PRAVARA INSTITUTE OF MEDICAL SCIENCES

(DEEMED TO BE UNIVERSITY)

Loni 413736, District- Ahmednagar, Maharashtra, India

Regulations Governing the Bachelor Degree Programmes of Pravara Institute of Medical Sciences –DU under Semester, Choice Based Credit System and Cumulative Grade Point Average System

Preamble:

PIMS-DU was established in 2003. Since its inception, as per the provisions of the UGC Regulations governing Deemed Universities, it has notified Regulations for academic administrations. Besides, based on the needs, it has formulated and enacted its own Regulations. Now it proposes to implement its own Regulations governing the Bachelor's Degree Programmes under Semester, CBCS and CGPA scheme.

UGC has mandated for the implementation of CBCS & CGPA for UG programmes. This initiative is to offer number of course options of study - core, compulsory, elective, specialization (Discipline Specific Elective -DSE), interdisciplinary courses and generic open electives and skill-oriented programmes. The guidelines call for Credit System, Choice Based System, Cumulative Grade Point Average Systems (CBCS-CGPA). Now PIMS-DU has drafted Regulation governing B. Sc in Biotechnology (Medical) – 3 years programme under semester / CBCS / CGPA system and further moving on to M. Sc in Medical Biotechnology leading to

integrated 5 years M. Sc or may have the provision to exit after 3 years of study to get B. Sc in Medical Biotechnology (3 year leading to B. Sc Medical Biotechnology) & also provide for eligible UG student of other university for a lateral entry to M. Sc leading to M. Sc Medical Biotechnology from Centre for Biotechnology.

1. Title and Commencement:

1.1. These Regulations shall be called "PIMS-DU Regulations governing the Bachelor of Science in Biotechnology (Medical) & (3 year UG program) and further leading to M. Sc Medical Biotechnology of 2 year (a total of 5 years for Integrated M. Sc Medical Biotechnology from Centre for Biotechnology.)

1.2. These Regulations shall come in to effect from the date of its assent by the Academic Council, Board of Management & the Vice Chancellor of the University & notification by the University.

2. Definitions:

2.1. **Academic Council, Board of Studies and Board of Management** means Academic Council, Board of Studies and Board of Management of PIMS-DU.

2.2. **Academic Year** means a time frame of a Programme comprising two semesters.

2.3. **Bachelor's Degree** means, a 3 years undergraduate "Bachelors Degree programme" offered by the faculty of Allied Health Sciences of PIMS-DU or offered / awarded by any recognition University.

2.4. **BOE** means Board of Examiners of the University or Board of Examiners in a particular subject, or group of subjects.

2.5. **BOS** means Board of Studies in a particular subject, or group of subjects.

2.6. **BOAE** means Board of Appointment of Examiners.

2.7. **CBT** means Centre for Biotechnology a constitute College of PIMS-DU.

2.8. **Committee** means Committee of BOM of PIMS-DU / or of AC of PIMS-DU.

2.9. **Course** means a logical and defined part of the Programme, offered in the form of Theory paper, Practical, Field work, Project work or any other form specified from time to time usually of 3 to 6 credits.

2.10. **Department** means, the Department of a concerned subject in the College / University.

2.11. **Fee** means the fee prescribed by PIMS-DU.

2.12. **Internal Assessment** (I.A.) means the evaluation conducted for a particular course during the semester by the class teacher for the students for a specified marking system.

2.13. **Semester** means an academic time frame of the Programme, comprising 15 weeks / 90 continuous teaching days in a given academic year.

2.14. **Semester End Examination** (SEE) means the examination conducted after the completion of 90 teaching days, offered course-wise for a specified duration.

2.15. **Student** means, a Student who has enrolled himself / herself for a 3 years Bachelor Degree Programme of the University.

2.16. **University** means PIMS-DU- Pravara Institute of Medical Sciences – Deemed to be University.

2.17. Definitions of Credit, Grade point, Credit Point, SGPA & CGPA

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 is 10% of the marks obtained in T/P course out of max 100. It is not on the basis of normalization in a given range for a GP & letter grade.
Credit point is Grade point x 100 divided by maximum marks for the said course x number of credits of Course (T/P/FW) = (Grade point for a course will be multiplied by number of credits for the course)
Example - 1. If maximum marks is 100 and marks scored is 60 and credits are 4, then GP: 6 & CP= 6 x 100/100= 6:0 x 4 =24 Credit points.

Example - 2. If the marks is 50 and marks scored is 30, and credit are 2, then GP: 3; GPs=3 x 100 / 50 = 6.0. Then CP= 6.0 x 2= 12.
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.

3. Eligibility Conditions for admission:

3.1 A student who has successfully completed 2 years Pre University (+2) Programme from any recognised board or any equivalent authority, with the minimum of aggregate marks prescribed, having studied the specified subjects is eligible for admission to Bachelor's Programme, subject to the following:

Must have studied + 2 with a minimum of 40% with any one of the 2 subjects in Life Sciences only with subject like Physics / Biology /Chemistry / Mathematics.

4. **Programme offered Intake & their content:**

PIMS-DU shall offer B. Sc programme in Medical Biotechnology of 3 year duration. Then the successful student may continue to further M. Sc Medical Biotechnology for 2 more years. Then it

will be called as integrated M. Sc in Medical Biotechnology. Otherwise, permitted to leave the programme after 3 years and get B. Sc in Medical Biotechnology (Lateral exit). Students with B. Sc Biotechnology and other Life Sciences from other Universities may enter to M. Sc Medical Biotechnology for 2 years (Lateral entry) and obtain M. Sc Medical Biotechnology (Independent). The intake shall be fixed by University from time to time.

Dual Degree Certification Programme: A student while pursuing a Graduation Programme may also concurrently pursue Career Oriented/Certificate/Diploma/Advanced Diploma courses as a value addition.

The University may make the mandatory participation in Credit Audit Courses and or the extracurricular activities of a specified version for the final award of degrees. It can be through an administrative order & marks or performance is not counted for award of class or rank. They are called credit –audit courses may be usually on soft skill or hard skills or talent related or service driven ones.

5. **Preparation of Syllabi by the Board of Studies (BOS):** The BOS in Medical Biotechnology of PIMS-DU shall form the syllabi for B. Sc in Medical Biotechnology & M. Sc in Medical Biotechnology (Integrated or Independent) on to the structural format of these Regulations (Course No., Title of the course, credits, Content, Delivery mode, evaluation & award of GP / CP / SGPA /CGPA).

   The BOS shall revise (major) their syllabi for B.Sc in 5 years & once in 3 years for PG programme. Any addition or deletion of the unit / topic in a given course without altering the title, credit and it is called minor revision. It may be done once in a year. If need be major content is also permissible.

   General Instruction for all BOS:

   5.1. The Board of Studies shall consider the aspects of course matrix-number of hours of instructions. Type of instruction, allocation of marks, overall hours of study / Course and need for continuity. They shall frame the syllabi for each course comprising of at least 4 units.

5.2. The Board of Studies shall clearly indicate the teaching - learning transactions, and the expected outcome of the study of the specific course.

The Board of Studies shall prepare Model Question Papers (based on accepted model for the Programme) as per the course structure and matrix.

5.3. The Board of Studies shall review the transaction of syllabi viz-a-viz the teaching-learning strategies and performance of students. It shall review the results and submit an evaluative analysis to the University for necessary action from time to time.

5.4. The University shall constitute regular or adhoc Board of Studies in the concerned or relevant subjects.

6. Medium of instruction, Types of Instruction, Programme structure and Transactions.

6.1. The medium of instruction for all the courses shall be English.

6.2. A student must opt to write the answers in examination in English.

6.3. The structure of the programme indicating the course number, credits, total marks, minimum marks for passing & other details are given in the **Annexure 1- 6**

6.4. The teaching Learning transactions may include the following components as specified by BOS as per Regulations: i) Lecture ii) Tutorials iii) Practicals iv) Demonstrations v) Field Work vi) Industrial Visit vii) Study Tour viii) Projects ix) Seminars x) Assignments and any other specifications.

7. Duration of the Programme and its completion.

7.1. The Duration of the Bachelor's Degree Programme shall be 3 academic years comprising 6 semesters. Each semester shall be of a minimum of 90 teaching days (16 weeks).

7.2. A student may successfully complete the Programme of six semesters, normally within 3 academic years. However, due to shortage of attendance or failure in examinations and becomes a repeater, a student shall complete the Programme successfully within a maximum period of 6 years from the date of admission and registration to first semester.

7.3. A student shall be eligible for improvement of the results within the maximum period of study either of all the semesters or particular semester /semesters.

7.4. Student appearing for examination due to failure or shortage of attendance or improvement shall be examined in the syllabi offered during the regular study of 3 years.

7.5. In case of circumstances leading to discontinuation of studies(for example marriage, maternity, medical, economic or any other justifiable reasons) the candidate may be permitted to complete the Programme from the point where he / she has left within five years from the date of discontinuation, subject to the approval of the Vice Chancellor. However, such students shall study as per the existing syllabi.

7.6. The duration of PG in Medical Biotechnology shall be 2 years / 4 semesters & each semester having 4-8 courses, each of 4 or 2 credits. Usually each semester may have 24 credits & 24 to 32 courses (T:P 1:1 or 1:2 ratio)

8. Attendance

8.1. A student shall attend not less than 75 % of the classes held during a semester for the courses prescribed to be eligible for appearing in semester end examination.

8.2. Classes (Theory, Practicals, Tutorial, Field Work, etc.) conducted during a semester for all the prescribed courses of a given semester of a Programme constitute the basis for calculating the minimum of 75% of attendance requirement.

8.3. A student who does not get satisfactory requirement of attendance of a semester shall repeat that semester as a regular student as and when offered by the University. However he/she shall be eligible to move over to the next semester, subject to other conditions specified. Besides, shortage of attendance to an extent of 10% may be condoned by the Vice Chancellor based on valid reasons and justification (participation in National /State Camps of NCC, NSS or any other activities sponsored by the government or on medical grounds on the basis of certification by a District Surgeon/District Medical officer). However he shall attend special classes organized by the Department for students with shortage of attendance.

8.4. The University shall announce the academic and administrative calendar of events regarding the admission process, fee structure, teaching-learning – evaluation process and other aspects concerned to the semester and Programme.

9. **Examination for Course**.

9.1. The performance of the student of a semester for each course shall be evaluated as under.

9.2. For the theory & practical courses, there shall be two components of examination.

9.2..1. Continuous Internal Assessment for a maximum of 30 % of total marks of a course comprising of two tests (written test / home assignments/ seminars etc.)

9.2..2. Semester End Examinations for each course for a maximum of 70% of total marks. The duration of the theory examination shall be 3 hours.

9.3. For the practical courses, there shall be Semester End Examinations for the entire70%marks allotted to the course as per course structure and matrix. The Practical Examinations shall be for 3 hours.

9.4. The marks sheet / list for Internal Assessment shall be submitted to the office of the Controller of Examination at least one week before the commencement of SEE as per existing rules.

10. **Conduction of Examination and evaluation**.

10.1. The Office of the Controller of Examination shall arrange to conduct the Semester End Examination for subjects.

10.2. The Controller of Examination shall announce the calendar of examination specifying the aspects regarding the registration of candidates, eligibility certification for list of candidates, payment of fees prescribed and tentative schedule of examination.

10.3. The Controller of Examination shall arrange to assign the registration numbers and issue of 'Hall Tickets' through the college to the certified eligible students.

10.4. The Controller of Examination shall announce the detailed 'Time-Table' and arrange to conduct the examination as per the prescribed rules and procedures specified in Examination Manual.

10.5. The University Board of Appointment of Examiners (BoAE), would constitute Board of Examiners (BoE) for each subject.

10.6. The Board of Studies of each subject shall submit the approved list of examiners to the office well in time based on seniority, specialization and other details.

10.7. The Board of Examiners shall arrange to set 3 sets of question papers for each of the assigned courses based on the syllabi. It shall set separate sets of question papers for repeaters / improvement candidates, in case of change in the syllabi. It shall follow the model question paper approved by the Board of Studies.

10.8. There shall be Central Evaluation of the theory answer scripts for subjects. The University may adopt coding or mixing of answer books. There shall be double examination difference of 15% & above will lead to third evaluation. The average of nearest two shall be taken.

The Semester End Practical or Field Work Examination for each course shall be conducted by two examiners: preferably one internal and one external examiner.

10.9. The Office of the Registrar (Evaluation) shall arrange for tabulation of marks awarded and determine the results.

11. Standard of passing.

11.1. A candidate securing a minimum marks of 50% and above in aggregate of Internal Assessment Marks and of Semester End Examination for each of the courses in a semester shall be declared to have passed in the said course.

11.2. There shall be no minimum marks for passing in continuous internal assessment.

A candidate scoring even zero marks or remains absent, for the test is eligible to appear for semester end examination. The marks secured in IA once are final.

11.3. The minimum for passing in Semester End Examination of any course is 50% of the maximum marks, wherever there is Internal Assessment component.

11.4. Candidates failing in any of the courses of a semester are eligible to reappear for the exanimation of said courses of the semester whenever they are offered – odd semester

in odd semester and even semester in even semester. There shall be no supplementary Examination

12. Promotion of next higher semester.

12.1. A student is permitted to move over to next semester irrespective of the result of the preceding semester. That means, there will be a fully Carry over System. It is for the candidate to clear the backlog of failed courses or for courses from which he/she has remained absent within the maximum duration specified for the programme.

12.2. There is no scope for improvement or re-examination for Internal Assessment marks. The Internal Assessment marks scored once shall be carried forward in case of repeaters or candidates seeking improvement for the respective courses.

13. Declaration of Results and Award of Class and Ranks.

13.1. The degree shall be awarded to the candidates who have passed all the courses of the programme of the six semesters.

13.2. A student failing in a semester can claim exemption from the Course(s), if he/she has secured minimum of 50% of maximum marks assigned for that course.

13.3. 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 -7**. The specimen of the marks card is given in the **Annexure – 1-6**.

13.4. Class will be awarded to the successful candidates considering the total marks secured in the courses during I to VI semesters.

13.5. The classification of successful candidates for the award of classes and CGPA, letter grade for the Programme is as follows:

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

The COE / Registrar Evaluation shall arrange to issue the marks cards for all the semesters & for overall passes of all semesters indicating both marks system with class system as well CGPA with letter grade. Only the grades and class shall be used for only the declaration of final /overall results. On other semester examination, it is pass or fail remarks.

13.6. The University shall announce the first five top scorers as Rank holders provided they have secured first class and without any gracing of marks at any stage and passing all the semester examinations at first attempt.

13.7. Students are eligible for gracing of marks per passing in a course, whole examination and award of class.

13.8. Gracing of marks shall be governed by the ordinance issued in this regard.

14. Improvement of Results.

14.1. A student is entitled to improve the performance by rejecting the results of whole semester end examinations of preceding semester (one / two/ three / four / five / six). Course wise rejection of results shall not be permitted. The provision for rejection shall be exercised only once for each semester, during the 3years Programme.

14.2. A student who has successfully passed the entire Programme of six semesters, desires to improve the performance and percentage of marks, is eligible to do so by rejecting

the performance of any of the whole semester end examination of semesters. Course wise rejection and improvement of results shall not be permitted. The candidates shall exercise this option only once.

14.3. A candidate desirous of improvement of results shall do so by submitting a duly filled in application and by paying the prescribed fees as per the Calendar of Examinations announced by the University. The student shall surrender the marks card of the said semester for which he is seeking improvement.

14.4. In case of no improvement in the results of the examination (after reappearance), the Candidate is entitled to retain the original results of the semester.

15. Examinations Grievance Redress & Reforms.

15.1. A student is entitled to seek retotaling of marks scored, obtain photocopy of answer script and revaluation of the answer script, subject to the submission of application and payment of the prescribed fee as per the time schedule announced.

15.2. There shall be a Committee appointed by the University to deal with grievances related to examination matter.

15.3. There shall be a Committee appointed by the University to deal with malpractice cases and award of penalties as per adopted standard procedures and scale of penalties.

15.4. The University BOE and BOS shall review the performance of the students after the completion of each semester and make suitable recommendations to the University.

15.5. There shall be an approved Examination Manual.

15.6. The Vice-Chancellor and the authorities may initiate any action as they deem it fit to implement the provision of these Regulations in order to maintain academic standards.

16. **Removal of Difficulties**.

16.1. If any difficulty arises while implementing the provision of these Regulations, the Vice-Chancellor shall take appropriate decision to remove the difficulty and inform the authorities of the University in their next meeting on the action taken.

17. **Repeal and Savings Clause**.

17.1. The earlier Regulations governing the Bachelor's Degree Programme shall stand repealed from the date of implementation of this new Regulations.

17.2. Not with standing anything contained in these Regulations, any order or instructions which are in vogue shall continue to be effective to the extent of their consistency with the provisions of these Regulations.

17.3. The University may issue such orders, instructions, procedures, formats and any other circulars, office memorandum as it may deem it fit to implement the provisions of these Regulations.

Approved by the Academic Council vide Resolution No. AC/2019/20/D20-2
dated: 20.3.2019

Incharge Director
Center for Biotechnology
PIMS-DU

Dean
Allied Health Sciences
PIMS-DU

Registrar
PIMS-DU

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UG Program in B. Sc in Medical Biotechnology & Pattern of Marks statement
[6 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 S	Credits	Internal Assessment marks		Semester End Exam.			Total Marks			GP	CP
					Max.	Secured	Max.	Min. for pass	Marks secured	Max.	Min. for pass	Secured		
	UMBTT 101	Theory	C	4	30		70	35		100	50			
	UMBTT 102	Theory	C	4	30		70	35		100	50			
	UMBTT 103	Theory	C	4	30		70	35		100	50			
	UMBTT 104	Theory	C	4	30		70	35		100	50			
	UMBTP105	Practical Course (Based on UMBTT 101 & UMBTT 102)	C	4	30		70	35		100	50			
Grand Total	UMBTP106	Practical Course (Based on UMBTT 103 & UMBTT 104)	C	4	30		70	35		100	50			
	4T+2P	4T + 2P		24	180		420			600				

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

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

Annexure - 2

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UG Program in B. Sc in Medical Biotechnology & Pattern of Marks statement
[6 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 S	Credits	Internal Assessment marks		Semester End Exam.			Total Marks			GP	CP
					Max.	Secured	Max.	Min. for pass	Marks secured	Max.	Min. for pass	Secured		
	UMBTT 201	Theory	C	4	30		70	35		100	50			
	UMBTT 202	Theory	C	4	30		70	35		100	50			
	UMBTT 203	Theory	C	4	30		70	35		100	50			
	UMBTT 204	Theory	C	4	30		70	35		100	50			
	UMBTP205	Practical Course (Based on UMBTT 201 & UMBTT 202)	C	4	30		70	35		100	50			
Grand Total	UMBTP 206	Practical Course (Based on UMBTT 203 & UMBTT 204)	C	4	30		70	35		100	50			
	4T+2P	4T + 2P		24	180		420			600				

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

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

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

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UG Program in B. Sc in Medical Biotechnology & Pattern of Marks statement
[6 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 S	Credits	Internal Assessment marks		Semester End Exam.			Total Marks			GP	CP
					Max.	Secured	Max.	Min. for pass	Marks secured	Max.	Min. for pass	Secured		
	UMBTT 301	Theory	C	4	30		70	35		100	50			
	UMBTT 302	Theory	C	4	30		70	35		100	50			
	UMBTT 303	Theory	C	4	30		70	35		100	50			
	UMBTT 304	Theory	C	4	30		70	35		100	50			
	UMBTP 305	Practical Course (Based on UMBTT 301 & UMBTT 302)	C	4	30		70	35		100	50			
Grand Total	UMBTP 306	Practical Course (Based on UMBTT 303 & UMBTT 304)	C	4	30		70	35		100	50			
	4T+2P	4T + 2P		24	180		420			600				

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

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

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

Annexure - 4

PRAVARA INSTITUTE OF MEDICAL SCIENCES

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UG Program in B. Sc in Medical Biotechnology & Pattern of Marks statement
[6 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 S	Credits	Internal Assessment marks		Semester End Exam.			Total Marks			GP	CP
					Max.	Secured	Max.	Min. for pass	Marks secured	Max.	Min. for pass	Secured		
	UMBTT 401	Theory	C	4	30		70	35		100	50			
	UMBTT 402	Theory	C	4	30		70	35		100	50			
	UMBTT 403	Theory	C	4	30		70	35		100	50			
	UMBTT 404	Theory	C	4	30		70	35		100	50			
	UMBTP 405	Practical Course (Based on UMBTT 401 & UMBTT 402)	C	4	30		70	35		100	50			
Grand Total	UMBTP 406	Practical Course (Based on UMBTT 403 & UMBTT 404)	C	4	30		70	35		100	50			
	4T+2P	4T + 2P		24	180		420			600				

U = Undergraduate
MBT = Biotechnology
T = Theory
P = Practical
401 = Semester IV x Course No.01
C = Core or compulsory paper / practical

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

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

Annexure - 5

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UG Program in B. Sc in Medical Biotechnology & Pattern of Marks statement
[6 Semesters + Credit & Grade based system]

Semester: V

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 S	Credits	Internal Assessment marks		Semester End Exam.			Total Marks			GP	CP
					Max.	Secured	Max.	Min. for pass	Marks secured	Max.	Min. for pass	Secured		
	UMBTT 501	Theory	C	4	30		70	35		100	50			
	UMBTT 502	Theory	C	4	30		70	35		100	50			
	UMBTT 503	Theory	C	4	30		70	35		100	50			
	UMBTPr 504	Project Work	C	4	30		70	35		100	50			
	UMBTP 505	Practical Course (Based on UMBTT 501 & UMBTT 502)	C	4	30		70	35		100	50			
	UMBTP 506	Practical Course (Based on UMBTT 503 & UMBTP 504)	C	4	30		70	35		100	50			
Grand Total	4T+2P	4T + 2P		24	180		420			600				

U = Undergraduate
MBT = Biotechnology
T = Theory
P = Practical
501 = Semester V x Course No.01
C = Core or compulsory paper / practical
Pr = Project Work

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

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

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UG Program in B. Sc in Medical Biotechnology & Pattern of Marks statement
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Semester: VI

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 S	Credits	Internal Assessment marks		Semester End Exam.			Total Marks			GP	CP
					Max.	Secured	Max.	Min. for pass	Marks secured	Max.	Min. for pass	Secured		
	UMBTT 601	Theory	S	4	30		70	35		100	50			
	UMBTT 602	Theory	S	4	30		70	35		100	50			
	UMBTT 603	Theory	S	4	30		70	35		100	50			
	UMBTT 604	Theory	S	4	30		70	35		100	50			
	UMBTP 605	Practical Course (Based on UMBTT 601 & UMBTT 602)	S	4	30		70	35		100	50			
Grand Total	UMBTP 606	Practical Course (Based on UMBTT 603 & UMBTT 604)	S	4	30		70	35		100	50			
	4T+2P	4T + 2P		24	180		420			600				

U = Undergraduate
MBT = Biotechnology
T = Theory
P = Practical
601 = Semester VI x Course No.01
C = Core or compulsory paper / practical

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

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

Class awarded

Annexure - 7

Calculation of SGPA and CGPA

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

SGPA for I Semester = SGPA for I Semester

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

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

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

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

$$\text{CGPA for I,II,III,IV,VandVI Sem} = \frac{\text{CP(I Sem)} + \text{CP(II Sem)} + \text{CP(III Sem)} + \text{CP(IV Sem)} + \text{CP(V Sem)} + \text{CP(VI Sem)}}{\text{Credits(I Sem)+Credits(II Sem)+Credits(III Sem)+Credits(IV Sem)+Credits (V Sem)+Credits(VI Sem)}}$$

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

B. Sc. (Medical Biotechnology)

To be implemented from Academic Year 2019-20

B. Sc Medical Biotechnology

Semester I

BASIC CHEMISTRY (UMBTT 101)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 101	Core	Basics Chemistry	4	0	4	60	4+2=**6**

Objective:

The main objective of the paper is to expose students to.

Outcome:

At the end of this course student should be able to understand basic principles of organic & Inorganic chemistry and develop skills in handling organic molecules. This is essential for undertaking practical training in Biochemistry and genetic engineering at the later stage.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Atoms & Molecules	Structure of atoms & molecules: Concept of orbital's, aufbau principle, periodic trends inm atomic properties, atomic spectra. Molecules: PE diagram, diatomic molecules, valence bond theory, hybridization, VSEPR theory, linear combination of atomic orbitals, homo and heteronuclear molecules, bond orders, magnetic properties, polyatomic molecules.	8
Unit II	Periodic Table	Periodic table- group and periods, s and p block elements, transition metals, d orbitals splitting in octahedral, tetrahedral and square planar environment – spectral and magnetic properties.	10
Unit III	Thermodynamics	Thermodynamics- second law of thermodynamics, entropy, spontaneous change, free energy, enthalpy, adiabatic demagnetization, reactions at equilibrium, interpretation of equilibrium constants, acid and bases, solubility equilibria, biological activity, thermodynamics of ATP.	10
Unit IV	Electrochemistry	Electrochemical cells, half cell reactions, reduction potentials, the electrochemical series, thermodynamic functions from cell potential measurements, liquid junction potentials, Debye Huckel Theory, over voltage	8
Unit V	Classification of organic compounds	Nomenclature structural and constitutional isomers, functional group chemistry (alcohol, aldehydes, ketones, esters, amines, amides etc.)	10

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

1. Physical Chemistry- A molecular approach by Mcquairee and Simon
2. Physical Chemistry by G M Barrow
3. Concise Inorganic Chemistry by J D Lee
4. Inorganic Chemistry by Shriven and Atkin
5. Physical Chemistry by P W Atkin
6. Physical Chemistry by Venullapalli
7. Physical Chemistry for Life Science and Biosciences by R Chang
8. Organic Chemistry by R T Morrison and R N Boyd
9. Organic Chemistry by P Y Bruice

PRACTICALS:

1. To Determine pKa Value of Weak Acid by pH Metry
2. To Determine Dissociation Constant of Oxalic Acid By pH Metry Titration
3. Organic Qualitative Analysis Compounds - 1,2,3,4
4. To Determine the Amount of Acetone in the Given Solution
5. To Determine the Amount of Phenol in the Given Solution
6. To Standardize NaOH Solution and Hence Find Strength of HCl By Using Standardized NaOH Solution.
7. To Standardize $KMnO_4$ solution and To Estimate Fe(II) Volumetrically By Using Standardized $KMnO_4$
8. To Determine The Molecular Weight of Given Monobasic Acid Volumetrically
9. To Find The Amount of Glucose In the Given solution
10. Preparation of Pthalimide from Pthalic Anhydride
11. Molecular Evolution in Plants- To Study and Specify Chlorophyll Pigment and Other Light absorbing Pigments in Variety of Plants.

MATHEMATICS & BIOSTATISTICS (UMBTT 102)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 102	Core	Mathematics & Biostatistics	4	0	4	60	4+2=**6**

Objective:

The objective of this course is learning and understanding basic concepts of Mathematics and Biostatistics.

Outcome:

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Elements of mathematics-I	**Derivatives:** derivative of function, Derivatives of First Principles, Derivatives of inverse, exponential functions and trigonometric functions, **Integration:** Methods of Integration: direct integration, integration by parts	8
Unit II	Elements of mathematics-II	**Determinant:** determinant of order 2 or 3, expansion of determinant, properties of determinant, Crammer rule **Matrix:** Types of matrix, Algebra of matrices, Inverse matrix. **Logarithm :** Fundamentals of logarithm, natural logarithm and logarithm to other bases, significance of logarithmic scales	8
Unit III	Basic concepts in Statistics	Terms and Definitions in Statistics, Population and Sample, Raw Data, Types of variables, Numerical variable (Continuous and discrete), Categorical variables (Nominal and ordinal), Outcome and exposure variables, Display of data for 1 variable, For categorical data: Bar Chart and Pie Chart, For numerical data: Histogram (different shapes) and Frequency Polygon Measurements of central tendency: Mean, Median, quartiles, percentiles, Mode Measures of spread: Range, Variance and Standard Deviation and its interpretation Normal deviation and its characteristics	12
Unit IV	Probability and combinations	Probability: Definition and basic formula, Probability of an event not occurring, Multiplicative rule to calculate the probability of occurrence of both of two events.	10

Sr. No.	Topic	Detail of syllabus	Hrs.
		Independent events, Non-independent events (conditional probability), Additive rule to calculate the probability of occurrence of at least on of two events, mutually exclusive events. Combinations: Definition and basic formula (nCr = n!/r!(n-r)!), Application in biology (pedigree analysis), Problems involving Combinations and Probability	
Unit V	Sampling, Hypothesis and significance	Sampling Variation, Population mean and standard error, Concept of Hypothesis test and null-hypothesis, t-test (concept and calculation), ANOVA, One way Anova (concept and calculation), SPSS and its application	10

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

1. Introduction to Mathematics for life scientist – by Edward Batschelet
2. Discrete Mathematics- Semyour Lipschutz & Marc Lipson-McGraw Hill
3. S. C. Gupta and V. K. Kapoor : Mathematical Statistics, Sultan Chand & Sons
4. Introduction to Biostatistics, Le and Chap (2009), Wilay and Sons.
5. Fundamentals of Biostatistics, B. Rosner (2005), Duxbury Press.
6. Medical Statistics from Scratch, Bowers (2008), Wiley and Sons.
7. Introduction to Bioinformatics, Arthur M. Lesk, Oxford University Press

EVOLUTIONARY BIOLOGY (UMBTT 103)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 103	Core	Evolutionary Biology	4	0	4	60	4+2=**6**

Objective:

This is a course in evolutionary biology that uses Flora and fauna examples to exemplify fundamental concepts in evolution. The course will concentrate on basic evolutionary mechanisms and its theory.

Outcome:

Students shall be able to understand evolution among non living and living things.

- Compressive and stepwise evolution among non living things.
- Emergence of life with simple geochemistry to complex biochemistry of current time.
- Relatedness among life forms through studying fossils & molecular evidence of evolution.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction	History of Life, theories of Evolution and Extinction Chemogeny, Biogeny, RNA World, Major Events in History of Life; Lamarckism; Darwinism; Neo-Darwinism; Background of extinction, Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail) and Role of extinction in evolution.	10
Unit II	Fossils and molecular phylogeny evidences	Evidences of Evolution Fossils and its types; Dating of fossils, Phylogeny of horse and human; Molecular evidences (Globin gene families as an example) and Molecular clock concept.	6
Unit III	Natural Selection	Processes of Evolutionary Change Organic variations; Isolating mechanisms; Natural selection (Industrial melanism, Pesticide / Antibiotic resistance); Types of natural selection (Directional, Stabilizing, Disruptive), Sexual Selection and Artificial selection.	12
Unit IV	Evolution in classes	Evolution in Plants and Fungi- Terrestrial algae, bryophytes, from swamps to uplands, angiosperm, fungi From Protozoa to Metazoa–The Cambrian explosion, protistan ancestry, the coelom,metamerism.	6
Unit V	Evolution in higher classes	Evolution Among Invertebrates The Origin of Vertebrates Evolution of Mammals Primate Evolution and Human Origins	12

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit VI	Social and cultural expects of Evolution	Culture and the Control of Human Evolution – Learning society & culture, cultural & biological evolution, Eugenics.	2

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

Evolution – by Monroe W. Strickberger

INTRODUCTION TO BIOTECHNOLOGY (UMBTT 104)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 104	Core	Introduction to Biotechnology	4	0	4	60	4+2=**6**

Objective:

The objective of the course is to enlighten the student with knowledge of biotechnology with techniques involved in Biotechnology and its use in the field of Medical and health care.

Outcome:

The anticipated knowledge, skills and/or attitude to be developed by the student are:

1. Be able to define the term "biotechnology" and appreciate its scope.
2. Have an awareness of the global significance of biotechnology and its resultant industries, and a broad knowledge of which are represented nationally and locally.
3. Be familiar with the key events in the development of biotechnology.
4. Be able to state the broad categories of biotechnological processes based on the products formed and/or the process or substrates used, and have detailed knowledge of examples of each of these
5. Have an understanding of the multidisciplinary nature of biotechnology and the associated role that has been played by enabling technologies in the development of biotechnology
6. Have an awareness of some of the current and future issues surrounding the relationship between biotechnology and government, investors, the environment and consumers and the impact of these on the development of future biotechnology enterprises.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Modern Biotechnology	What is biotechnology? Ancient Biotechnology Classical Biotechnology The Foundation of Modern Biotechnology	6
Unit II	The DNA Revolution: Promise and Controversy	The First Recombinant DNA Experiments Concerns about Safety Drafting the NIH Guidelines Current and Future Concerns	6
Unit III	Microbial Biotechnology	Commercial Production of Microorganisms Bioconversion Microorganisms and Agriculture Products from Microorganisms Bioremediation	6
Unit VI	Animal Biotechnology	Gene Transfer Methods in Animals Transgenic Animals Animal Diseases	6

Sr. No.	Topic	Detail of syllabus	Hrs.
		Animal Propagation Conservation Biology Regulation of Transgenic Animals	
Unit V	Marine Biotechnology	Aquaculture Marine Animal Health Algal Products Fuels from Algae Algal Cell culture Medical Application Transgenic Fish	8
Unit VI	The Human Genome Project	Goals of the human genome Genetic Linkage Maps Polymorphic DNA Markers Ethical, legal, and social implications	4
Unit VII	Medical Biotechnology	Gene Therapy Gene Delivery Methods Viral Delivery Models Commercialization Vaccines Tissue Engineering Xenotransplantation Drug Delivery	8
Unit VIII	Forensic and DNA Profiling	Satellite DNA Single and Multi-locus VNTRs, RFLPs DNA Profiling, PCR,	4

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

1. Biotechnology: An Introduction - by Susan R. Barum
2. Biotechnology A Laboratory course - by Jeffrey M. Becker, Guy A. Caldwell, Eve Ann Zachgo
3. Basic of Biotechnology – by Dr. A. Jayakumaran Nair
4. Biotechnology – by Keshav Trehan

Semester II

BIOPHYSICS (UMBTT 201)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 201	Core	Biophysics	4	0	4	60	4+2=**6**

Objective:

- To introduce the concepts in Biophysics and allied subjects
- To enrich students' knowledge
- To help the students to build interdisciplinary approach
- To inculcate sense of scientific responsibilities and social and environment awareness.
- To help students build-up a progressive and successful career

The restructured syllabus combines basic principles of Biophysics in light of advancements in technology. The syllabus aims to impart basic knowledge with emphasis on its applications to make the students industry ready.

Outcome:

At the end of the course student will be able to demonstrate knowledge of fundamental concept in physics & chemistry that underlie biological process. Define charactertic nucleic acid protein and examine parameter that determine their stability & function

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction	Concept of biophysics, divisions of biophysics	1
Unit II	Thermodynamics	Thermodynamics terms and basic concepts, laws of thermodynamics and living organisms. First law of thermodynamics; enthalpy. Second law of thermodynamics, entropy , comparison of living and non-living system as thermodynamic system	2
Unit III	Transport across the cell membrane	Structure of the cell membrane, ECF and ICF, pores and channels of the cell membrane, Types of transport: diffusion, active transport, osmosis. Importance of various transport mechanisms.	5
Unit IV	Membrane potentials	Resting membrane potential and action potentials, definition, generation, propagation in tissues (nerve, muscle), ionic basis for development of potentials	5
Unit V	Nerve	Structure, classification of nerve fibers, properties of nerve fibers, strength duration curve,saltatory conduction in myelinated and unmylinated fibers	5
Unit VI	Muscle	Structure of skeletal muscle-contractile proteins,	6

Sr. No.	Topic	Detail of syllabus	Hrs.
		molecular basis of muscle contraction, types of muscle fibers, properties of skeletal muscle – all or none law, types of contraction, refractory period. Neuormuscular junction and impulse transmission across NMJ and factors affecting neuromuscular junction impulse transmission.EMG.	
Unit VII	Haemodynamics	Composition of blood, functions of blood, plasma proteins-types, functions, formed elements of blood, blood flow resistance, factors affecting haemodynamics, Poiseullie' law.	5
Unit VIII	C.V.S.	Structure of cardiac muscle, properties, cardiac cycle-pressure-volume changes, heart sounds, correlation of pressure volume, ECG, heart sound, cardiac output-factors affecting cardiac output, methods to determine cardiac output. Generation and conduction of cardiac impulse, ECG: lead arrangement, normal waves and their significance with reference to lead II.	6
Unit IX	Biophysics of vision	Properties of light, basics of optics, structure of the eye, errors of refraction, colour vision, functions of rods and cones, colour blindness, ERG.	5
Unit X	Bioacoustics	Physics of sound, decibel system, Structure of the ear, sound perception. Ultrasound and its application.	5
Unit XI	Structure of atom, isotopes and isobars, application of isotopes in biological science Radioactivity	Types of radiation, properties of radiations, detection and measurement of radioactivity. Units of radioactivity, application of radioactivity, radiation hazards and radiation protection. Application of radiobiology in treatment of cancer, 3D printing.	5
Unit XII	Environmental factors	Noise, noise hazards, vibrations-effect, EMF properties, hazards. Protection measures.	5
Unit XIII	Cybernetics	Homeostasis, Control of Mechanisms, feedback mechanisms – types.	5

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

1. Biophysics, an introduction. 1st edition. (2002) Cotteril R. John Willey and Sons Ltd., USA
2. Textbook of optics and atomic physics, 8th edition (1989) P.P. Khandelwal, Himlaya Publishing House, India.
3. Nuclear Physics: An Introduction. 2nd edition (2011). S. B. Patel. Anshan Publication, India
4. Biophysics.1st Edition (2004).M.P. Arora. Himalaya publishing House, India.
5. A Text Book of Biophysics.1st Edition (1996).R. N. Roy. New Central Book Agency (P) Ltd, Calcutta, India.
6. Text Book Of Physiology, Vol.1,2..6th Edition (2016). Avichal Publishing Company, India.

CELL BIOLOGY (UMBTT 202)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 202	Core	Cell Biology	4	0	4	60	4+2=**6**

Objective:

The objective of the course is to familiarize the students with basic concepts of cell Biology. This is essential for taking further courses in Biotechnology during the next couple of years.

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	Cells and Genomes	Universal features of cells Genome diversity and tree of life Genetic information in eukaryotes	6
Unit II	Principles of microscopy	Working principle & uses of: Light Microscopy Phase contrast microscopy Electron microscopy (EM): Scanning EM (SEM) & Transmission EM (TEM)	8
Unit III	Ultra structure and functions of **cytoskeleton** & cellular organelles	**Cytoskeleton-structure & function**, Nucleus and Chromosomes Biosynthesis of mitochondria, Chloroplast (genomes) Ribosomes; Golgi complex Lysosomes (Vacuoles and micro bodies) Endoplasmic Reticulum and Golgi apparatus	10
Unit VI	Intracellular compartments and Protein Sorting	The compartmentalization of cells The Transport of molecules between the nucleus and the cytosol The Transport of Proteins into Mitochondria and Chloroplasts; Peroxisomes; The Endoplasmic Reticulum	10
Unit V	Intracellular Vesicular Traffic	The Molecular Mechanisms of Membrane Transport Transport from the ER through the Golgi Apparatus Transport from the trans Golgi Network to Lysomes Transport into the Cell from the Plasma Membrane: Endocytosis Transport from the trans Golgi Network to the Cell Exterior: Exocytosis	14

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED:

Reference Book:

1. Cell Biology - S.C. Rastogi
2. Cell and Molecular Biology - De Robertis
3. Cell and Molecular Biology - Lodish
4. Cytology, Genetics and mol. Biology - P.K. Gupta
5. Biotechnical cell biology - Veer Bala Rastogi
6. Cell biology, Genetics, Mol. Biology - P.S.Verma & V.K. Agrawal
7. Mol. Biology of cell - Albert et al
8. The Cell - Cooper

PRACTICALS:

1. Microscope – Bright field and Dark field
2. Structure observation - Prokaryotic & Eukaryotic cell
3. Cell count - Prokaryotic & Eukaryotic cell
4. Cell division - Mitotic stages - Preparation of Onion Root Tip
5. Cell division - Meiotic stages - Preparation of Flower bud
6. Cell division – Binary fission of yeast
7. Polytene and diplotene chromosome
8. Microtome – Temporary & permanent slide preparation.

Reference Books

1. David A. Thompson. 2011. Cell and Molecular Biology Lab. Manual.
2. P.Gunasekaran. 2007. Laboratory Mannual in Microbiology. New Age International.
3. D O Hall, S E Hawkins. 1974. Laboratory Manual of Cell Biology. British Society for Cell Biology, Published by Crane, Russia.
4. Mary L. Ledbetter. 1993. Cell Biology: Laboratory Manual. Edition: 2. Published by RonJon Publishing. Incorporated.

BASIC LABORATORY METHODS (UMBTT 203)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 203	Core	Basic Laboratory Methods	4	0	4	60	4+2=**6**

Objective:

This course has been designed to introduce the student to laboratory, Preparations of reagents, measurements and various classical and modern techniques used in biochemical research. The course encompasses the principles, significance, applications, and limitations of these techniques. The basic instrumentation is also included.

Outcome:

At the end of this course student will be able to understand advanced level concepts of analytical tools, their principle and applications in the area of Biotechnological.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to Biotechnology Lab and workplaces	Introduction, Technologies of modern biotechnology, Applications of Biotechnology; Organization of a biotechnology company, Biotechnology workplaces and safety in Laboratory.	9
Unit II	Math's in Biotechnology Laboratory	Exponents and Scientific notations; use of Logarithms; Units of measurements; Proportional relationships- Percent solution preparations, units of conversions; concentration and dilutions	10
Unit III	Laboratory measurements	Measurement of weight, measurement of volume, measurement of temperature, measurement of pH and measurement of light	8
Unit VI	Laboratory solutions	Preparation of molar solution, buffers. Cleaning glassware's	6
Unit V	Basic Laboratory Techniques	Spectrophotometry, Quantification of Protein and Nucleic acid Concentration, Chromatography, Gel Electrophoresis of Proteins and Nucleic acids, Overview of Protein Purification-Isolation and Characterization of the Enzyme Alkaline Phosphatase From *Escherichia Coli*., Enzymatic Methods of Analysis, Polymerase Chain Reaction (PCR).	15

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED:

Basic Laboratory methods for Biotechnology – by Lisa Seidman

PRACTICALS:

1. Laboratory Instrumentation
2. Glassware Washing And Sterilization
3. Pipetting: Handling
4. Normality and Molarity: Preparation
5. Preparation of Buffer Solution
6. Verification of Beer's Law
7. Spectrophotometry: Principles And Handling
8. Microscopy: Principles and Working
9. Basic Rules of Handling Enzymes, Microbes and DNA
10. Centrifugation: Principles and Handling
11. Filtration: Principles and Handling
12. Column Chromatography
13. Examination of Mammalian Blood Smear
14. Monochrome Staining
15. Gel Electrophoresis

COMPUTATIONAL METHODS IN BIOTECHNOLOGY (UMBTT 204)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 204	Core	Computational Methods in Biotechnology	4	0	4	60	4+2=**6**

Objective:

The objective of the course is to enlighten the student with knowledge of biotechnology with techniques involved in Biotechnology and its use in the field of Medical and health care.

Outcome:

At the end of this course student would be able to understand basic principles of Computing, Networking and Programming.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Knowing Computers	Basic Applications of Computer, Components of Computer System- Input devices; Output devices; Computer Memory; Antivirus, Programming languages for Bioinformatics.	8
Unit II	Operating System	Basics of Operating System; Basics of popular operating system (LINUX, WINDOWS); the User Interface; Task Bar; Icons; Menu; Running an Application; Changing Mouse Properties	10
Unit III	Power point & Spreadsheet	Basics of PowerPoint presentation; Entering and Editing Text; Preparation of Slides and slideshow; Inserting Word Table or An Excel Worksheet; Adding Clip Art Pictures; Inserting Other Objects; Resizing and Scaling an Object Presentation of Slides; Choosing a Set Up for Presentation; Rehearse timing: Short cut keys Introduction – Basics of Spreadsheets; Manipulation of Cells; Entering Text, Numbers and Dates; Creating Text, Number and Date Series; Editing Worksheet Data; Formatting spread sheet; Formulas and Function; Short cut keys	12
Unit IV	Hardware and Software	Introduction of Hardware and Software Types of Hardware, Applicatio software and system software. Difference between hardware and software	8
Unit V	Communication Using The Internet	Basic of Computer Networks; Local Area Network (LAN); Wide Area Network (WAN); Internet; Concept of Internet; Applications of Internet; Connecting to the Internet; Troubleshooting; World Wide Web (WWW). E-mail Account & Its Functions. Role of computer in Biological field.	10

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

REFERENCE BOOKS

1. The complete reference Microsoft Reference access 2007 by Virginia Anderesen.
2. Microsoft Office 2003: The Complete Reference (Osborne Complete Reference Series) by Jennifer Kettell, Guy Hart-Davis, Curt Simmons and Jennifer Kettell
3. E-Book: Microsoft Office 2010 Ultimate Tips & Tricks
4. Computer Fundamentals , 4th edition (2004) P.K. Sinha, BPB publication, India
5. Computer Networks. 4th edition (2008). Tanenbaum. Pearson Education, India
6. Introduction To Database Management Systems, 1st edition, (2004), Atul Kahate, Pearson education, India

PRACTICALS:

1. Use of internet – Downloading & Installing software/plug-ins on
2. Windows 98/XP and later versions (Acrobat Reader, Post Scripts Viewer, etc.)
3. Searching/Surfing on the WWW
4. Spreadsheet Applications (Microsoft Excel): Worksheet Basics: Entering information in a Worksheet, Saving & Opening a Worksheet, Editing, Copying & Moving data, Inserting, Deleting & Moving Columns & Rows, Clearing
5. PowerPoint Presentation- Creating a Presentation Using a Template, Entering and Editing Text, Inserting Word Table or an Excel Worksheet; Adding Clip Art Pictures and Other Objects, Resizing and Scaling an Object Presentation of Slides, Transition and Slide Timings

Semester III

GENERAL MICROBIOLOGY (UMBTT 301)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 301	Core	General Microbiology	4	0	4	60	4+2=**6**

Objective:

The objective of course is to familiarize the students with bacteria viruses their structure metabolism, disease caused by bacteria & viruses & their control

Outcome:

On completion of this course students are able to

1. Get an idea about historic events in micro
2. Know about microscope
3. Get theoretical concepts of related stain, staining tech.
4. Understand concept of growth & reproduction of bacteria
5. Get knowledge about control of microorganism

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to micro	Scope and history of Microbiology. Classification and identification of microorganism. A. Discovery of microscope & microorganism, (Antony van leeuwenhoek & Robert Hooke), Abiogenesis v/s biogenesis (Aristotle's notice about spontaneous generation, Francesco Redi's expt. Louis pasteur & tyndall expt.) B. Golden Era of Micro a. Contribution i. Louis pasteur (fermentation, Rabies, Pasteurization & cholera vaccine) ii. Robert Koch (Koch postulate, germ theory of disease) iii. Discovery of viruses (TMv & BQ) iv. River's postulate v. Contribution of Joseph lister Antiseptic surgery vi. Paul ehrlich (Chemotherapy) vii. Elie metchinkoff (phagocytosis) viii. Edward jenner (vaccination)	10

Sr. No.	Topic	Detail of syllabus	Hrs.
		ix. Alexander fleming (vaccination) x. Discovery of streptomycin by Waksman b. Modern ERa of microbiology- carl woese classification based on 16sr RNA.	
Unit II	Types of Microorganism & their differentiating characters	Prokaryote, Eukaryotes, 3 domain & 5 domain system of classification: Bacteria, Protozoa, Fungi, Algae, Viruses	10
Unit III	Staining technique	Definition of stain- types of stain (Basic & advance) Properties & role of fixative, mordants, decolourisers & accentuator Monochrome & negative staining Differential staining – gram staining	10
Unit IV	Cultivation of Microorganism	Cultivation of bacteria – culture media, preservation methods of bacteria culture & maintenance.	05
Unit V	Growth	Kinetics of bacterial growth (exponential growth mode) Growth curve & generation time, Diauxic growth Measurement of bacterial growth – methods i. Microscopic method (direct microscopic count, counting cells using improved neubaur petroff – haussers chamber ii. Plate count (total viable count) iii. Turbidostatric method (including nephelometry) iv. Estimation of biomass (dry mass, packed cell volume)	15
Unit VI	Control of Microorganism	Sterilization & disinfection 1. Sterilization – physical agent –heat, radiation, filtration 2. Disinfection- a. chemical agents & their mode of action – aldehyde, halogens, quaternary ammonium compound, phenol & phenolic comp. b. heavy meals, alcohols, dyes, detergents c. cha of an idea disinfectant	10

METHODOLOGY

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

BOOKS RECOMMENDED:

1. General Microbiology: Vol. I & 2 by Powar & Daginawala
2. Microbiology by Prescotte
3. Microbiology by H. A. Modi
4 General microbiology by stanier

PRACTICALS:

1. To study compound Microscope.
2. Sterilization and disinfections
3. Preparation of culture media
4. Staining procedures
5. Monochrome staining
6. Gram Staining
7. Motility of microorganisms
8. Aseptic transfer techniques
9. Streak plate method
10. Spread plate method
11. Pour plate method
12. Biochemical tests
13. IMViC test

HUMAN BIOCHEMISTRY (UMBTT 302)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 302	Core	Human Biochemistry	4	0	4	60	4+2=**6**

Objective:

To introduce and familiarize the undergraduate students with overall concept of metabolism and basic bioenergetics with respect to significant biomolecules and their metabolism.

Outcome:

Undergraduate students should be able to have comprehensive understanding of significant biomolecules and their metabolism through evolved biochemical pathway.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to Biochemistry	Introduction to basic features of Carbohydrates, Lipids, Amino acids, Nucleotides	6
Unit II	Overview of metabolism	Anabolic and catabolic processes that forms core metabolic pathways Essential role of coenzymes and co-factors, such as, NAD, FAD, Acetyl-CoA, ATP etc.	8
Unit III	Glycolysis & the Oxidation of Pyruvate	Essential features of glycolysis Features of first phase and second phase of glycolysis Regulation of glycolysis, oxidation of pyruvate to Acetyl-CoA	6
Unit VI	The Citric Acid Cycle	The logic of TCA cycle Production of reducing equivalents and their use in ETC TCA cycle intermediate and their use in biosynthesis of biomolecules such as amino acids, fatty acids, Energetics of TCA cycle	6
Unit V	The Respiratory Chain & Oxidative Phosphorylation	Features of mitochondrial membrane, location of various enzyme complex Electron transport chain (ETC), generation of proton gradient across inner mitochondrial membrane , Chemiosmotic coupling and generation of ATP	6
Unit VI	Biosynthesis and oxidation of Fatty Acids	Initial and controlling steps in fatty acid synthesis Fatty acid synthase complex and its features Regulation of fatty acid synthesis, Oxidation of fatty acid through beta oxidation pathway	6
Unit VII	Biosynthesis and catabolism of the	Use of intermediates from TCA Cycle, Glycolysis and other pathways as precursors of hydrocarbon skeleton for	8

Sr. No.	Topic	Detail of syllabus	Hrs.
	Nutritionally Nonessential Amino Acids	amino acid biosynthesis Significance of Nitrogenase in N2 Fixation, Glutamate dehydrogenase, Glutamine synthase, Transaminases in amino acid metabolism, Biosynthesis of Urea	
Unit VIII	Conversion of Amino Acids to Specialized Products	Participation of amino acids into biosynthesis of diverse products, compounds and derivatives Such as heme, purines, pyrimidines, harmones, neurotransmitters and biological active peptides	6
Unit IX	Metabolism of Purine & Pyrimidine Nucleotides	Biosynthesis of purine nucleotides Biosynthesis of pyrimidine nucleotides Regulation of purine and pyrimidine biosynthesis Metabolic disorders of purine and pyrimidine metabolism	8

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED:

1. Harper's Illustrated Biochemistry –30th Ed @2015, 31st Ed @2018 Robert Murray, Peter A., Mayes, Victor W. Rodwell, Daryl K. Granner (McGrawHill Lange)
2. Leninger: Principles of Biochemistry 4th Ed @2007, 7th Iinternational Ed @2017(W.H. Freeman and Co. NY)
3. Zubay's Principles of Biochemistry, 5th Ed @2017 by Veer Bala Rastogi., K R Aneja (Medtech)
4. Biochemistry 4th Ed, Reginald Garret., Charles Grisham @2010 Brooks/Cole, Cengage Learning
5. Textbook of Biochemistry 7th Ed @2011 by Thomas Devlin (John Willey and Sons Inc)

PRACTICALS:

1) Separation of plasma from blood
2) Estimation of protein by Biuret's Method
3) Estimation of protein Folin Lowry Method
4) Estimation of serum albumin by BCG Method
5) Estimation of serum carbohydrates by Anthrone Method
6) Estimation of Urea Nitrogen by Diacetyl Monoxime Method

GENETICS & MOLECULAR BIOLOGY (UMBTT 303)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 303	Core	Genetics & Molecular Biology	4	0	4	60	4+2=**6**

Objective:

This course is designed to given an understanding about the basics of molecular biology classical genetics & molecular aspects.

Outcome:

To study the structure of nucleic acids:

- To understand the gene expression and regulation in Prokaryotes & Eukaryotes.
- To gain better knowledge in both Prokaryotes & Eukaryotes about the Gene Mutation, Repair Mechanisms, Nuclear Genome Organization, Genes and gene numbers.
- Comprehensive and detailed analysis of fine structure of the gene.
- Analyze the role of transposable elements in prokaryotes and eukaryotes.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Mendelian genetics	Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back crosses, Chromosomal theory of inheritance, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes.	10
Unit II	Chromosome Structure and Function	Chromosome Morphology, Chromosome Abnormalities,Types of Chromatin. Codominant alleles. Incomplete dominance, Multiple alleles, Epistasis. Polygenic Inheritance, Pleiotropy, Human Chromosome Abnormalities, Cytogenetics	6
Unit III	Nucleic Acid Structure and Function	Introduction, Deoxyribonucleic acid, Ribonucleic acid, Chemical differences between DNA & RNA, DNA Replication, DNA as genetic material, structure of DNA replication, Types of DNA, Semiconservative nature of DNA replication, Replication of DNA in prokaryotes and eukaryotes.	6
Unit IV	DNA Damage and Repair	DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-primming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication	10
Unit V	Transposable Elements	General features of Transposable elements, Transposable	4

Sr. No.	Topic	Detail of syllabus	Hrs.
		elements in prokaryotes-IS element, Retroviruses Retrotransposons- Ty elements in yeasts	
Unit V	Gene Transfer in Bacteria	Introduction, Conjugation, Transduction Transformation, Transposition, Recombination.	6
Unit VI	Transcription and Translation	Introduction, Transcription, Translation, Genetic Code, Transfer RNA, Function of Ribosome, The Central Dogma, Protein Synthesis	8
Unit VII	Control of Gene Expression	Introduction, Gene Control in Prokaryotes, The lac Operon, The trp Operon, Gene Control in Eukaryotes, Control of Eukaryotic Transcription Initiation, Transcription and Processing of mRNA	10

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED

Text Books: A text book of genetics by Sambhamurthy

Reference Books

1. Garder, Principles of genetics, Wiley Publications, 8th edition
2. Levin, Gene VI to Gene VIII, Oxford Pub.
3. Friefelder, Essentials of Molecular Biology, Panima Pub
4. T. A. Brown, Genome-4 4th Edition
5. Old & primrose, Principle of Gene Manipulation, Blackwell Pub.
6. Weaver Molecular Biology, Mc Graw Hill
7. Brown, Gene Cloning and DNA analysis, Blackwell Pub.
8. Winnacker, From genes to clones , Panima Pub.
9. Snustard & Simmons- 5th Ed. Principles of Genetics

PRACTICALS:

1. Study of polyploidy in onion root tip by colchicine treatment.
2. Karyotyping with the help of photographs
3. Preparation of solutions for Molecular Biology experiments
4. Isolation and purification of genomic DNA from prokaryotes.
5. Isolation and purification of genomic DNA from eukaryotes.
6. Isolation and purification of plasmid DNA.
7. Observation of DNA - Agarose gel electrophoresis.
8. Quantification of nucleic acids – DNA & RNA – Chemical and UV method.
9. Separation of protein by SDS PAGE
10. Staining of proteins - Coomosie brilliant blue & AgNO3.

Reference Books

1. M. Mooyoung. 1985. Comprehensive Biotechnology. Vol. 2, 3 & 4. Pergamon press.
2. Dr. David A Thompson. 2011. Cell and Molecular Biology Lab Manual.
3. George M. Malacinski. 2013. Freifeder's Essentials of Molecular Biology. Norosa Publishing House.
4. Stanely R. Maloy, Jhon E Cornan Jr, David Freifelder. 1994.Microbial genetics. 2nd Edition. Jones and Bartlett publisher.

HUMAN PHYSIOLOGY (UMBTT 304)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 304	Core	Human Physiology	4	0	4	60	4+2=**6**

Objective:

- The learning provides a solid foundation for understanding the structure and function of the human body.
- To introduce the students to the Physiological concepts, control mechanisms and to study the functions of body systems- with emphasis on clinical relevance.

Outcome:

- On completion of the course, student will be able to
- have an enhanced knowledge and appreciation of human physiology
- understand the functions of important physiological systems including the respiratory, excretion, digestive and circulatory systems.
- be able to perform, analyze and report on experiments and observations in physiology

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Digestive system	Organization of Gastro Intestinal Tract (Overview of Buccal cavity, Oesophaus, Stomach, Small intestine,Large intestine,Liver and Pancrease). Digestive Enzymes, Secretion of saliva, Gastric juice,Intestinal juice,Bile. Digestion and absorption of Carbohydrate, Lipid and Protein & their nutritional importance.	12
Unit II	Circulatory system	Structure of Heart,Arterial system,Venous system,Poratl system,Conducting sysem of heart, Heart beat, Arterial Blood Pressure, ECG, Artificial pace maker, Blood coagulation: process & disorder	12
Unit III	Endocrinology	Properties of Hormones, Function and Disease associated with Hypo and Hyper secretion of Hormones secreted by Pituitary gland, Thyroid gland, Parathyroid gland, Pancreas, Mechanism of hormone action.	12
Unit IV	Respiration	Hemoglobin and myoglobin,Transport of Oxygen and Carbon dioxide in Blood, Oxygen dissociation curve, Bohr's effect and Haldane's effect, Common respiratory disorders (Asthama, Pneumonia, Diptheria).	12
Unit V	Excretion	Excretory system: Kidney, Ureter and Urinary bladder, Urea formation, Urine formation, Composition of urine,	12

Sr. No.	Topic	Detail of syllabus	Hrs.
		Acid base balance, Haemodialysis , Renal disorders.	

METHODOLOGY

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

BOOKS RECOMMENDED:

1. Ross and Wilson, Anatomy and Physiology in Health and Illness, Churchill Livingstone, 9th Edition, 2001.
2. Gerard. J. Tortora. Principles of Human Anatomy and physiology, Harper Collins College Publishers, 7th Edition, 2005.
3. Arthur C. Guyton & John E. Hall, Text Book of Medical Physiology, W.B.Saunders Company, London, 12th Edition, 2015.
4. Saraswathi, P., Handbook of Anatomy for Nurses Jaypee Brothers Medical Publishers (P) Ltd, 1st Edition, 2014.
5. Gillian Pocock, Christopher D. Richards, The human Body – An introduction for Biomedical and Health Sciences, Oxford University Press, USA, 2013.
6. William F.Ganong, Review of Medical Physiology, 22nd Edition, McGraw Hill, New Delhi, 2010.
7. Animal Physiology, 1990 4th edn. Kunt Schmidt, Neilson, Cambridge University Press Cambridge.
8. Physiology of Mammals & other vertebrates, 1980, 2nd edn. Marshall & Hughes. Cambridge Univrsity Press Cambridge.
9. Human Physiology, Vol.I & II 1980.12th edn.Dr.C.C.Chatterjee, Medical applied,Agency, Calcutta.

PRACTICALS:

1. Determination of Blood Group
2. Estimation of hemoglobin

Semester IV

MEDICAL MICROBIOLOGY (UMBTT 401)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 401	Core	Medical Microbiology	4	0	4	60	4+2=**6**

Objective:

The objective of the course is to familiarize the students with bacteria, viruses & other pathogens related with infection diseases in human.

Outcome:

On completion of this course students will be able to understand different bacteria viruses & pathogen that course infection in different systems of human body. Also students will be able to understand how to control these infections.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	The clinical manifestion of infection – an introduction	Upper respiratory tract infection Lower respiratory tract infection Urinary tract infection Sexually transmitted disease Gastrointestinal tract infection Obstetric & prenatal infection Multisystem zoonoses Worldwide virus infection Infection in compromised host	12
Unit II	Strategies for control – an introduction	Antimicrobial agents & chemotherapy	12
Unit III	Vaccination	Vaccination – history,aims of vaccination,vaccines can be of different type	12
Unit IV	Passive and non specific immunotherapy	Passive immunization with antibody,non specific cellular immunostimulation ,correction of host immunodeficiency,Probiotics.	12
Unit V	Hospital acquired infection,sterilization and disinfection	Common hospital infections, important causes of hospital infection,sources and routes of spread hospital infection host factors and hospital infection,prevention of hospital infection,sterilization and disinfection	12

METHODOLOGY

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

BOOKS RECOMMENDED:

1. Medical microbiology- Mims
2. Medical microbiology - David Greenwood
3. Diagnostic microbiology - Bailey & Scott

PRACTICALS:

LIST OF EXPERIMENTS

1. Staining procedures
2. Negative staining
3. Capsule staining
4. Endospore staining
5. Isolation of microorganism- staphylococcus aureus
6. Antibiotic sensitivity test by disc diffusion method
7. Antibiotic sensitivity by serial dilusion method

ANIMAL TISSUE CULTURE (UMBTT 402)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 402	Core	Animal Tissue Culture	4	0	4	60	4+2=**6**

Objective:

To improve theoretical & Practical fundamental of cell and tissue culture techniques in animals. 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 Animal cell & their uses.

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	12
Unit II	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	12
Unit III	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	12
Unit VI	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	12
Unit V	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	12

METHODOLOGY

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

BOOKS RECOMMENDED

1. Cell and Tissue Culture: Lab Procedures in Biotechnology by Alan Doyle (ed) J. Bryan Griffith (ed)
2. "Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications" by R Ian Freshney
3. "Animal Cell Culture: A Practical Approach (Practical Approach Series)" by John Masters
4. "Animal Cell and Tissue Culture" by Mathur Shivangi
5. Basic Cell Culture 2nd Edition by JM Davis Oxford University Press.2002.

PRACTICALS:

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

IMMUNOLOGY (UMBTT403)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 403	Core	Immunology	4	0	4	60	4+2=**6**

Objective:

To introduce and familiarize the undergraduate students with overall concept of immune system, action mechanism and applications in research and biomedical field.

Outcome:

The undergraduate students should be able to have basic and broad overview of immunology and its applications in the challenging fields of medicine and in basic and applied research in immunology.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to the Immune System	General properties of immune response, Components (Hematopoiesis, Cells, organs and molecules) of the Immune System, Innate Immunity; The Early Defense against Infections (Anatomic barriers).	12
Unit II	Antigen Capture and Presentation to Lymphocytes	Antigen Recognition in the Adaptive Immune System: Cell-Mediated Immunity Humoral Immunity	12
Unit III	Immunologic Tolerance and Autoimmunity	Self-Nonself Discrimination in the Immune System and Its Failure Mechanism of tolerance: Central tolerance, Peripheral tolerance Autoimmune diseases in human	12
Unit VI	Immune Responses against Tumors	Cancer: origin and malignant transformation Tumors of the immune system, tumor antigens Tumor evasion of the immune system, Cancer immunotherapy Immunity to Noninfectious Transformed and Foreign Cells	12
Unit V	Hypersensitivity Diseases	Types of hypersensitive responses: Type I, II, III, IV an overview Disorders Caused by Immune Responses	06
Unit VI	Congenital and Acquired Immunodeficiencies	Diseases Caused by Defective Immune Responses	06

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED:

Reference Book:

1. Immunobiology by Janeway
2. Immunolgy by Roitt
3. Kuby Immunology 6th Ed by Kindt, Goldsby Osborne
4. Cellular Immunology – Biotol
5. Cellular and molecular immunology 5th Ed@2005 by Abbas and Lichtman
6. Cellular and Molecular Immunology 1st South Asia Edition@2018 by Abbas., Litchman., Pillai

PRACTICALS:

1. Determination of Blood Group
2. Differential counting of blood
3. Ouchterlony test
4. Coombs test: Direct
5. Coombs test: Indirect
6. WIDAL Test

BIOINFORMATICS (UMBTT404)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 404	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.	10

Sr. No.	Topic	Detail of syllabus	Hrs.
		Mathematical Modeling of Biochemical Systems. Why Biologists Model	
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
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.	10
Unit VI	Tools for genomics and proteomics	Introduction, From Sequencing Genes to Sequencing Genomes, Analysis of Raw Sequence Data: Base calling 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, 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

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

Semester V

GENETIC ENGINEERING (UMBTT 501)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 501	Core	Genetic Engineering	4	0	4	60	4+2=**6**

Objective:

To provides a comprehensive introduction to fundamentals and applications of genetic engineering . The course is designed to give students an up-to-date understanding of a wide array of techniques that are used in genetic manipulation. This course encompasses the detailed procedure of genetic engineering so that students can become familiar with the Recombinant DNA Technology and its applications.

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	Introduction	Introduction to genetic engineering and recombinant DNA technology. Various steps involved in rDNA technology. Isolation of genes. Enzymes of rDNA technology - Restriction endonucleases, exonuclease, DNA modifying enzymes - Polymerase, Transferase, Kinase and Ligase.	12
Unit II	Different types of Vectors	Plasmids, Phage vectors, Cosmids, Phagemids, Virus vectors, Shuttle vectors and expression vectors- YAC, BAC- *S. cerevisiae* system as a model.	10
Unit III	Cloning Strategies	Cloning vectors for *E. coli*., Cloning vectors for Eukaryotes. Methods of transformation- Calcium chloride, Electroporation, microinjection, and biolistic methods. Construction of genomic libraries and cDNA Libraries. Probe construction, recombinant selection and screening	12
Unit IV	Recombinant DNA techniques	Blotting Techniques, Autoradiography, Hybridization, Molecular Probes and Nucleic acid labelling , DNA sequencing, PCR, Mutagenesis, Analysis of gene expression , DNA fingerprinting, RAPD, RFLP, AFLP, Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and Arhizogenes, Ti plasmids, Strategies for gene transfer to plant cells	16
Unit V	Application of rDNA Technology	Transgenic animals – Production of Insulin, Production of recombinant vaccines – Heptitis – B, Production of GM foods and crops, Ethics and safety of GMO's	10

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED:

1. Biotechnology-Fundamentals and Applications- SS Purohit
2. Principles of gene manipulation-Old and Primrose
3. Gene Biotechnology-Jogdand
4. Molecular Biology-Twyman
5. Principles of genetics-Klug
6. Molecular Biology of the gene-Watson
7. Molecular Cloning (Vol 1,2,3)-Sambrook and Russell

LIST OF EXPERIMENTS

1. Isolation of chromosomal DNA from plant cells & Agarose gel Electrophoresis
2. Isolation of chromosomal DNA from *E.coli*& Agarose gel Electrophoresis
3. Qualitative and quantitative analysis of DNA using spectrophotometer
4. Plasmid DNA isolation
5. Restriction digestion of DNA
6. Making competent cells
7. Transformation of competent cells.
8. Demonstration of PCR
9. Demonstration of RFLP

ENZYME TECHNOLOGY (UMBTT 502)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 502	Core	Enzyme Technology	4	0	4	60	4+2=**6**

Objective:

To introduce and familiarize the undergraduate students with overall concept of enzyme at the interface of chemistry, biophysics, biochemistry and biotechnology as interdisciplinary approach and to underline its significance in biology.

Outcome:

Undergraduate students should be able to have comprehensive understanding of properties, kinetics, and functioning of enzymes as well as their production, applications in research and applied fields.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction	Enzymes are mainly proteins, enzymes are classified by the reactions they catalyze.	6
Unit II	Enzyme function	Enzymes affect reaction rates not equilibria, Reaction rates and equilibria have precise thermodynamic definition, Principles behind catalytic power and specificity of enzymes, Weak interaction between enzyme and substrate are optimized in transition state, Enzyme use binding energy to provide reaction specificity and catalysis, Specific catalytic groups contribute to catalysis.	10
Unit III	Enzyme Kinetics	Kinetics and mechanism, Substrate concentration and rate of reaction, Quantitative expression of relationship between substrate concentration and rate of reaction, The meaning of Vmax and Km, Enzymes catalyzing reactions involving two or more substrate Pre-steady state kinetics can provide evidence for specific reaction.	10
Unit IV	Enzyme Inhibition	Reversible and irreversible, Effect of pH, Examples of enzymatic reactions.	8
Unit V	Regulatory enzymes	Allosteric enzymes are regulated by non-covalent binding of modulators, Allosteric organs are exceptions to many general rules, two models explain the kinetic behavior of allosteric enzymes, Other mechanisms of enzyme regulation.	8
Unit VI	Production of enzymes	Enzymes from animal and plant sources, Enzymes from	09

Sr. No.	Topic	Detail of syllabus	Hrs.
		microbial sources, Large scale production, Biochemical fundamentals, Genetic engineering, Recovery of enzymes, Isolation of soluble enzymes, Enzyme purification, Immobilised enzymes, Legislative and safety aspects.	
Unit VII	Synthesis of chemicals using enzymes	Hydrolytic enzymes, Chiral building blocks for synthesis, Reduction and oxidation, Use of enzymes, in sugar chemistry, Use of enzymes to make amino acids and peptides.	09

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED:

Reference Books:

1. A text of biochemistry, - A.V.S.S. Rama Rao 9th ed. (UBS Publisher's and Distributors) Ltd.)
2. Leninger: Principles of Biochemistry, 3nd Ed. – Nelson D. et al (Worth Publishers)
3. Basic Biotechnology, 2nd Ed. – Ratledge, C and Kristiansen B. (Cambridge)
4. Biochemistry, 5th, - Ed. Breg, J.M. Tymoczko J.L. and Stryer L. (W.H. Freeman & Co.)
5. Molecular Biology of the Cell, 2nd-5th Ed. – Alberts B. et al (Garland Publishing)
6. Molecular Cell Biology, 2nd -7th Ed. – Lodish et.al

PRACTICALS:

1. Assay of chymotrypsin and trypsin.
2. Isolation and partial purification of enzymes, amylases and cellulases.
3. Localization of enzymes – mitochondrial (SDH) and cytosolic (GSH)
4. Determination of characteristics of enzyme-catalyzed reaction (Vmax and Km).
5. Effect of temperature and pH on the rate of enzyme catalysed reaction.
6. Effect of inhibitors/activators on enzyme catalyzed reactions.
7. Immobilization of enzymes.
8. Characterisation of immobilised enzymes.

INDUSTRIAL & FERMENTATION TECHNOLOGY (UMBTT 503)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 503	Core	Industrial & Fermentation Technology	4	0	4	60	4+2=**6**

Objective:

To acquaint students with technical and biological aspect of microbial utilisation of for production of metabolites

Outcomes :

After completion of this course, students will be able to understand:

1. Design of various reactor used in industries.
2. Criteria for selection of media for microbial growth.
3. Methos of strain improvement and preservation of culture.
4. Upsream as well as downstream processing involved in fermentation.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to fermentation technology	History, scope and development of fermentation technology,isolation and screening of industrially important microorganisms- primary and secondary screening, Maintenance of strain, strain improvement.	15
Unit II	Fermentation media	Natural and synthetic media, basic components of an media (carbon sources, nitrogen sources, vitamins, mineral,antifoaming agents), role of buffers in media, process of aeration and agitation.	15
Unit III	Fermentor design	Basic design of fermentor,type of fermentors,scale up study and product development. Downstream processing and product recovery, regulation and safety.	12
Unit IV	Production of microbial products	Production of alcohol, organic acid- citric acid antibiotic - penicillin,amino acid – glutamic acid, vitamin – B1, single cell protein (scp)	18

METHODOLOGY:

The course would be taught through lectures.

BOOKS RECOMMENDED:

1. Peter f stanbury – principles of fermentation technology.
2. Allan Whitaker – principles of fermentation technology
3. H.j.Peppler,D.Perlman – microbial technology

PRACTICALS:

1. Isolation of antibiotic producing microorganisms from soil.
2. Isolation of enzyme producing microorganisms from soil.
3. Production of alcohol.

DISSERTATION (UMBTPr 504)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTPr 504	Core	Project Work	4	0	4	60	**4+2**=6

B. Sc Dissertation Project: Each candidate needs to complete a short dissertation project. Prior to proposing a project, the students must have identified a research topic and a mentor who is familiar with their prospective inquiry and who is willing to provide guidance and oversee the project.

Semester VI

MOLECULAR DIAGNOSTICS (UMBTT 601)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 601	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 to Disorders	Biochemical disorders, Immune disorders Infectious disease, parasitic disease, Genetic disorders, chromosomal disorders, single cell disorders and complex traits	10
Unit II	Chromosomal Disorder Diagnostics	Autosomal; sex chromosomal; karyotype analysis, G-banding, in situ hybridization (FISH), and comparative genomic hybridization (CGH).	10
Unit III	DNA diagnostics	PCR based diagnostics; ligation chain reaction, southern blot diagnostics, array-based diagnostics, DNA sequencing, genetic profiling, single nucleotide polymorphism.	12
Unit IV	Biochemical Diagnostics	Inborn errors of aromatic amino acids, haemoglobinopathies, mucopolysaccharidoses, lipidoses, and glycogen storage disorders.	10
Unit V	Immunodiagnostics	Diagnosis of infectious diseases, respiratory diseases (influenza, etc.) Viral diseases-HIV etc., bacterial diseases, enteric diseases, parasitic diseases and mycobacterium diseases. Phage display, immunoarrays, FACs	10

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

1. Textbook: Molecular Diagnostics: Fundamentals, Methods and Clinical Applications. Authors: Lela Buckingham and Maribeth Flaws. Ph.d , Lela Buckingham Publisher: F A Davis Co
2. Molecular Diagnostics: Techniques and Applications for the Clinical Laboratory Wayne W. Grody, Robert M. Nakamura, Frederick L. Kiechle, Charles Strom, Publisher: Academic Press;

PRACTICALS:

1. Isolation of Genomic DNA
2. Nucleic acid labeling and southern hybridization
3. Automated DNA sequencing (Demo)
4. RNA isolation, Pulsed Field Gel Electrophoresis, PAGE
5. PCR based diagnosis of human and plant bacterial pathogen.

IMMUNO TECHNOLOGY & DIAGNOSTICS (UMBTT 602)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 602	Specialized	Immuno Technology & Diagnostics	4	0	4	60	4+2=**6**

Objective:

The objective of this course is to provide Students with detail understanding of different cells of the immune system and their role in immune protection as well as application of immunological techniques. The course will provide knowledge about role of immune system in pathogenesis of cancer, autoimmune disease and different infectious diseases.

Outcome:

At the end of the course students will be able to

- Apply the knowledge of immune associated mechanisms in medical biotechnology research.
- Demonstrate immunological techniques.
- Interpret association of immune system with cancer, autoimmunity, transplantation and infectious disease.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction	Scope of Immunotechnology, preparation and purification of antigens, extraction of antigens from pathogens, parasites& other biological materials. Antigen fractionation & purification, preparation of synthetic antigens, recombinant antigens.	
Unit II	Production of Antibodies	Production, purification & characterization of Antibodies. Different kinds of Immunization procedures. Purification of Immunoglobulins, Characterization of Immunoglobulins.	
Unit III	Production of Hybridoma & Monoclonal Antibody	Hybridoma & Monoclonal Antibody techniques, Production of Murine Hybridoma, Production of Monoclonal Antibodies in cultures, Purification of MCAbs, Characterization of MAbs & labeling of Antibodies.	
Unit IV	Immunological Methods	Cellular Immunological methods, Markers of Immunocompetent cells, separation & purification of Immunocompetent cells. Flow Cytometry and FACS, Functional test for Immunocompetent cells & Histocompatibility testing.	
Unit V	Immunological Assays & Diagnostics	Agglutination tests, Radio Immuno assays, Enzyme Immuno assays, Immunoblotting, immunoflourescence techniques, Immunodiffusion, Rocket Immuno Electrophoresis, ELISA, Western Blot Analysis.	

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

Reference Book:

1. Janeway C. A. Travers P., Walport M., Immuno biology: the immune system in health and disease, Garland Science Publishing New York (2012) 8th ed.
2. Owen J. A., Punt J., Strandfold S.A, Jones P.P., Kuby- Immunology W.H. Freeman & Company (2013), 7 th ed.
3. Delves P. J., Martin J. S., Burton R. D., Roitt M. I. Roitt's Essential Immunology, Wiley Blackwell (2011) 12th ed.
4. Khan F.H. The Elements of Immunology, Pearson Education (2009)

PRACTICALS:

1. Blood film preparation and identification of cells
2. Immuno-diffusion
3. Hemagglutination
4. Agglutination inhibition
5. Rocket immune-electrophoresis,
6. Western blotting
7. ELISA
8. Epitope prediction using Immuno-informatics tool
9. Isolation of Peripheral blood mononuclear cells.

FOOD BIOTECHNOLOGY (UMBTT 603)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 603	Specialized	Food Biotechnology	4	0	4	60	4+2=**6**

Objective:

The course will provide a broad grounding in concepts techniques & issues involved in food products & their processing.

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.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction	Major component of foods, constituents of food, food processing, food spoilage – introduction, causes of food spoilage, food poisoning, food borne intoxication food borne infection.	08
Unit II	Food preservation & processing	Introduction, necessary, methodology, principles and methods of food preservation, Low temperature preservation-methods-chilling, refrigeration & cold storage, High temperature preservation- blanching, pasteurization, sterilization & conning,	10
Unit III	Drying, dehydration & concentration	Introduction-factors affecting rate of drying & dehydration, drying methods, concentration methods of conc., changes effect at drying dehydration & concentration on quality of foods.	08
Unit IV	Food irradiation & Food fermentation	Introduction- radiation sources, measurement of radiation dose, type of radiation, factors affecting food irradiation, effect of irradiation, Food fermentation- Introduction, method, common fermented food	10
Unit V	Preservation using sugar, salt & acids	Food preserved using sugar, Salt- introduction, antimicrobial activity of salt, food product preserved using salt. Acid- introduction, common food preserved using acid	12
Unit VI	Probiotics	History, importance, mode of action of Probiotics, characteristics of Probiotics, action of Probiotics, advantages of Probiotics, disadvantages.	12

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

Reference Book:

1. Technology of food preservation – Desrosiser N.W.
2. Introduction to food science & technology- Stewart G.P. & Amerine N. A.
3. Food processing handbook- Brennan J.G.
4. Food processing & preservation- B. Sivasankar
5. Essential of food science – Vickie A.N.

PRACTICALS:

1. Demonstration of effect of blanching on food quality characteristics.
2. Preservation using heat
3. Preservation by low temperature
4. Preservation by high concentration of sugar (jam/ jelly syrup)
5. Preservation by using salt (pickling)
6. Drying and dehydration of fruit
7. Drying and dehydration of vegetables

PLANT BIOTECHNOLOGY (UMBTT 604)

Course Code	Category	Course Name	L	T	P	Total Hr	Credits (T+P)
UMBTT 604	Specialized	Plant Biotechnology	4	0	4	60	4+2=**6**

Objective:

The aim is to teach set of in vitro techniques, methods and strategies related to plant biotechnology. Students will learn how to create genetic variability for the improvement of crops, to improve the state of health of planted material and to increase the number of desirable germplasm.

Outcome:

At the end of the course the student will able to gain fundamental knowledge in plant biotechnology and their applications.

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction	History of PTC, Concept of Cellular Totipotency. Laboratory Organization, Sterilization Techniques, Media Preparation. Types of media – MS, Nitsh, Gamborgs. Plant growth regulators. Cytoplasmic Male Sterility.	08
Unit II	Micropropagation	Techniques and various steps involved in micropropagation, Production of disease free plants, Commercial aspects and limitations of micropropagation	08
Unit III	Production of Haploids & Embryo culture	Plant tissue culture techniques, in-vitro pollination and fertilization, embryo culture and its applications, embryogenesis and organogenesis.	08
Unit IV	Genetic manipulation of plants	Introduction, protoplast isolation, culture and regeneration, methods of fusing protoplasts, somatic hybridization. Genetic Engineering: *Agrobacterium* plant interaction, Ti and Ri plasmids. T-DNA transfer, Genetic Transformation: *Agrobacterium* mediated gene delivery cointegrated and binary vectors, direct gene transfer: PEG – mediated, electroporation, particle bombardment.	12
Unit V	Molecular markers and marker assisted selection	Molecular markers and marker assisted selection, Applications of plant transformations/ transgenics, Commercial transgenic crops.	10
Unit VI	Plant secondary metabolites	Primary vs secondary metabolites, Production of secondary metabolites and other compounds using plant cell culture, Hairy root culture, Immobilized cell system.	08
Unit VII	Molecular farming	Molecular farming of Alkaloids, Useful enzymes, Therapeutic proteins, custom- made Antibodies, Edible vaccines.	06

METHODOLOGY

The course would be taught through lectures.

BOOKS RECOMMENDED:

1. Chawla, 2003. Introduction to Plant Biotechnology (2nd edn) Oxford and IBH Publishers.
2. R.C. Dubey, A Text Book of Biotechnology. S.Chand & Co Ltd, New Delhi.
3. Chrispeel M.J, Sadava D.E, 1994. 2nd Revised edition, Plants, Genes and Agriculture, Jones and Barlett Publication, Boston. 28.
4. Satyanarayana . U, 2008, Biotechnology, Books and Allied (p) Ltd.
5. R. Keshava Chandran and K.V. Peter. Plant Biotechnology. First edition. University Press (India) Pvt Ltd, Hyderabad.
6. Plant tissue culture Theory and Practice - S.S Bhojwani and M.K. Razdan., Elsevier.
7. Plant cell and tissue culture - S. Narayanaswamy
8. Plant biotechnology - Ignacimuthu, Oxford and IBH pub
9. Plant biotechnology – J Hammond, et. al., Springer Verlag
10. Practical application of plant molecular biology – R J Henry, Chapman & Hall
11. Genetic Transformation of Plants: Jackson JF, Linskens H
12. Plant Tissue Culture Concepts and Laboratory Exercises: Robert N Trigiano, Dennis JGray
13. Applied and fundamental Aspects of Plant Cell, Tissue, and Organ Culture: Reinert J and Bajaj.
14. Lydiane Kyte & John Kelvins (1996) Plants from test tubes. An introduction to Micropropogation (3rd Edition) Timber Press, Partland.
15. Kumar H.D (1991) A Text Book on Biotechnology (2nd Edition). Affiliated East West Press Private Ltd. New Delhi.
16. Chrispeel M.J. and Sdava D.E. (1994) Plants, Genes and Agriculture, Jones and Barlett Publishers, Boston.
17. Reinert J. and Bajaj Y.P.S (1997) Applied and Fundamental Aspects of Plant Cell, Tissue, and Organ Culture, Narosa Publishing House.

PRACTICALS:

1. Sterilization techniques – glasswares, media and laminar air flow chamber
2. Preparation of simple growth nutrient (Knop's medium) full strength, solid and liquid.
3. Preparation of complex nutrient medium (Murashige &Skoog's medium & B5)
4. Callus induction and sub-culturing.
5. To select, prune, sterilize and prepare an explant for culture.
6. To demonstrate various steps of Micropropagation.
7. Isolation of plant genomic DNA from the leaf sample
8. Suspension cultures and their maintenance.