENCE:

J Sambrook & D. W. Russell (2001). Molecular cloning: a laboratory manual Vol 1,2 & 3, CSHL Press.

HUMAN BIOCHEMISTRY (MBTT 103)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT103	Core	Human Biochemistry	4	0	4	60	4+2=**6**

Objective:

The Objective of the course is to familiarize the students with the fundamental and advances in Human Biochemistry.

Outcome:

At the end of the course, the student will have sufficient scientific understanding of the subject & have good knowledge of various bimolecular, their factions & metabolism.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Chemical basis of life	Composition of living matter; Water- properties, pH, pKa, Buffers, Handerson-Hasselbach equations, ionization and hydrophobicity; Emergent properties of biomolecules in water; Water as a reactant.	5
Unit II	Proteins	Amino acids as building blocks of proteins and their classification,pI and pKa values, Primary, Secondary, Tertiary and Higher order structure of Proteins, Protein Sequencing, Ramchandran Plot, Conjugated proteins- Glycoproteins, Lipoproteins, Heamproteins.	10
Unit III	Enzymes	Enzyme classification, General principles of catalysis, Quantitation of enzyme activity and efficiency, Enzyme characterization and Michaelis-Menten kinetics, Enzyme inhibition and covalent modification, enzyme regulation,- Jackob & Monod model, Ribozymes. Enzyme immobilization	10
Unit IV	Carbohydrates	Mono- Di- and Polysaccharides, Optical isomerism, Glycolysis, Gluconeogenesis, Pentose phosphate pathways, Citric acid cycle.	9
Unit V	Lipids	Classification of lipids & fatty acids and structural analysis of fatty acids, Glycerols, Waxes, Glycolipids, Phospholipids, Sphingolipids, Sterols, Lipoproteins, β-oxidation, Biosynthesis of Cholesterol & its significant, Fatty acids. Ketogenesis	9
Unit VI	Nucleic acids	Biosynthetic pathways of purines and pyrimidines, degradation pathways	8
Unit VII	Bioenergetics	Basic principles; Equilibria and concept of free energy; Group transfer, concept of Entropy, Enthalpy and free energy , Oxidation and Reduction reactions, Electron Transport Chain, Metabolic regulations including the role of hormones – Inhibitor, Michel theory	9

METHODOLOGY

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

Books Recommended:

Harper's Illustrated Biochemistry
A text of biochemistry, - A.V.S.S. Rama Rao 9th ed. (UBS Publisher's and Distributors Pvt. Ltd.)
Leninger: Principles of Biochemistry, 3nd Ed. – Nelson D. et al (Worth Publishers)
Biochemistry, 5th, - Ed. Breg, J.M. Tymoczko J.L. and Stryer L. (W.H. Freeman &Co.)
Lubert Stayer,(Latest) Biochemistry,II edition ,W.H.Freeman and CO.NY

PRACTICALS IN BIOCHEMISTRY (4 Hrs. per Week)

LIST OF EXPERIMENT

1. Calibration of pH meter
2. Estimation of Proteins By Biuret Method
3. Estimation of Protein By Lowry Method
4. Estimation of Serum Albumin By BCG Method
5. Estimation of SGPT
6. Estimation of Serum Alkaline Phosphatase
7. Estimation of Serum Creatinine
8. Estimation of Urea Nitrogen
9. Estimation of Cholesterol By Zak's ferric Chloride Method
10. Estimation of Carbohydrates By Anthrone Method
11. Separation of Proteins by SDS-PAGE
12. Separation of serum protein by paper electrophoresis

HUMAN PHYSIOLOGY (MBTT 104)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT 104	Core	Human Physiology	4	0	4	60	4+2=**6**

Objective:

The objective of the course is to study the physiological aspects of the human systems and its role in functioning of all the major organs of the body.

Outcome:

At the end of the course, the students will be able to understand the integral mechanism operatly in the human system among with regulation of each system.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Basic concepts and principles	Introduction and background (homeostasis, control systems), Biophysics of blood flow, Regulation of respiration, Auto regulation of renal blood flow and the concept of clearance	7
Unit II	Sensory Organs	Eye, Ear, Nose, Tongue and Skin: Functions & Disorders	5
Unit III	Digestive system	Functions & Disorders, Pharynx, oesophagus, Stomach and Intestines, Liver & Pancreas, Peritoneum	5
Unit IV	Circulation system	Heart rate and the significance, Cardiac cycle, HR factors ECG- Machine, Recording, Abnormalities types Causative Factors Reporting & Interpretation.	8
Unit V	Respiration system	Respiration, Mechanism, Inspiration, Expiration Gas exchange mechanism Lung surfactant, compliance Lung volume and capacity Respiratory Exercises, Artificial Respiration Basis & Techniques	8
Unit VI	Genito-Urinary System	Kidney, Urethra, bladder, Urethra, Female Reproductive System, Male Reproductive System	7
Unit VII	Skeletal system	Mechanism of contraction, Difference between 3 types of muscles, Electro myography & mechanical recording of muscle contraction, Locomotion, Diseases of muscles, Dystrophies,	7
Unit VIII	Nervous System	Nerve fibres, types ,functions, injuries, impulses & velocity	5
Unit IX	Endocrine system	Hormones, Functions & Disorders	5
Unit X	Genetic testing	Genetic testing, Eugenics and Aging	3

METHODOLOGY

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

Books Recommended:

Textbook of Medical Physiology by C. Guyton
Physiology by C. Chatterjee
Human Anatomy & Physiolgy by Tortora
Medical physiology by Chaudhary
Anatomy and histology by Ross and Wilson
Human Anatomy and Physiology by Creager

PRACTICAL IN HUMAN PHYSIOLOGY (4 hrs per week)

LIST OF EXPERIMENTS

1. Blood grouping
2. Haemoglobin estimation
3. Total WBC and RBC count
4. Erythrocyte sedimentation rate
5. Differential Counting of Blood
6. PVC count

SEMESTER II

MEDICAL MICROBIOLOGY (MBTT 201)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT 201	Core	Medical Microbiology	4	0	4	60	4+2=**6**

Objective:

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

Outcome:

After completion of this course students are expected to be able to.

- Demonstrate theory and practical skill in microscopy and their handling technique and staining procedure.
- Know various culture media and their application
- Understand physical and chemical means of sterilization on
- Know various biochemical test to analysis, understand, basic concept of chemical reaction that occur in lining system.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to Microbiology	Scope and history of Microbiology. Classification and identification of microorganism.	6
Unit II	Characteristics	Cultivation of bacteria. Culture media, preservation methods of bacterial cultures and maintenance, growth kinetics	6
Unit III	Microorganism-Bacteria	Morphology & fine structure of Bacteria	8
Unit IV	Host-parasite relationship	The host-parasite relationship, Symbiotic associations, Characteristics of parasitism, Entry, exit and transmission. Normal flora, various sites of normal flora	8
Unit V	Bacteriology	Bacteria of medical importance, Gram Positive Cocci- *Staphylococcus, Streptococcus,* Gram Negative - *Neissaria* Gram Positive Bacilli- *Bacillus anthraxis, Clostridium* Gram Negative Bacilli- members of *Pseudomonadaceae, Vibrio cholera,*Other: *Mycoplasma, Ricketasia,*	10
Unit VI	Virology & Mycology	General properties of viruses, classification of viruses, Laboratory diagnosis of viral infections, viral cultivation, Roll of antiviral agent Structure and characteristics of fungi, differences between Bacteria and fungi, culture and laboratory diagnosis, Medical importance of fungi.	10
Unit VII	Epidemiological aspects	Control of infection and disease, hospital acquired infection, Prevention & control.	6
Unit VIII	The Clinical manifestation of infection	Respiratory tract infections, Urinary tract infections, Sexually transmitted diseases, Gastrointestinal tract infections, Meningitis	6

	infection		

METHODOLOGY

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

Books Recommended:

General Microbiology: Vol. I & 2 by Powar & Daginawala
Microbiology by Pelzer
Microbiology by Prescott
General Microbiology by Stanier
Instant notes in Microbiology by Nicklin
Medical Microbiology by Mims
Medical microbiology by C.P. Baweja
Medical microbiology by Ananthnarayanan
Parasitology by Chatterjee
Mycology by Jagdish chander
Diagnostic microbiology by Bailey & Scott

PRACTICAL IN MEDICAL MICROBIOLOGY (4 hrs per week)

LIST OF EXPERIMENTS

1. Preparation of culture media
2. Staining procedures
3. Negative staining
4. Gram Staining
5. Aseptic transfer techniques
6. Streak plate method
7. Spread plate method
8. Pour plate method
9. Biochemical tests
10. IMViC test
11. Triple Sugar Iron test
12. Catbohydrate fermentation test
13. Isolation and identification of bacterial pathogen from clinical specimen
14. Urine sample
15. Pus sample
16. Blood sample/any other
17. Antibiotic sensitivity test (Disk diffusion method and well diffusion method)
18. Techniques for diagnosis of viral infections
19. HIV
20. Dengue
21. Techniques for diagnosis of parasitic infections
22. Malaria

IMMUNOLOGY & IMMUNOTECHNOLOGY (MBTT 202)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT 202	Core	Immunology & Immunotechnology	4	0	2	60	4+2=**6**

Objective:

The objectives of this course are to learn about structural features of components of immune system as well as their function. The major emphasis of this course will be on development of immune system and mechanisms by which our body elicit the immune response. This will be imperative for students as it will help them to think like an immunologist and predict about nature of immune response that develops against bacterial, viral or parasitic infection, and prove it by designing new experiments.

Course Outcomes:

On completion of this course, students should be able to:

- Evaluate the usefulness of immunology in different pharmaceutical companies;
- Identify the proper research lab work- ing in the area of their own interests;
- Apply their knowledge and design immunological experiments to demonstrate innate, humoral or cytotoxic T lymphocyte responses and figure out the kind of immune responses in the setting of infection (viral or bacterial) by looking at cytokine profile.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Antigens, Immunoglobulins Structure and Function	Overview of Antigens, Basic and fine structure of immuneglobulin: light chains, heavy chains and sequences, Antigen determinants on Immunoglobulin: Isotopic, allotypic, Idiotypic, Immunoglobulin super family	8
Unit II	Generation of B cell and T cell responses	Brief introduction of Antibodies, Organization and expression of immunoglobulin genes, Antigen-Antibody interactions: Principles and Applications, Major Histocompatibility Complex Antigen Processing and Presentation T cell receptor, T cell maturation, activation, and differentiation B cell generation, activation, and differentiation	12
Unit III	Immune Effector Mechanisms	Cytokines, The Complement system, Cell mediated effector responses, Leukocyte migration and inflammation, Hypersensitive reaction	8
Unit IV	Immuno techniques	Strength of antigen and antibody, interactions: Antibody affinity, antibody avidity, Cross reactivity, Precipitation reactions, agglutination reactions (Immunodiffusion and Immunoelectrophoretic technique), Radioimmunoassay, Enzyme linked Immunosorbant./Assay(ELISA), Western Blotting, Immuno precipitation.	12
Unit V	The Immune System in Health and Disease	Immune response to infectious diseases, Vaccines, AIDS and other immunodeficiencies , Autoimmunity, Transplantation immunology Cancer and the immune system.	10

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit VI	CMI and Imaging techniques	CD nomenclature, Identification of immune Cells; Principle of Immunofluoresence Microscopy, Flurochromes; Staining techniques for live cell imaging and fixed cells; Flow cytometry, Instrumentation, Applications; Cell Cytotoxicity	10

METHODOLOGY

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

BOOKS RECOMMENDED:

1. Immunology – Kuby et.al
2. Cellular Interactions and immunobiology – BIOTOL series
3. Immunology – Roitt et. al.
4. Immunobiology – Janeway Travers et. al
5. Cellular and molecular Immunology - Abbas A.K., Lichtman A.H. and Pober, J.S.
6. Immunobiology 3rd ed. – Janeway Travers
7. Brostoff, J., Seaddin, J. K., Male, D., & Roitt, I. M. (2002). Clinical Immunology. London: Gower Medical Pub.
8. Murphy, K., Travers, P., Walport, M., & Janeway, C. (2012). Janeway's Immunobiology. New York: Garland Science.
9. Paul, W. E. (1993). Fundamental Immunology. New York: Raven Press.
10. Goding, J. W. (1986). Monoclonal Antibodies: Principles and Practice: Production and Application of Monoclonal Antibodies in Cell Biology, Biochemistry, and Immunology. London: Academic Press

PRACTICAL IN IMMUNOLOGY & IMMUNOTECHNOLOGY (4 hrs per week)

LIST OF EXPERIMENTS

1. Animal handling
2. Blood collection
3. Routes of drug administration
4. Dissection of mice lymphoid organ (spleen)
5. Latex agglutination method
6. Determination of Phagocytic index
7. Clinical diagnostic immunoblotting/ SDS PAGE
8. ELISA
9. Immunoassay – immuno diffusion method, rocket electrophoresis
10. ICT for malaria and HIV detection

CELL CULTURE (ANIMAL & PLANT) (MBTT 203)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT 203	Major	Cell Culture (Animal & Plant)	4	0	4	48	4+2=**6**

Objective:

To improve theoretical & Practical fundamental of cell and tissue culture techniques in animals & plants. To provides to students with the ability to adopt basic cell culture procedure for various research requirements.

Outcome:

At the end of this course the student will able to understand how to initiate grow & harvest the eukaryotic cell & their uses. They will be also able to understand the applications of *in vitro* biology for clonal propagation.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to animal tissue culture	Historical background, The application of tissue culture(Stem Cells tissue engineering, industry and Research), Terminology, Stages in cell culture	8
Unit II	Introduction to plant tissue culture	History & development of PTC, nutrient medium, plant growth regulators: mode & mechanism of action Incubation system & maintenance of *in vitro* culture	
Unit III	Outline of the key techniques of animal cell culture	Setting up the laboratory, Culturing cells, Maintaining the culture, Quantification of cells in cell culture, Cloning and selecting cell lines, Hazards and safety in the cell culture laboratory	8
Unit VI	Animal cell culture media	General cell culture media design, Natural media, Synthetic media, Further considerations in media formulation, Nutritional components of media, The role of serum in cell culture, Choosing a medium for different cell type	8
Unit V	Cell Separation and Characterization of cell lines	Cell separation – Methods of Cell separation – Density, antibody based, FACS, MACS technology. Cell Characterization - Species identification, linkage of tissue markers. Cell Morphology – Microscope, Staining	8
Unit VI	Preservation of animal cell lines	Variation and instability in cell lines, Preservation of cell lines, Freezing of cells, Thawing of cells, Quantification of cell viability, Cell banks	8
Unit VII	Plant, Cell & organ culture	Growth & development of plant cell & tissue in vitro. Callus culture, cell suspension culture, organ culture, organogenesis & embryogenesis. Applications of plant tissue culture: mass propagation, synthetic seeds & disease elimination	

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit VIII	Large scale animal cell culture	Culture parameters, Scale up of anchorage-dependant cells, Culture vessels, Suspension culture, Perfusion techniques, bioreactors	8

METHODOLOGY

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

BOOKS RECOMMENDED

Cell and Tissue Culture: Lab Procedures in Biotechnology by Alan Doyle (ed) J. Bryan Griffith (ed)
"Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications" by R Ian Freshney
"Animal Cell Culture: A Practical Approach (Practical Approach Series)" by John Masters
"Animal Cell and Tissue Culture" by Mathur Shivangi
Basic Cell Culture 2nd Edition by JM Davis Oxford University Press.2002.
Plant biotechnology by B. D. Singh, Kalyani Publication
Plant Biotechnology by chawla H. S. Oxford & IBH
Plant tissue culture by Bhojwani & Razdan

PRACTICALS IN CELL CULTURE (ANIMAL & PLANT) (4 Hrs. per Week)

LIST OF EXPERIMENT

1. Layout of Animal Tissue Culture laboratory
2. Washing of glasswares
3. Sterilization of glasswares
4. Preparation of culture media
5. Thawing of Animal cell lines
6. Passaging of Animal cell lines
7. Cell quantification and Cell viability
8. Cryopreservation of cell cultures
9. Preparation of Plant tissue culture media
10. In vitro propagation through shoot tip and nodal culture
11. Production of synthetic seeds
12. Production of callus and culture
13. Transformation by *Agrobacterium* based vector systems and regulation

CLINICAL BIOCHEMISTRY (MBTT 204)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT 204	Core	Clinical Biochemistry	4	0	4	60	4+2=**6**

Objective:

The objectives of this course are to build upon previous knowledge of biochemical pathways and immunology to develop an appreciation of applications of these knowledge in clinical diagnostics and treatment. The course shall make students aware about various disease diagnostic techniques, disease pathologies and clinical case studies within the context of each topic.

Outcomes:

Students should be able to:

- Understand applications of clinical biochemistry in diagnostics;
- Understand the molecular basis of various pathological conditions from the perspective of biochemical reactions.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to clinical biochemistry	Clinical specimen Considerations - Types of Samples, Sample Processing, Sample Variables, Chain of Custody; Infection control, composition and types of blood specimens, preservation, influence of nutrition, drugs, posture, *etc.* Choice and correct use of anticoagulants; Care of the specimens, identification, transport, storage, influence of temperature, freezing/thawing; Laboratory safety and regulations – Safety awareness, safety equipment, biological, chemical, fire and radiation safety; Method evaluation and quality management, Basic concepts, Reference interval study, Diagnostic efficiency, Method evaluation, Quality Control and quality management.	10
Unit II	Amino acids and protein biochemistry	Amino acids – Inborn errors of amino acids: Aminoacidopathies, Amino Acid Analysis, formation of homocystinuria, cystinuria and cystinosis, phenyl ketonuria and alkaptonuria, albinism, tyrosinemia. Plasma proteins - Prealbumin (Transthyretin), Albumin, Globulins; Total Protein abnormalities – Hypoproteinemia, Hyperproteinemia; Methods of analysis – Quantification of specific proteins, Serum protein electrophoresis, Immunochemical methods; Proteins in other body fluids – Urinary proteins and Cerebrospinal fluid proteins; Non-protein nitrogen compounds (Physiology, clinical application, methods and pathophysiology) – Urea, Uric acid, Creatine, Creatinine, Ammonia.	10
Unit III	Clinically important enzymes and related pathophysiology	Enzymes of clinical significance - Creatine Kinase, Lactate Dehydrogenase, Aspartate Aminotransferase, Alanine Aminotransferase, Alkaline Phosphatase, Acid Phosphatase, Glutamyl transferase, Amylase, Lipase, Glucose-6-Phosphate Dehydrogenase, Drug-Metabolizing Enzymes, Tumour markers, Bone markers, Cardiac markers, liver markers, Inborn errors associated with carbohydrate metabolism; Inborn errors of	10

Sr. No.	Topic	Detail of syllabus	Hrs.
		metabolism - Glycogen storage diseases, Fructosuria, Fructose intolerance, Pentosuria, Galactosuria, Urine screening.	
Unit IV	Diagnosis and treatment of carbohydrate disorders	Blood glucose regulation (fasting/pp/random) –hormones influencing carbohydrate utilization, Insulin, glucagon, glucocorticoids, epinephrine, growth hormone. Hyperglycemia, Diabetes Mellitus - Aetiology and pathophysiology of Diabetes Mellitus, Symptoms and complications, Criteria for Testing for Prediabetes diabetes, Criteria for the Diagnosis of Diabetes Mellitus, Criteria for the Testing and Diagnosis of Gestational Diabetes Mellitus, Hypoglycemia.	10
Unit V	Transport mechanism and associated disorders	Transport of plasma lipids, lipoprotein metabolism, lipid profile and diet, PUFA and dietary fiber, Diagnosis and conditions of lipid disorders – Arteriosclerosis, Hyperlipoproteinemia, Hypercholesterolemia, Hypertriglyceridemia, Combined Hyperlipoproteinemia, Apolipoprotein Methods.	10
Unit VI	Assessment of organ system function	Pituitary function test, adrenal function - Introduction to Hormones and Pituitary Function - hypophysiotropic or hypothalamic hormones; Anterior pituitary hormones; Liver Function - Biochemical functions - Excretory and Secretory, Synthetic, Detoxification and Drug Metabolism, Liver function alterations during disease – Jaundice, Cirrhosis, Tumors, Drug- and Alcohol-Related Disorders Assessment of liver function/liver - Function tests: Bilirubin, Urobilinogen in Urine and Faeces, Enzymes, Tests Measuring Hepatic Synthetic Ability, Hepatitis. Cardiac Function - Cardiovascular Disease, Diagnosis of heart disease - Laboratory Diagnosis of Myocardial Infarction, Markers of Congestive Heart Failure. Renal Function - Glomerular Filtration, Tubular Function, Elimination of Nonprotein Nitrogen Compounds, Water, Electrolyte, and Acid-Base Homeostasis, Endocrine Function, 1,25-Dihydroxy Vitamin D3, Clearance Measurements, 2-Microglobulin, Myoglobin, Microalbumin, Urinalysis, Pathophysiology – Glomerular Diseases, Tubular Diseases, Urinary Tract Infection/Obstruction, Renal Calculi, Renal Failure. Pancreatic Function and Gastrointestinal Function - Physiology of pancreatic function, Diseases of the pancreas, Tests of pancreatic function - Secretin/Cholecystokinin Test, Tubeless gastric function test, Tests of intestinal function - Lactose intolerance Test.	10

METHODOLOGY

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

BOOKS RECOMMENDED

Recommended Textbooks and References:

1. Michael L. Bishop, Edward P. Fody and Larry E. Schoeff; (2013). Basic Principles and Practice of Clinical Chemistry, (7th Ed). Lippincott Williams and Wilkins.
2. Stryer, L. (2002). Biochemistry, (8th Ed). Freeman.
3. D.M. Vasudevan and Sreekumari, S, (2010). Textbook of Biochemistry for Medical Students, (6th Ed). Jaypee Brothers Medical Publishers, New Delhi.
4. Sucheta Dandekar; (2010). Concise Medical Biochemistry, (3rd ed), Elsevier Health.
5. Satyanarayana and Chakrapani, (2013), Biochemistry; (4th Ed). Elsevier.
6. Clinical Biochemistry- Metabolic & Clinical aspects by William J. Marshall et al.– 3rd Edition Churchill Lirigstone- Elsevier
7. Textbook of Clinical Biotechnology- Ramnik Sood, CBS publications
8. Clinical Biotechnology- Lecture notes by Walker et al, 9th edition, Wiley Blackwell
9. Clinical Biotechnology-Ahmed, Oxford
10. Clinical Chemistry-Principles, Techniques & Correlation – M.L. Bishop, Edward P. Fody, Larry E. Schoeff- 8th edition- Wolter Kluwer.
11. Testz fundamental of Clinical Chemistry and Molecular Diagnostics by Carl A. Burtis & David E. Bruns, 7th edition, Elsevier publication.

PRACTICALS IN CLINICAL BIOCHEMISTRY (4 Hrs. per Week)

1. Estimation of protein by Lowry method.
2. Estimation of blood glucose by Ortho-Toluidiene method.
3. Estimation of total protein and A: G ratio.
4. Estimation of blood urea by diacetyl monoxime method.
5. Estimation of serum creatinine by Jaffe's method.
6. Estimation of serum uric acid by phosphotungstate method.
7. Estimation of serum triglycerides
8. Qualitative Analysis of Urine for the presence of normal and abnormal constituents.

SEMESTER III

GENETIC ENGINEERING (MBTT 301)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT 301	Core	Genetic Engineering	4	0	4	60	4+2=**6**

Objective:

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

Outcome:

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

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Recombinant DNA technology- Introduction and Tools	The recombinant DNA concept, Milestones in genetic engineering, Tools of Genetic Engineering; Enzymes, Nuclease, The Restriction Endonucleases, Phosphodiesterase, Polynucleotide kinase, DNA ligase, DNA polymerase I, Reverse transcriptase, Terminal deoxynucleotidyl transferase, Poly A polymerase	10
Unit II	Vector System	Salient features of cloning vector, types of cloning vectors- plasmids, cosmids, phages (lambda and M13 phages), animal (SV40, Baculo) and plant (CMV) viruses, Artificial chromosomes- YACs and MACs	10
Unit III	The Means: Constructing, Cloning, and Selecting	Ligation of foreign DNA to vectors - cohesive and blunt end methods - homopolymer tailing and adaptors, Techniques of gene transfer - transformation, transfection, micro injection, electroporation, lipofection and biolistics, Screening Cloned Populations of Recombinants, Preparation of gene libraries and c-DNA libraries	14
Unit IV	Molecular Mapping of genome	DNA synthesis methods-Chemical and enzymatic. DNA sequencing techniques-Maxam & Gilbert method, Sangers dideoxy chain termination method, Automated DNA sequencing. Genetic and physical mapping techniques. PCR, molecular markers in genome analysis- RFLP, RAPD & AFLP analysis, molecular markers PCR based. MicroRNAs and RNA Interference.	14
Unit V	Applications of Genetic Engineering	Genetic diseases- Detection and Diagnosis, Gene therapy – *ex vivo, in vivo*, DNA marker technology in plants, DNA fingerprinting, Genetically engineered biotherapeutics and vaccines and their manufacturing, Transgenic animals and Bio-pharming	12

METHODOLOGY

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

BOOKS RECOMMENDED:

Molecular Biology of the gene - J. Watson
Genes VI, VII and VIII - Benjamin Lewin
Molecular Biotechnology Principles and application of recombinant DNA
Molecular Biology - Robert F. Weaver
Plant Molecular Biology: A practical approach. - C.H. Shaw (2006), Panima Pub. Corp.
Molecular cloning Vol. 1-3. Sambrook and Russel. 2001. CSH press.
Principles of gene manipulation. 1994. Old and Primrose, Blackwell Scientific Publ.
Principles and techniques of biochemistry and molecular biology, 6th Ed. Wilson Keith and Walker John (2005) Cambridge University Press, New York.
DNA Cloning : A practical approach D.M. Glover and D.B. Hames, R.L. Press,Oxford, 1995
Molecular and cellular methods in Biology and Medicine, P.B. Kaufman, W. Wu , D. Kim andL.J. Cseke, CRC Press Florida 1995

PRACTICALS: IN GENETIC ENGINEERING (4 hrs per week)

List of Experiments:

1. Competent Cell Preparation
2. Transformation *E.coli.*
3. Isolation of plasmid DNA by alkaline lysis mini preparation
4. Gel Elusion
5. Restriction digestion of vector DNA
6. Random Fragment Length Polymorphism
7. Random Amplified Polymorphic DNA
8. Southern hybridization
9. DNA amplification by PCR and analysis by Agarose gel electrophoresis
10. Manual DNA sequencing (Demo)

MOLECULAR DIAGNOSTICS (MBTT 302)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT 302	Specialized	Molecular Diagnostics	4	0	4	60	4+2=**6**

OBJECTIVE:

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

The objectives of this course are to sensitize students about recent advances in molecular biology and various facets of molecular medicine

OUTCOME:

Students should be able to understand various facts of molecular procedures and basics of genomics, proteomics and metabolomics that could be employed in early diagnosis and prognosis of human diseases.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction and History of diagnostics	Diseases- infectious, physiological and metabolic errors, genetic basis of diseases, inherited diseases. Infection – mode of transmission in infections, factors predisposing to microbial pathogenicity, types of infectious diseases- bacterial, viral, fungal, protozoans and other parasites. Philosophy and general approach to clinical specimens.	12
Unit II	Metabolic disorders and its causes	Traditional methods for the diagnosis of metabolic errors. Disease due to genetic disorders - Identifying human disease genes. Cancer- different types of cancers, genetics of cancer- Oncogenes, tumour suppressor genes. Methods available for the diagnosis of genetic diseases and metabolic disorders. Genetic disorders- Sickle cell anaemia, Retinoblastoma, Cystic Fibrosis and Sex – linked inherited disorders.	11
Unit III	Immunodiagnostics	Diagnosis of infectious diseases, respiratory diseases (influenza, etc.)Viral diseases-HIV etc., bacterial diseases, enteric diseases, parasitic diseases and mycobacterium diseases.	08
Unit IV	Molecular Diagnosis	Nucleic acid amplification methods and types of PCR: Reverse Transcriptase-PCR, Real-Time PCR, Inverse PCR, Multiplex PCR, Nested PCR, Alu-PCR, Hot-start, In situ PCR, Long-PCR, PCR-ELISA, Arbitrarily primed PCR, Ligase Chain Reaction. Proteins and Amino acids, Qualitative and quantitative techniques: Protein stability, denaturation; amino acid sequence analysis	12
Unit V	Hybridization technique, DNA sequencing and Radiation in diagnostics	Southern, Northern, in-situ (including FISH), microarrays – types and applications; Protein extraction and analysis (including PAGE and its variations); Western Blot, Automated DNA sequencing, Advances in DNA sequencing- New Generation sequencing Methods, Pyrosequencing, · Microarrays, basic principles of X-Rays in diagnostics, MRI, CT-scan, radio isotopes in disease and diagnostics.	12
Unit VI	Molecular Oncology	Detection of recognized genetic aberrations in clinical samples from cancer patients; types of cancer-causing alterations revealed by next-generation sequencing of clinical isolates; predictive biomarkers for personalized onco-therapy of human diseases such as chronic myeloid leukemia, colon, and melanoma as well as matching targeted therapies with patients.	05

METHODOLOGY

The course would be taught through lectures and tutorials.

BOOKS RECOMMENDED:

1. Campbell, M.A and Heyer L.J., Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition, CSHL Press, Pearson/Benzamin Cummings San Francisco, USA, 2007.
2. Andrew Read and Dian Donnai, New Clinical Genetics, Scion Publishing Ltd, Oxfordshire, UK, 2007.
3. James W Goding, Monoclonal antibodies: Principles and Practice, 3rd Edition, Academic Press, 1996.
4. George Patrinos and Wilhelm Ansorage, Molecular Diagnostics, 1st Edition, Academic Press, 2005.
5. Lela Buchingham and Maribeth L Flawsm, Molecular Diagnostics: Fundamentals, Methods and Clinical Applications, 1st Edition, F A Davis Company, Philadelphia, USA, 2007.
6. Medical Microbiology, Edited by Greenwood, D, Slack, R and Peutherer, J, ELST Publishers.
7. Parasitology, Chatterjee K.D, Chatterjee Medical Publishers.
8. Bailey & Scott's Diagnostic Microbiology, Betty A. Forbes , Daniel F. Sahm, Alice S. Weissfeld , Ernest A. Trevino, Published by C.V. Mosby
9. Jawetz, Melnick, & Adelberg's Medical Microbiology, Geo F. Brooks, Stephen A. Morse, Janet S. Butel.
10. Fundamentals of Molecular Diagnostics. David E. Bruns, Edward R. Ashwood, Carl A. Burtis. Saunders Group.
11. Henry's Clinical Diagnosis And Management By Laboratory Methods Mcpherson

PRACTICALS IN MOLECULAR DIAGNOSTICS (4 Hrs. per Week)

1. Isolation of genomic DNA from peripheral blood.
2. Agarose gel electrophoresis
3. Determinations of DNA Quality & Concentration by spectrophotometry
4. Polymerase chain reaction (PCR)
5. RFLP/RAPD
6. Automated DNA Sequencing/Nextgen Sequencing
7. SDS-PAGE and Western blotting
8. RNA isolation
9. cDNA Synthesis
10. Molecular diagnosis of Human Immunodeficiency virus (HIV) by Western Blotting

BIOINFORMATICS (MBTT 303)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT 303	Core	Bioinformatics	4	0	4	60	4+2=**6**

Objective:

The objective of the course is to enlighten the student with basic concepts and technique in Bioinformatics and its use in the field of Medical and health care.

Outcome:

- Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics.
- Existing software effectively to extract information from large databases and to use this information in computer modeling.
- An understanding of the intersection of life and information sciences, the core of shared concepts, language and skills the ability to speak the language of structure-function relationships, information theory, gene expression, and database queries.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Biology in the computer age: An Introduction to Bioinformatics	How Is Computing Changing Biology? Isn't Bioinformatics Just About Building Databases? What Does Informatics Mean to Biologists?? How Do I Understand Sequence Alignment Data? What Challenges Does Biology Offer Computer Scientists? What Skills Should a Bioinformatician Have? Why Should Biologists Use Computers? How Can I Configure a PC to Do Bioinformatics Research? What Information and Software Are Available? Can I Learn a Programming Language Without Classes? How Can I Use Web Information How Do I Understand Sequence Alignment Data? How Do I Write a Program to Align Two Biological Sequences? How Do I Predict Protein Structure from Sequence? What Questions Can Bioinformatics Answer?	10
Unit II	Computational approaches to biological questions.	Introduction, Computational Methods in Bioinformatics What Biologists Model, Accessing 3D Molecules through a 1D Representation, Abstractions for Modeling Protein Structure. Mathematical Modeling of Biochemical Systems. Why Biologists Model	10
Unit III	Biological research on the web	Introduction, Using Search Engines, Boolean Searching, Search Engine Algorithms, Finding Scientific Articles, Using PubMed Effectively, The Public Biological Databases, Data Annotation and Data Formats, 3D Molecular Structure Data, DNA, RNA, and Protein Sequence Data, Genomic Data, Biochemical Pathway Data	10

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit IV	Sequence analysis, pairwise alignment, and database searching	Introduction, Genefinders and Feature Detection in DNA, Predicting Gene Locations, Feature Detection, Pairwise Sequence Comparison, Scoring Matrices, Gap Penalties, Global Alignment, Local Alignment, Tools for local alignment, Sequence Queries against Biological Databases, Local Alignment-Based Searching Using BLAST, The BLAST algorithm	10
Unit V	Multiple sequence alignments, trees and profiles	Introduction, Taxonomy and Evolution, Concept of molecular evolution, Terms: Orthologs, paralogs and xenologs. Multiple sequence alignment: MSA by Clustal-W, Application of MSA Phylogenetic inferences, Phylogenetic trees based on neighbor joining, Software for phylogenetic analysis, Profiles and motifs:General concepts FASTA	10
Unit VI	Tools for genomics and proteomics	Introduction, From Sequencing Genes to Sequencing Genomes,Analysis of Raw Sequence Data: Basecalling Sequencing an Entire Genome, The shotgun approach, The clone contig approach, NCBI Genome Resources, TIGR Genome Resources, EnsEMBL, Other Sequencing Centers, Annotating and Analyzing Whole Genome Sequences, Genome Annotation Functional Genomics: New Data Analysis Challenges, Sequence-Based Approaches for Analyzing Gene Expression Proteomics, Tools for Proteomics Analysis	10

METHODOLOGY

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

Books Recommended:

Developing Bioinformatics computer skills – Gibas C and Jambeck P
Introduction to bioinformatics – T.K. Attwood and Parry-Smith D.J.
Introduction to Bioinformatics: Lesk, A.M. Oxford University press.
Developing Bioinformatics Computer Skill: Cynthia Gibbs and Per Jambeck. O'Reilly & Associates.

PRACTICAL IN BIOINFORMATICS (4 hrs per week)

LIST OF EXPERIMENTS

1. Introduction to SPDBV (deep view).
2. Basic exercise in protein structure visualization.
3. Basic exercise in protein structure visualization coloring.
4. To study the PubMed using internet.
5. To study the NCBI website using internet
6. BLAST
7. FASTA

RESEARCH METHODLOGY, INTELLECTUAL PROPERTY RIGHTS, BIOETHICS & BIOSAFETY (MBTT 304)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT 304	Core	Research Methodology, Intellectual Property Rights, Bioethics & Biosafety	4	0	0	60	4+0=**4**

Objective:

To provide fundamental theoretical knowledge to the students about patent, copyrights & IPR protection acts.

To provide knowledge in Bioethics and aware them the legal, safety and public policy issues raised due to the progress in Biotechnology.

Outcome: On completion of this course, students should be able to:

- Understand the rationale for and against IPR and especially patents;
- Understand why India has adopted National IPR Policy and be familiar with broad outline of patent regulations;
- Understand different types of intellectual property rights in general and protection of products derived from biotechnology research and issues related to application and obtaining patents;
- Gain knowledge of biosafety and risk assessment of products derived from recombinant DNA research environment release of genetically modified organisms, national and international regulations;
- Understand ethical aspects related to biological, biomedical, health care and biotechnology research.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction	Definition- Objectives- Types- Significance of Research- Steps in research process- Criteria for good research. Defining and formulating a research problem- Literature survey- Development of working hypothesis.	10
Unit II	Intellectual Property Rights	Introduction to IPR, IPR in India, IPR in abroad, Types of IPR- Patent, Copyright, Trademark, Design & Trade Secret Biotechnology & IPR- Commercial potential of biotechnology inventions; Patenting Biotechnological Inventions- Objective, Concept of novelty, Concept of inventive step, Microorganism, Moral issues in patenting biotechnological inventions.	10
Unit III	IPR : Protection	Plant Varieties Protections- Objective, Justification, International position, Plant Variety Protection in India. Protection of geographical indication- Objective, Justification, International position, Multilateral Treaties, National level, Indian positions Protection of traditional knowledge- Objective, Concept of traditional knowledge, Bioprospecting & Biopiracy, Protectability.	10
Unit IV	Bioethics	Bioethics- History & Introduction; Social, Legal & Ethical Issues in biotechnology, ethical concerns of biotechnology research, Bioethics Committees	10

Sr. No.	Topic	Detail of syllabus	Hrs.
		Animal ethics- Norms in India-Licensing of animal house- Ethical clearance norms for conducting studies on human subjects, IAEC	
Unit V	Bio-safety	Introduction a& development of Bio-safety; Practices & Principles; General lab equipments; Definitions & Bio-safety levels, 1, 2, 3, 4,; Biological safety cabinets, centrifuge; Shipment of biological specimens; Biological waste management; Decontaminations, Bio-safety manuals; Medical surveillance, Emergency response.	20

METHODOLOGY

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

Books Recommended:

1. T. M. Murray & M. J. Mehlman, Encyclopedia of ethical, legal and policy issues in biotechnology, John Wiley & sons 2000.
2. Ethical Issues in Biotechnology by Richard Sherlock & John D. Morrey, Rowman & Littlefield Publishers
3. Singh K. Intellectual Property Rights on Biotechnology, BCIL, and Newdelhi-1993.
4. Shaleesha A. Stanley, Bioethics, Wisdom educational service-2010.
5. Ganguli, P. (2001). Intellectual Property Rights: Unleashing the Knowledge Economy. New Delhi: Tata McGraw-Hill Pub.
6. Recombinant DNA Safety Guidelines, 1990 Department of Biotechnology, Ministry of Science and Technology, Govt. of India. Retrieved from http://www.envfor.nic.in/divisions/csurv/geac/annex-5.pdf.
7. Office of the Controller General of Patents, Design & Trademarks; Department of Industrial Policy & Promotion; Ministry of Commerce & Industry; Government of India. http://www.ipindia.nic.in/
8. National IPR Policy, Department of Industrial Policy & Promotion, Ministry of Commerce, GoI
9. Complete Reference to Intellectual Property Rights Laws. (2007). Snow White Publication Oct.
10. Wolt, J. D., Keese, P., Raybould, A., Fitzpatrick, J. W., Burachik, M., Gray, A., Wu, F. (2009). Problem Formulation in the Environmental Risk Assessment for Genetically Modified Plants. Transgenic Research, 19(3), 425-436. doi:10.1007/s11248-009-9321-9
11. Craig, W., Tepfer, M., Degrassi, G., & Ripandelli, D. (2008). An Overview of General Features of Risk Assessments of Genetically Modified Crops. Euphytica, 164(3), 853-880. doi:10.1007/s10681-007-9643-8

SEMESTER IV

FOOD & INDUSTRIAL BIOTECHNOLOGY (MBTT 401)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT 401	Core	Food & Industrial Biotechnology	4	0	2	60	4+2=**6**

Objective: The course will provide a broad grounding in concepts techniques & issues involved in food products & their processing and also the objective of the course is to familiarize students with fermentation of antibiotic, alcohol and alcoholic beverages, fermentation of organic acid and amino acid.

Outcome: On completion of this course students will be able to understand - principle's involving food preservation. Via fermentation processes. Understand the principle's that make a food product safe for consumption. Understand the principles & current practices of processing techniques & the effect of processing parameter on product quality. Also after completion of this course student will be able to understand production of antibiotics, alcohol, organic acid and amino acid.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Bioreactor Technology	Bioreactor / Fermenter: Types & operation of Bioreactors, Introduction to Batch, Fed-batch and Continuous culture systems, s, Limitations of bioreactors, Stages of fermentation processes, Media design for fermentation processes, Solid substrate fermentation, advantages & disadvantages of solid substrate & liquid fermentations	12
Unit II	Downstream Processing	Importance of downstream processing and methods of downstream processing , centrifugation, filtration, precipitation, dialysis,, Chromatographic techniques- gel filtration, ion exchange chromatography and affinity chromatography, electrophoresis, capillary electrophoresis, Quality assurance techniques and its importance in marketing.	14
Unit III	Immobilized systems	Methods of enzyme immobilization: Adsorption, entrapment, Direct covalent linking, cross-linking. 3. Kinetics of immobilized enzymes, effect of solute partition & diffusion on the kinetics of immobilized enzymes, Enzyme electro-catalysis (Biosensors)	10
Unit IV	Food Biotechnology	Introduction, Elementary idea of canning and packing, Sterilization and pasteurization of food products, Probiotic, prebiotic and functional foods: Concepts and applications in food; Functional foods (oat products, milk and dairy products, sea food products); Biopreservatives; Production of alcoholic beverages and post fermentation processing of beer, wine, whiskey.	14
Unit V	Biotechnology industry and medicine	Production of important primary metabolites (Citric acid, Lactic acid), Production of Enzymes (proteases, amylases, lipases), Antibiotics, therapeutic applications, developing recombinant proteins with therapeutic & diagnostics applications, vaccine development- insulin, Singe Cell Protein.	10

METHODOLOGY

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

BOOKS RECOMMENDED:

1. Introduction to food processing- Jelen P.
2. Preservation of fruits and vegetables – Girdhari lal, G. S. Siddappa, G. L. Tondon
3. A handbook on PHM of fruits and vegetables – P. Jacob John
4. Technology of Cereal – Kent N. L.
5. Food packaging – Robert son G.L.
6. Principles of fermentation technology – 2nd edition peter F. Standbury, Allan Whitaker
7. Microbial technology – Vol-1 & 2 – H. J. Peppler and D. Perlman
8. A.H. Patel " Industrial Microbiology" Macmillan.
9. Presscott, S.C. and Cecil G. Dunn, "Industrial Microbiology", Agrobios (India), 2005.
10. Cruger,Wulf and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing, 2000.
11. C.F.A Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999.
12. K.G.Ramawat & Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand publications.
13. Industrial microbiology: An introduction. Mike J. Waites, Neil Morgan, John Rackey, Gary Higton, John S. Rockey.
14. Bioreactor recovery in bioprocess technology. Biotol Series
15. Principles of fermentation technology. P. F. Stanbury et al.
16. Gautam, N. C., Food Biotechnology in Comprehensive Biotechnology, Vol. 6., Shree i. publishers, New Delhi, 2007.
17. Gutierrez – Lopez, G. F. et. al., Food Science and Food Biotechnology. CRC Publishers, Washington, 2003

PRACTICAL IN PHARMACEUTICAL BIOTECHNOLOGY (4 hrs per week)

LIST OF EXPERIMENTS

1. Estimation of casein protein in milk.
2. Isolation of proteolytic enzymes from soil sample
3. Production of baker's yeast and inoculums preparation
4. Production of lactic acid, citric acid & ethanol
5. Preparation of standard plot of protein
6. Preparation of standard plot of sugar
7. Growth of microorganism and yield calculation

NANOBIOTECHNOLOGY (MBTT 402)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT 402	Major	Nanobiotechnology	4	0	4	60	4+2=**6**

Objective:

To sensitize the students from a varied background about the biotechnological basics & culminates into modern day application of nanoscience in biotechnology.

Outcome:

After the end of this course, the student will able to develop a fundamental understanding of basic concept of Nanobiotechnology and its uses in the field of life sciences & medical.

Student will be able to evaluate applications of various concepts & techniques of Nanobiotechnology to facilitate batter biotechnological advancement & innovations which can drive medicines.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Nanobiotechnology: an overview	Nanobiotechnology & Nanomaterials: Background, Preparation & characterization, Wet chemical processes, Mechanical processes, Methods to synthesis Nanoparticles: Bacteria, Yeast & Fungi in Nanoparticles synthesis	10
Unit II	Biomaterials science	Third generation biomaterials (2000 onwards), Types of biomaterials : Cellulose, Polyesters, Overview about biopolymers Chemistry of biodegradable solid polymers, Mode of erosion, Molecular structure effects on hydrolytic breakdown, Factors influencing Hydrolysis rate, Degradable materials for biological recognition, Biomaterials in tissue engineering, Micro/nanotechnology and biomaterials, Nanofabrication and nanotechnology.	10
Unit III	Fabrication and characterization of nanostructures	Introduction, Nanoparticle synthesis techniques: Methodology and classification, Solid-state synthesis of Nanoparticles, Vapour-phase systhesis of Nanoparticles, Solution processing of nanoparticels, Sol-gel processing, Solution precipitation, Water-oil microemulsion (reverse micelle) method, Characterization of nanostructure, Thin film deposition, Nanospheres, Atomic force microscope, High-resolution imaging of biological and nanostrucutred material, Fourier transform infrared spectroscopy, Importance of infrared spectroscopy, Differential scanning calorimetry.	10
Unit IV	Nanotechnology in biomedical applications	Introduction, Application of micro-and nano-electromechanical devices to drug delivery converging technology using MEMS and NEMS biological sciences, Implantable Devices, Reservoirs for controlled release, Stents, Enteral (Mucosal) Delivery, Photodynamic therapy in targeted drug Administration, Combination therapy, Targeting specific cellular function-sensitive linkages, Enhancement of PDT by the PS, Conjugation to carrier molecules, Synthetic peptides, Polymers, Composite	10

		targeting, Advances in the manufacturing, Types, and applications of biosensors, Biosensor types, Biosensor market-manufacturers, potential and drivers, Biomedical Sensors and biosensors, Sensors in modern medicine, Interaction of the sensor with its body tissue, Sensing modalities, Quantum Dot technology in cancer treatment, Quantum dots in early diagnosis of cancer, Advantages of inorganic quantum dots over. Nanotechnology: A focus on Advanced drug delivery system Nanoparticles as drug carriers, Evading phagocytosis, Nanotechnology and opportunities for agriculture and food systems, Genetically modified organism, Use in gene expression and histopathology, Pathogen detection.	
Unit V	Nanomedicine and novel drug delivery systems	Introduction, Drug delivery systems, Microcapsules and microspheres, The enhanced permeability and retention effect, PEG-protein conjugates, Polymer therapeutics, Polymer-drug conjugates, Polymeric micelles, Liposomes, Nanomaterials for drug delivery, Across the blood brains barrier, Nanoparticles target cancer cells *in vivo,* Dendrimers as Nanoparticulate drug carriers, Dendrimers as drug carriers, Encapsulation of drugs in Dendrimers, Conjugation of drug in Dendrimers, Cell-penetrating peptides in combination with Nanoparticles for novel drug delivery, Bioresponsive hydrogels, Bioresponsive hydrogels for drug delivery, Application of materials in medicine: Cardiovascular medical devices, Peripheral stents and stent grafts, Orthopaedic applications, Orthopaedic biomaterials, Orthopaedic biomaterials: Clinical Concerns, Orthopaedic biomaterials: Wear, Orthopaedic biomaterials Corrosion	10
Unit VI	Health and environmental impacts of nanotechnology	Introduction, Engineered Nanomaterials of relevance to human health, Engineered Nanomaterials in the body, Routes of entry : Gastrointestinal tract , Skin, Lungs, Toxic mechanisms, Environmental implications of Nanoparticles, Toxicological health effects caused by Nanoparticles, Pulmonary inflammation induced by ultrafine particles, Nanotechnology and ethical responsibility	10

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

Reference Book:

1. Nanobiotechnology, Subbiah Balaji
2. Nanotechnology: A Fundamental Approach, Dr. U. Kumar
3. Nanobiotechnology: Concepts, applications and perspectives, Chtistolf M. Niemeyer, Chand A. Mirkin, Wiley Publishers
4. Nanotechnology: A Gentle Introduction to next big idea, mark Ratner and Daniel Ratner
5. Nanotechnology: willian Illsey Atkinson, JAICO publishing house.
6. Bio Molecular Computation for Bio nanotechnology, Liu and Shimohara, Artech house- London.

PRACTICALS IN NANOBIOTECHNOLOGY (4 Hrs. per Week)

1. Synthesis of Nanoparticles from fungus / bacteria / plant (Demonstration)
2. Characterization of Nanoparticles through UV spectrophotometer

CLINICAL RESEARCH (MBTT 403A)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT 403A	Elective	Clinical Research	4	0	4	60	4+2=**6**

Objective:

The objective of the course is to impart the knowledge of clinical research which can be used for drug discovery and development.

Outcome:

At the end of the course the student will be capable to design, execute & inspects data of clinical research & trials.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to Clinical Research	Introduction to Clinical Research, Terminologies and definition in Clinical Research, Origin and History of Clinical Research, Difference between Clinical Research and Clinical Practice, Types of Clinical Research, Phases of clinical research, Clinical Trials in India –The National Perspective, Post marketing surveillance Pharmaceutical Industry – Global and Indian Perspective	6
Unit II	Pharmacology & Drug development	Introduction to Pharmacology, Concept of Essential Drugs, Routes of Drug Administration, Introduction to Drug Discovery and Development-Hurdles in Drug Development, Sources of Drugs Approaches to Drug Discovery, Pharmacovigilance, Factors affecting drug response	8
Unit III	Preclinical Studies	Guidelines For Care And Use Of Laboratory Animals, Introduction To Preclinical Pharmacology, Introductory Talk on Animal studies : present status, Pre – Clinical Toxicity, Lab Animals in Pharmacology, Preclinical drug testing, Calculation of first human dose, Investigational New Drug Application, Clinical trials New Drug Application and Approval	8
Unit IV	Guidelines and Regulations in Clinical Research	International Conference on Harmonization (ICH)-Brief history of ICH, Structure of ICH, ICH Harmonization ProcessGood Clinical Practice: ICH guidelines, Indian GCP guidelines (CDCSO guidelines),.ICMR Guidelines - Ethical Guidelines for Biomedical Research on Human Subjects, Schedule Y, Institutional Review Board / Independent Ethics Committee Stakeholders in clinical research (Investigators, sponsors, CRO,SMO), Clinical Trial Protocol and Protocol Amendment(S), Investigator's Brochure, Essential Documents for the conduct of a Clinical Trial, Introduction of Clinical Trial Regulation, European Medicine Agency, Food and Drug Administration (US FDA), Drug and cosmetic act, GMP	10
Unit V	Clinical Development	Research question, Case report form, Informed Consent, Preparing data collection forms, Protocol writing, New drug discovery process- purpose, main steps involved in new drug discovery process, timelines of each steps, advantages and purposes of each	10

		steps, ethics in clinical research, unethical trials, Phase-I, II, III, IV trials. -Introduction and designing, -Principles of sampling, -Inclusion and exclusion criteria, -Methods of allocation and randomization, -Informed consent process in brief -Termination of trial, -Safety monitoring in clinical trials	
UNIT VI	Clinical Regulatory requirements	Audit/ Inspection, Fraud and Misconduct in Clinical Trials Conflict of interest in Clinical research, Vaccine trails in children Bioavailability and Bioequivalence, How to fill an ADR reporting form and methods for causality assessment, Risk to benefit ratio bias and confounding factor, Uses of placebo	10
Unit VII	Marketing	Promotional inputs & development of Medico-Marketing, Prescribing Information (PI) Or Package Insert (PI), Publication issues	4
Unit VIII	Data management	Clinical data management (CDM): Introduction, CRF Design, Electronic Data Capture, Data Validation, Discrepancy Management, Clinical Data Coding, SAE Reconciliation, Archiving clinical data	4

METHODOLOGY

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

BOOKS RECOMMENDED

1. Basic and Clinical Pharmacology, Prentice hall, International, Katzung, B.G.
2. Remington Pharmaceutical Sciences, Lippincott, Williams and Wilkins
3. Drug interaction, Basic Bussiness Publ, Bombay, J.K. Mehra
4. Central Drugs Standard Control Organization. Good Clinical Practices-Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health; 2001.
5. International Conference on Harmonization of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonized Tripartite Guideline. Guideline for Good Clinical Practice.E6; May 1996
6. Ethical Guidelines for Biomedical Research on Human Subjects 2000. Indian Council of Medical Research, New Delhi

PRACTICAL IN CLINICAL RESEARCH (4 hrs per week)

LIST OF EXPERIMENTS

1. Introduction to animal house
2. Handling of lab animals
3. Various routes of drug administration (lab animals)
4. Assessment of adverse drug reaction
5. Documentation for clinical research

REGENERATIVE MEDICINE (MBTT 403B)

Course Code	Category	Course Name	L	T	P	Total Hours	Credits (T+P)
MBTT 403B	Elective	Regenerative Medicine	4	0	4	60	4+2=**6**

Objective:

The course deals with the understanding of *in vitro* regeneration of organs, therapeutics and application of stem cells in medicine.

Outcome: After completing the course, the student should be able to

- describe different types of stem cells and their specific characteristics
- describe methods of applications to replace damaged or destroyed cells including tissue engineering
- account for regenerative medicine applications to human diseases
- account for and evaluate methods and techniques within the research field, their practical execution and application

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Tissues	Introduction: Basic definition, Structural and organization of tissues: Epithelial, connective, vascularity and angiogenesis. Current scope of development and use in therapeutic and in-vitro testing.	14
Unit II	Cell Culture	Cell culture: Different cell types, progenitor cells and cell differentiations, different kinds of matrix, cell-cell interaction. Aspect of cells in culture, Bioreactors.	15
Unit III	*In vitro* organogenesis	Scaffolds & tissue engineering – Basic properties. In vitro organogenesis -Engineering tissues for replacing bone, skin and liver	15
Unit IV	Stem Cells and Wound healing	Stems cells: introduction, types (Adult & embryonic), Properties, sources; haematopoiesis, Es cells, Blood from Es cells. Basic wound healing. Cell migration, transport limits on 3D cultures. Application of FACs, flow cytometer, SNPs analysis	16

METHODOLOGY

The course would be taught through lectures, demonstrations and laboratory visit.

Books Recommended:

1. Principles of tissue engineering, Robert. P.Lanza, Robert Langer & William L. Chick, Academic press-2008
2. Tissue Engineering, B. Palsson, J.A. Hubbell, R.Plonsey & J.D. Bronzino, CRC- Taylor & Francis-2004
3. Tissue Engineering, Bernhard Palsson, Sangeeta Bhatia , , Pearson Prentice Hall, 2003
4. Culture of Cells for Tissue Engineering, Academic press,1997 3. Gordana Vunjak-Novakovic, R. Ian Freshney

DISSERTATION (MBTD 404)

Course Code	Course Name	Credit
MBTD 404	Dissertation	04