MAHATMA GANDHI UNIVERSITY
KOTTAYAM

B.Sc. BIOTECHNOLOGY

REGULATION, SCHEME AND SYLLABUS
OF
COMMON, CORE AND COMPLEMENTARY COURSES
AS PER THE NEWLY INTRODUCED C.B.C.S PROGRAMME
2017

Department of Biotechnology

MAR AUGUSTHINOSE COLLEGE

RAMAPURAM

MAHATMA GANDHI UNIVERSITY, KOTTAYAM

REGULATIONS FOR UNDER GRADUATE PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM 2017

Preamble

Mahatma Gandhi University introduced Choice Based Credit and Semester and Grading System in colleges affiliated to the University from the Academic Year 2009-10, under **Direct Grading System**. Subsequently, the Kerala State Higher Education Council constituted a committee of experts headed by Prof. B Hridayakumari, to study and make recommendations for the improvement of the working of the Choice Based Credit and Semester System in colleges affiliated to the Universities in the State. The State Government accepted the recommendations of the Committee and the Syndicate and the Academic Council of the Mahatma Gandhi University has resolved to reform the existing CBCSS regulations. Accordingly Regulations for Under Graduate Programmes under Choice Based Course-Credit-Semester System and Grading, 2013,was introduced in the University from the Academic year 2013-14 onwards, under Indirect Grading System. The University Grants Commission, in order to facilitate student mobility across institutions within and across the states insisted to introduce uniform grading system in the Universities. On the basis of the UGC directives, various Board of Studies / Expert committees framed draft Regulations and syllabi for various UG Programmes to be made effective from 2016-17 academic year onwards. The Academic Council held on 18th July 2016 resolved to postpone the implementation of the regulations and syllabi for UG Programmes and to implement from 2017-2018 academic year after detailed discussions with the experts and other stake holders. On the basis of the suggestions put forth by the joint meeting of Faculties and also based on the discussions and suggestions in the workshops conducted for the purpose, Chairpersons of various faculties submitted modified draft Regulations, Scheme and Syllabi and text books for various undergraduate Programmes and the Standing committee of the Academic Council at its meeting held on 5th May 2017 resolved to recommend to the Academic council to approve the modified Regulations, Scheme and Syllabi and text books for various undergraduate programmes. Hence it becomes necessary to issue modified Regulations as follows.

1. TITLE

1.1. These regulations shall be called "**MAHATMA GANDHI UNIVERSITY REGULATIONS FOR UNDER GRADUATE PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM 2017**"

2. SCOPE

2.1 Applicable to all regular Under Graduate Programmes conducted by the University with effect from 2017 admissions, except for Professional and B.Voc. Programmes. Also applicable to Distance/Private Undergraduate Programmes with suitable modifications. Under Graduate Programmes in Management Studies are included as non-professional programmes.

2.2 Examinations of the courses being run under the Distance/Private registration scheme shall be conducted annually.

2.3 Medium of instruction is English except in the case of language courses other than English unless otherwise stated therein.

2.4 The provisions supersede all the existing regulations for the Regular/Distance/ Private Undergraduate programmes to the extent herein prescribed.

3. DEFINITIONS

3.1. ***'Academic Week'*** is a unit of five working days in which the distribution of work is organized from day one to day five, with five contact hours of one hour duration on each day.

3.2. **'Choice Based Course**' means a course that enables the students to familiarize the advanced areas of core course.

3.3. ***'College Coordinator'*** is a teacher nominated by the College Council to co-ordinate the continuous evaluation undertaken by various departments within the college. He/she shall be nominated to the college level monitoring committee.

3.4. ***'Common Course I'*** means a course that comes under the category of courses for English.

3.5 ***'Common Course II'*** means additional language.

3.6. ***'Complementary Course'*** means a course which would enrich the study of core courses.

3.7. ***'Core course'*** means a course in the subject of specialization within a degree programme. It includes a course on environmental studies and human rights.

3.8. ***'Course'*** means a portion of a subject to be taught and evaluated in a semester (similar to a paper under annual scheme).

3.9. ***'Credit'*** is the numerical value assigned to a paper according to the relative importance of the syllabus of the programme**.**

3.10. ***'Department'*** means any teaching department in a college.

3.11. ***'Department Coordinator'*** is a teacher nominated by a Department Council to co-ordinate the continuous evaluation undertaken in that department.

3.12. ***'Department Council'*** means the body of all teachers of a department in a college.

3.13. ***'Faculty Advisor'*** means a teacher from the parent department nominated by the Department Council, who will advise the student on academic matters.

3.14. ***Grace Marks*** shall be awarded to candidates as per the University Orders issued from time to time**.**

3.15. ***'Grade'*** means a letter symbol (A, B, C, etc.), which indicates the broad level of performance of a student in a Paper/Course/ Semester/Programme.

3.16. ***'Grade Point'*** (GP) is the numerical indicator of the percentage of marks awarded to a student in a course.

3.17. ***'Institutional Average (IA)'*** means average mark secured (Internal + external) for a course at the college level.

3.18. ***'Open Course'*** means an optional course which the student is free to take at his/her will. Open course shall be a non-major elective course offered by the Departments other than the parent Department.

3.19. **'*Parent Department'*** means the department which offers core course/courses within an undergraduate programme.

3.20. ***'Programme'*** means a three year programme of study and examinations spread over six semesters, the successful completion of which would lead to the award of a degree.

3.21. ***'Semester'*** means a term consisting of a minimum **90** working days, inclusive of tutorials, examination days and other academic activities within a period of six months**.**

3.22. ***'University Average (UA)'***means average mark secured (Internal + external) for a course at the University level.

3.23. ***'Vocational Course'*** **(Skill Enhancement Course)** means a course that enables the students to enhance their practical skills and ability to pursue a vocation in their subject of specialization.

3.24. Words and expressions used and not defined in this regulation shall have the same meaning assigned to them in the Act and Statutes of the University.

4. ELIGIBILITY FOR ADMISSION AND RESERVATION OF SEATS

4.1 Eligibility for admissions and reservation of seats for various Undergraduate Programmes shall be according to the rules framed by the University in this regard, from time to time.

5. DURATION

5.1 The duration of U.G. programmes shall be ***6 semesters***.

5.2 There shall be two Semesters in an academic year, the "ODD" semester commences in June and on completion, the "EVEN" Semester commences. There shall be two months vacation during April/May.

5.3 No student shall be allowed to complete the programme by attending more than 12 continuous semesters.

6. REGISTRATION

6.1. The strength of students for each programme shall be as per the existing orders, as approved by the University.

6.2. The college shall send a list of students registered for each programme in each semester giving the details of courses registered including repeat/re-appearance courses to the University in the prescribed form within **45** days from the commencement of the Semester.

6.3. Those students who possess the required minimum attendance during a semester and could not register for the semester examination are permitted to apply for Notional

Registration to the examinations concerned enabling them to get promoted to the next class.

7. SCHEME AND SYLLABUS

7.1. The U.G. programmes shall include **(a)** Common Courses I and II, **(b)** Core Course(s), **(c)** Complementary/Vocational Courses, and **(d)** Open Course.

7.2. There shall be one Choice Based course (Elective Course) in the sixth semester. In the case of B.Com Programme there shall be an elective stream from third semester onwards.

7.3. Credit Transfer and Accumulation system can be adopted in the programme. Transfer of Credit consists of acknowledging, recognizing and accepting credits by an institution for programmes or courses completed at another institution. The Credit Transfer Scheme shall allow students pursuing a programme in one University to continue their education in another University without break.

7.4. A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass for a course. For a pass in a programme, a separate minimum of **Grade D** is required for all the individual courses. If a candidate secures **F Grade** for any one of the courses offered in a Semester/Programme, **only F grade** will be awarded for that Semester/Programme until he/she improves this to **D Grade** or above within the permitted period. (See Clause 5.3)

7.5. Students who complete the programme with "D" grade in the Mahatma Gandhi University "Regulations for Under Graduate Programmes under Choice Based Credit System 2017"will have one betterment chance within 12 months, immediately after the publication of the result of the whole programme.

7.6. Students discontinued from previous regulations CBCSS 2013, can pursue their studies in the Mahatma Gandhi University "Regulations for Under Graduate Programmes under Choice Based Credit System 2017"after obtaining readmission. These students have to complete the programme as per the Mahatma Gandhi University "Regulations for Under Graduate Programmes under Choice Based Credit System 2017".

7.7. The practical examinations (external/internal) will be conducted only at the end of even semesters for all programmes. Special sanction shall be given for those programmes which need to conduct practical examinations at the end of odd semesters.

8. PROGRAMME STRUCTURE

Model I BA/B.Sc.

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	22
d	Credits required from Common Course II	16
e	Credits required from Core course and Complementary courses including Project	79
f	Open Course	3
g	Minimum attendance required	75%

Model I/II B.Com

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	14
d	Credits required from Common Course II	8
e	Credits required from Core and Complementary/Vocational courses including Project	95
f	Open Course	3

g	Minimum attendance required	75%

Model II BA/B.Sc.

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	16
d	Credits required from Common Course II	8
e	Credits required from Core + Complementary + Vocational Courses including Project	93
f	Open Course	3
g	Minimum attendance required	75%

Model III BA/B.Sc./B.Com

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	8
d	Credits required from Core + Complementary + Vocational Courses including Project	109
e	Open Course	3
f	Minimum attendance required	75%

9. EXAMINATIONS

9.1 The evaluation of each paper shall contain two parts:

(i) Internal or In-Semester Assessment (ISA)

(ii) External or End-Semester Assessment (ESA)

9.2. The internal to external assessment ratio shall be 1:4.

Both internal and external marks are to be rounded to the next integer.

All papers (theory & practical), grades are given **on a 7-point scale** based on the total percentage of marks, ***(ISA+ESA)*** as given below:-

Percentage of Marks	Grade	Grade Point
95 and above	S Outstanding	10
85 to below 95	A^+ Excellent	9
75 to below 85	A Very Good	8
65 to below 75	B^+ Good	7
55 to below 65	B Above Average	6
45 to below 55	C Satisfactory	5
35 to below 45	D Pass	4
Below 35	F Failure	0
	Ab Absent	0

10. CREDIT POINT AND CREDIT POINT AVERAGE

Credit Point (CP) of a paper is calculated using the formula:-

CP = C × GP, where C is the Credit and GP is the Grade point

Semester Grade Point Average (SGPA) of a Semester is calculated using the formula:-

SGPA = TCP/TC, where TCP is the Total Credit Point of that semester.

Cumulative Grade Point Average (CGPA) is calculated using the formula:-

CGPA = TCP/TC, where TCP is the Total Credit Point of that programme.

Grade Point Average (GPA) of different category of courses viz. Common Course I, Common Course II, Complementary Course I, Complementary Course II, Vocational course, Core Course is calculated using the formula:-

GPA = TCP/TC, where TCP is the Total Credit Point of a category of course.

TC is the total credit of that category of course

Grades for the different courses, semesters and overall programme are given based on the corresponding CPA as shown below:

GPA	**Grade**
9.5 and above	**S Outstanding**
8.5 to below 9.5	**A+ Excellent**
7.5 to below 8.5	**A Very Good**
6.5 to below 7.5	**B+ Good**
5.5 to below 6.5	**B Above Average**
4.5 to below 5.5	**C Satisfactory**
3.5 to below 4.5	**D Pass**
Below 3.5	**F Failure**

11. MARKS DISTRIBUTION FOR EXTERNAL AND INTERNA EVALUATIONS

The external theory examination of all semesters shall be conducted by the University at the end of each semester. Internal evaluation is to be done by continuous assessment. For all courses without practical total marks of external examination is 80 and total marks of internal evaluation is 20. Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

11.1 For all courses without practical

a) Marks of external Examination : 80

b) Marks of internal evaluation : 20

Components of Internal Evaluation of theory	**Marks**
Attendance	**5**
Assignment /Seminar/Viva	**5**
Test papers (2x5=10)	**10**
Total	**20**

11.2 For all courses with practical total marks for external evaluation is 60 and total marks for internal evaluation is 15.

For all courses with practical

a) Marks of external Examination : 60

b) Marks of internal evaluation : 15

Components of Internal Evaluation	**Marks**
Attendance	**5**
Assignment /Seminar/Viva	**2**
Test papers (2 x 4)	**8**
Total	**15**

(c) For practical examinations total marks for external evaluation is 40 for internal evaluation is 10

Components Internal evaluation of Practical	**Marks**
Attendance	2
Test paper (1 x 4)	4

Record*	4
Total	**10**

*Marks awarded for Record should be related to number of experiments recorded and duly signed by the teacher concerned in charge.

All three components of internal assessments are mandatory.

11.3 For projects

a) Marks of external evaluation : 80

b) Marks of internal evaluation : 20

c)

Components of External Evaluation of Project	**Marks**
Dissertation (External)	50
Viva-Voce (External)	30
Total	**80**

*****Marks for dissertation may include study tour report if proposed in the syllabus.

Components of internal Evaluation of Project	**Marks**
Punctuality	5
Experimentation/data collection	5
Knowledge	5
Report	5
Total	**20**

Attendance Evaluation for all papers

% of attendance	**Marks**
90 and above	5
85 – 89	4
80-84	3
76-79	2

75	1

(Decimals are to be rounded to the next higher whole number)

13. ASSIGNMENTS

Assignments are to be done from 1st to 4th Semesters. At least one assignment should be done in each semester for all courses.

14. SEMINAR/VIVA

A student shall present a seminar in the 5th semester for each paper and appear for Viva-voce in the 6th semester for each course.

15. INTERNAL ASSESSMENT TEST PAPERS

Two test papers are to be conducted in each semester for each course. The evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of internal assessments are to be kept in the college for one year and shall be made available for verification by the University. The responsibility of evaluating the internal assessment is vested on the teacher(s), who teach the course.

15.1 Grievance Redressal Mechanism

Internal assessment shall not be used as a tool for personal or other type of vengeance. A student has all rights to know, how the teacher arrived at the marks. In order to address the grievance of students, a three-level Grievance Redressal mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1: Department Level:

The Department cell chaired by the HOD, Department Coordinator, Faculty Advisor and Teacher in-charge as members.

Level 2: **College level**

A committee with the Principal as Chairman, College Coordinator, HOD of concerned Department and Department Coordinator as members.

Level 3: **University Level**

A Committee constituted by the Vice-Chancellor as Chairman, Pro-Vice-Chancellor, Convener - Syndicate Standing Committee on Students Discipline and Welfare, Chairman-Board of Examinations as members and the Controller of Examination as member-secretary.

15.2 The College Council shall nominate a Senior Teacher as coordinator of internal evaluations. This coordinator shall make arrangements for giving awareness of the internal evaluation components to students immediately after commencement of I semester

15.3 The internal evaluation marks/grades in the prescribed format should reach the University before the 4th week of October and March in every academic year.

16. External Examination

The external theory examination of all semesters shall be conducted by the University at the end of each semester.

16.1 Students having a minimum of 75% average attendance for all the courses only can register for the examination. Condonation of shortage of attendance to a maximum of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme may be granted by the University on valid grounds. This condonation shall not be counted for internal assessment. Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on production of participation/attendance certificates, within one week, from competent authorities and endorsed by the Head of the institution. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also. Those students who are not eligible even with condonation of shortage of attendance shall repeat the **semester** along with the next batch after obtaining readmission.

16.2 All students are to do a **project in the area of core course.** This project can be done individually or in groups(not more than five students) for all subjects which may be carried out in or outside the campus. Special sanction shall be obtained from the Vice-Chancellor to those **new generation programmes** and programmes on **performing arts** where students have to take projects which involve larger groups. The projects are to be identified during the II semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners appointed by the University. External Project evaluation and Viva / Presentation is compulsory for all subjects and will be conducted at the end of the programme.

16.3 There shall be supplementary exams only for fifth semester. Notionally registered candidates can also apply for the said supplementary examinations. For reappearance/ improvement for other semesters the students can appear along with the next batch.

16.4 A student who registers his/her name for the external exam for a semester will be eligible for promotion to the next semester.

16.5 A student who has completed the entire curriculum requirement, but could not register for the Semester examination can register notionally, for getting eligibility for promotion to the next semester.

16.6 A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the University examination for the same semester, subsequently. There shall be no improvement for internal evaluation.

17. All courses shall have unique alphanumeric code. Each teacher working in affiliated institutions shall have a unique identification code and this code is to be noted with the valuation, invigilation and all other examination duties.

18. PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, standard and application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. She/he shall also submit a detailed scheme of evaluation along with the question paper. A question paper shall be a judicious mix of short answer type, short essay type /problem solving type and long essay type questions.

19. RANK CERTIFICATE

The University publishes rank list of top 10 candidates for each programme after the publication of 6^{th} semester results. Rank certificate shall be issued to candidates who secure positions from 1^{st} to 3^{rd} in the rank list. Candidates who secure positions from fourth to tenth in the rank list shall be issued position certificate indicating their position in the rank list.

Candidates shall be ranked in the order of merit based on the CGPA scored by them. Grace marks awarded to the students should not be counted fixing the rank/position. Rank certificate and position certificate shall be signed by the Controller of Examinations.

Pattern of questions Papers

(a) Without practical

Sl. No.	Pattern	Marks	Choice of questions	Total marks
1	**Short Answer/problem type**	**2**	**10/12**	**20**
2	**Short essay/problem**	**5**	**6/9**	**30**
3	**Essay/problem**	**15**	**2/4**	**30**
			Total	**80**

(b) With practical

Sl. No.	Pattern	Marks	Choice of questions	Total marks
1	**Short Answer/problem type**	**1**	**10/12**	**20**
2	**Short essay/problem**	**5**	**6/9**	**30**
3	**Essay/problem**	**10**	**2/4**	**20**
			Total	**60**

Each BOS shall specify the length of the answers in terms of number of words. Pattern of questions for external examination of practical papers will decided by the concerned Board of Studies/Expert Committees.

19. MARK CUM GRADE CARD

The University under its seal shall issue to the students a MARK CUM GRADE CARD on completion of each programme, which shall contain the following information:

(a) Name of the University

(b) Name of the College

(c) Title & Model of the Undergraduate Programme

(d) Name of the Semester

(e) Name and Register Number of the student

(f) Date of publication of result

(g) Code, Title, Credits and Maximum Marks (Internal, External & Total) of each course opted in the semester.

(h) Internal, External and Total Marks awarded, Grade, Grade point and Credit point in each course opted in the semester.

(i) The total credits and total credit points in the semester.

(i) Semester Grade Point Average (SGPA) and corresponding Grade.

(k) Cumulative Grade Point Average (CGPA), GPA corresponding to Common Courses I and II, Core Course, Complementary Courses, Vocational Courses and Open Course.

(l) The final Mark cum Grade Card issued at the end of the final semester shall contain the details of all courses taken during the final semester examination and shall include the final Grade(SGPA) scored by the candidate from **1st to 5th** semesters, and the overall Grade for the total programme.

20. There shall **be 3 level monitoring** committees for the successful conduct of the scheme. They are -

1. Department Level Monitoring Committee (DLMC), comprising HOD and two senior-most teachers as members.

2. College Level Monitoring Committee (CLMC), comprising Principal, College Council secretary and A.O/Superintendent as members.

3. University Level Monitoring Committee (ULMC), headed by the Vice-Chancellor, Pro-Vice-Chancellor, Conveners of Syndicate Standing Committee on Examination, Academic Affairs and Registrar as members and the Controller of Examinations as member-secretary.

21. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Vice-Chancellor shall, for a period of one year from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any programme with such modifications as may be necessary.

22. The Vice Chancellor is authorized to make necessary criteria for eligibility for higher education in the grading scheme, if necessary, in consultation with other Universities. The Vice Chancellor is also authorized to issue orders for the perfect realization of the Regulations.

Annexure I – Model Mark cum Grace Card

Mahatma Gandhi University

Section: Priyadarshni Hills P.O.

Student ID: Kottayam

Date:

MARK CUM GRADE CARD

Name of candidate :

Name of College :

Permanent Register Number (PRN) : Degree:

Name of the Programme :

Name of Examination : First Semester Examination Month and Year

Date of publication of result :

Course Code	Course Title	Credit (C)	Marks						Percentage of total marks	Grade awarded (G)	Grade point (GP	Credit point (Cx GP)	Result
			External		Internal		Total						
			Awarded (E)	Maximum	Awarded (I)	Maximum	Awarded (E + I)	Maximum					
	Common Course I Common Course II Core Course Complementary Course I Complementary Course II/ Vocational Course Total Total credit points (TCP) Total credit (TC) SGPA: Grade:												

Annexure II – Model Mark cum Grace Card (VI Semester)

Mahatma Gandhi University

Section: Priyadarshni Hills P.O.

Student ID: Kottayam

Date:

MARK CUM GRADE CARD

Name of candidate :

Name of College :

Permanent Register Number (PRN) : Degree:

Name of the Programme :

Name of Examination : First Semester Examination Month and Year

Date of publication of result :

Course Code	Course Title	Credit (C)	Marks						Percentage of total marks	Grade awarded (G)	Grade point (GP	Credit point (Cx GP)	Result
			External		Internal		Total						
			Awarded (E)	Maximum	Awarded (I)	Maximum	Awarded (E + I)	Maximum					
	Core 9 Core 10 Core 11 Core 12 Choice Based Course Project SGPA Grade												

		Credit	GPA	Grade	Month & Year	Result
	Semester I Semester II Semester III Semester IV Semester V Semester VI					
	Common Course I Common Course II Complementary Course I Complementary Course II Core Course Open Course					
	Overall programme CGPA:					

Annexure III

Reverse side of the Mark cum Grade Card (COMMON TO ALL SEMESTERS)

Description of the Evaluation Process

Grade and Grade Point

The Evaluation of each Course comprises of Internal and External Components in the ratio 1:4 for all Courses.

Grades and Grade Points are given on a 7-point Scale based on the percentage of Total Marks (Internal + External) as given in Table 1.

(Decimals are to be rounded to the next whole number)

Credit point and Credit point average Grades for the different Semesters and overall Programme are given based on the corresponding CPA, as shown in

Table 1

% of marks	Grade	GP
Equal to 95 and above	S Outstanding	10
Equal to 85 and < 95	A^+ Excellent	9
Equal to75 and < 85	A Very Good	8
Equal to 65 and < 75	B+ Good	7
Equal to 55 and < 65	B Above Average	6
Equal to 45 and < 55	C Satisfactory	5
Equal to 35 and < 45	D Pass	4
Below 35	F Failure	
	Ab Absent	

Credit point **(CP)** of a paper is calculated using the formula CP = C x GP,

where C is the Credit; GP is the Grade Point

Grade Point Average (GPA) of a Course/ Semester or Programme (cumulative) etc. is calculated using the formula $\mathbf{GPA} = \frac{TCP}{TC}$

where TCP is the Total Credit Point; TC is the Total Credit

CPA	
Equal to 9.5 and above	**S Outstanding**
Equal to 8.5 and < 9.5	**A+ Excellent**
Equal to7.5 and < 8.5	**A Very Good**
Equal to 6.5 and < 7.5	**B+ Good**
Equal to5.5 and < 6.5	**B Above Average**

Equal to4.5 and < 5.5	**C Satisfactory**
Equal to 3.5 and < 4.5	**D Pass**
Below 3.5	**F Failure**

Note: A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass for a paper. For a pass in a programme, a separate minimum of **Grade D** is required for all the individual papers. If a candidate secures **F Grade** for any one of the paper offered in a Semester/Programme **only F grade** will be awarded for that Semester/Programme until he/she improves this to **D GRADE** or above within the permitted period.

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MAHATMA GANDHI UNIVERSITY

KOTTAYAM

B.Sc. BIOTECHNOLOGY

SCHEME AND SYLLABUS

OF

CORE AND COMPLEMENTARY COURSES

AS PER THE NEWLY INTRODUCED C.B.C.S PROGRAMME

2017

CONTENTS

(Prepared by Board of Studies and Faculty)

ACKNOWLEDGEMENT

The Board of Studies, the faculty and members of syllubus revision committee expresses sincere gratitude towards thehonourable Vice Chancellor, Pro vice Chancellor and the Registrar of MahatmaGandhi University. The guidelines and expertise provided by the syndicate members and the timely help from the administrative staff are acknowledged.

INTRODUCTION

The BSc Biotechnology Programme offered by M G University provides core and complementary courses as per the regulations of UGC. In the first semester programme, students are introduced to the basics of Life Sciences and the evolution of Biotechnology as a multidisciplinary branch of science. In connection with this, a methodology paper is incorporated in the first semester. As knowledge in Genetics, Cell and Molecular Biology, Biochemistry and Microbiology is essential to explore the principles of Biotechnology, these areas are incorporated as courses in various semesters of the programme. rDNA technology and Biotechnological approaches in Plant Science, Animal science and Environmental Science are constituted as separate courses. Properly designed experiments are incorporated in all semesters to provide ample opportunity for the students to gain sufficient practical knowledge in the subject. Extreme care has also being taken to incorporate essential principles of Environmental services and Ecology into the newly designed curriculum. The syllabus also comprises of choice based courses, electives and complementary courses that are being instrumental in expanding the knowledge domain of the subject.

OBJECTIVES

The syllabus has been designed with the following objectives:

- The curriculum should provide a platform for understanding basic life science along with advanced topics of Biotechnology.
- The curriculum should be able to make the students competent in both theoretical and practical aspects of the subject.
- The curriculum should carry multiple options in terms of electives for incorporating innovative ideas generated in this field.
- The interdisciplinary nature of the subject is to be incorporated to have option for employment and higher studies.

DURATION OF THE COURSE

Duration of the course is two years. Each year is divided into two semesters.

EVALUATION

The scheme involves external and internal evaluation which is conducted according to the regulations of MahatmaGandhi University.

SCHEME OF THE PROGRAMME

Sem.	Sl.No.	Course	Inst.Hrs.	credits	
I Sem.		Common 1 English	5	-	4
	Core1	BT1CRT01Basic Life Sciences	5	-	4
	core 2	BT1CRT02Methodology in Biotechnology	5	-	4
	Core 3	BT1CRP01 PracticaL-Basic Life Sciences	-	2	2
	Compl.-1	Biochemistry-1	2	-	2
	Compl.-2	Microbiology-1	2	-	2
	Compl.-3	Practical Biochemistry-1	-	2	1
	Compl.-4	PracticalMicrobiology -1	-	2	1
		Total			20
II Sem		Common 2 English	5	-	4
	Core 4	BT2CRT03 Cell Biology	4	-	4
	Core 5	BT2CRT04 Elementary Chemistry for Biology	4	-	3
	Core 6	BT2CRT05 Evolution & Developmental Biology	2	-	2
	Core 7-	BT2CRP02 Practical- Cell Biology	2	-	2
	Compl.-5	Biochemistry-2	2	-	2
	Compl.-6	Microbiology-2	2		2
	Compl.-7	PracticalBiochemistry-2	2	-	1
	Compl.-8	Practical Microbiology-2	2	-	1
					21
III Sem.	Core - 8	BT3CRT06 Immunology	5	-	4
	Core 9	BT3CRT07 Genetics	5	-	4
	Core10	BT3CRT08 Biostatistics and Computer application	4	-	3
	Core–11	BT4CRP03– Practical- Immunology and Genetics.	3	-	3
	Comp.-9	Biochemistry-3	2	-	2

	Compl.-10	**Microbiology-3**	**2**	**-**	**2**
	Compl.-11	**Practical Biochemistry-3**		**2**	**1**
	Compl.-12	**Practical Microbiology-3**		**2**	**1**
					20
Sem.		**Course**	**Inst..Hrs.**		**Credits**
			T	**L**	
IV Sem	**Core12**	**BT4CRT09Molecular Biology**	**5**	**-**	**4**
	Core13	**BT4CRT10 Enzymology**	**4**	**-**	**4**
	Core14	**BT4CRT11 Biophysics and Bioinformatics**	**4**	**-**	**3**
	Core15	**Practical Molecular biology and Enzymology**	**-**	**4**	**3**
	Compl.13	**Biochemistry-4**	**2**	**-**	**2**
	Compl.14	**Microbiology-4**	**2**	**-**	**2**
	Compl.15	**Practical Biochemistry-4**	**-**	**2**	**1**
	Compl.16	**PracticalMicrobiology-4**	**-**	**2**	**1**
	Total				**20**
V Sem.	**Core 16**	**BT5CRT12 Recombinant DNA technology**	**6**	**-**	**4**
	Core17	**BT5CRT13- Environmental Biotechnology**	**4**	**-**	**4**
	Core 18	**BT5CRT14 Animal Biotechnology**	**6**	**-**	**4**
	Core 19	**BT5CRP05 Practical rDNA Technology and Environmental Biotechnology**		**5**	**4**
	core 20	**Open Course(A/B/C)**	**4**	**-**	**3**
		Total			**19**
VISem.	**Core21**	**BT6CRT15Plant Biotechnology**	**5**	**-**	**4**
	Core22	**BT6CRT16 Industrial Biotechnology**	**5**	**-**	**4**
	Core23	**BT6CBT01-Choice Based Course(A/B/C)**	**5**	**-**	**4**
	Core24	**BT6CRP06 Practical Environmental Biotechnology and Plant Biotechnology**	**5**	**-**	**4**
	Core25	**BT6CRP07 Project and viva voce**	**-**	**5**	**4**
					20
		Total credits			**120**

Open course

BT5OPT01A- Tissue culture techniques
BT5OPT01B - Biotechnology for sustainable development
BT5OPT01C - IPR and patents

Choice based Course

BT6CBT01A - Bioinformatics
BT6CBT01B - Nanotechnology
BT6CBT01C - Diseases and Diagnostic Biotechnology

Complimentary Course

BT1CMT01 Cell Biology
BT2CMT02 Genetics
BT3CMT03 Molecular Biology and Recombinant DNA Technology

The programme includes a study tour/field visit and the report about the same should be submitted by each student.

SEMESTER I

Common Courses

MAHATMA GANDHI UNIVERSITY

SYLLABI FOR COMMON COURSES - UG PROGRAMMES

2017 ADMISSIONS ONWARDS

COURSE 1- Fine-tune Your English

Course Code	**EN1CC01**
Title of the course	**Fine-tune Your English**
Semester in which the course is to be taught	**1**
No. of credits	**4**
No. of contact hours	**90**

AIM OF THE COURSE

The course is intended to introduce the students to the basics of grammar, usage and effective communication.

OBJECTIVES OF THE COURSE

On completion of the course, the student should be able to:
1. confidently use English in both written and spoken forms.
2. Use English for formal communication effectively.

COURSE OUTLINE

Module 1 **(18 Hours)**

The Sentence and Its Structure - How to Write Effective Sentences – Phrases -What Are They? - The Noun Clauses - The Adverb Clause - "If All the Trees Were Bread and Cheese" - The Relative Clause - How the Clauses Are Conjoined -

Word-Classes and Related Topics - Understanding the Verb - Understanding the Auxiliary Verb - Understanding the Adverbs - Understanding the Pronoun - The Reflexive Pronoun - The Articles I - The Articles II - The Adjective - Phrasal Verbs - Mind Your Prepositions

Module 2 **(18 Hours)**

To Err Is Human - Concord - A Political Crisis - Errors, Common and Uncommon - False Witnesses - The Anatomy of Mistakes- A Fault-finder Speaks - A Lecture on AIDS - A Test for You, Reader - Ungrammatical Gossip - Round Circles and Equal Halves: A Look at Tautology - Comparisons are Odious - In Defence Of A Friend - An Invitation

Spelling and Pronunciation - Pronunciation: Some Tips - More Tips on Pronunciation – Spelling - An Awesome Mess? - Spelling Part II

Module 3 **(18 Hours)**

Singleness of Meaning - Shades of Meaning - Confusing Pairs - What Is the Difference? - Mismatching Mars the Meaning

The Tense and Related Topics - 'Presentness' and Present Tenses- The 'Presentness' of a Past Action - Futurity in English - Passivization

Idiomatic Language- 'Animal' Expressions - Idiomatic Phrases - 'Heady' Expressions - Body Language

Module 4 **(18 Hours)**

Interrogatives and Negatives - Negatives- How to Frame Questions -What's What? The Question Tag

Conversational English - Polite Expressions - Some Time Expressions - In Conversation - Is John There Please?

Miscellaneous and General Topics - On Geese and Mongooses - Pluralisation - On Gender and Sexisms

Reading – Kinds of Reading – Recreational Reading – Study-type Reading Survey Reading – The Process of Reading – Readability – The Importance of Reading – Previewing - Skimming

Module 5 **(18 Hours)**

The world of words- have a hearty meal- word formation-Use the specific word- word games-the irreplaceable word- Let's play games- body vocabulary

Very Good but Totally Incompetent - Long Live the Comma - The Possessive Case- Letter Writing- Academic Assignments

Get your doubts cleared

Core Text: ***Fine-tune Your English*** **by Dr Mathew Joseph.** Orient Blackswan and Mahatma Gandhi University

Core 1 - BT1CRT01 BASIC LIFE SCIENCES

Total hours of instruction: 90 Hours/ week: 5 Credit: 4

Module I: 30Hrs

Nutrition-digestive system, mechanism of digestion-enzymes, absorption of carbohydrate, lipid and proteins, storage and mobilization of food reserves , respiration, respiratory system – structure, function, mechanism, Hb - structure and function, regulation of respiration.

Module II: 15 Hrs

Lymphatic system, lymph – functions,Excretion - structure of kidney and nephron, glomerular filtration, urine-normal and abnormal constituents

Module III 15 Hrs

Nervous coordination: Structure of neuron, transmission of nerve impulse, Synapse; structure and function, neurotransmitters: Types and functions.

Module IV: 15 Hrs

Absorption and transport of water: Theories on absorption, macro and micro nutrients, transpiration, Photosynthesis: photosystems, cyclic and noncyclic photophosphorylation, calvin cycle, Rubisco, CAM plants

Module V: 15Hrs

Plant growth regulators-auxin, cytokinin, gibberellin, ethylene, abcisic acid, plant movements-tropic,tactic and nastic movements, photoperiodism, vernalisation.

References:

1. Medical Physiology –A C Guyton, J E Hall, Saunders/ Elsevier pub.
2. Animal Physiology for BSc and MSc- Mohan p Arora, Himalaya Pub, india
3. Medical Physiology- A. B.SMahapatra- Current Books International, IndiaPub.
4. Foundation course in Biology- Agarwal, Ane books.
5. Text Book of Plant Physiology - V Verma, Ane Books
6. Fundamentals of Plant Physiology - V.K.Jain, S Chand Pub.,New Delhi, India.
7. Essentials of Modern Biology - R C Sobti and VL Sharma, Ane books, New Delhi
8. Plant Anotomy, - B. P. Pandey. S. Chand & Company Ltd. New Delhi
9. Animal physiology- B S Thyagi, S Chand Publishers., India

Core 2 - BT1CRT02 METHODOLOGY IN BIOTECHNOLOGY
Total hours of instruction: 90 Hours/ week: 5 Credit : 4

Module I: 15Hrs

Biotechnology - Definitions, multidisciplinary nature, scope, History of Biotechnology , trends, scope of research, milestones in the development of Biotechnology, Biotechnology in ancient world.

Module II: 20Hrs

Conventional and modern biotechnology: Fermentation- definition. Conventional fermentation practices- marine fermented products, Definition and scope of Bioprocess technology, recombinant DNA technology, Bioinformatics and biorobotics, Genetically modified organisms: merits and demerits. Blue biotechnology, Green biotechnology, White Biotechnology..

Module III: 25Hrs

Major Biotechnology institutes and companies in India, Global trend of biotechnology industry. Introduction to Good Laboratory Practices (GLP), Quality control in manufacturing, Good Manufacturing practices (GMP), Marketing of Biotechnological products, Impact of Biotechnology on society, Biotechnology and IPR.

Module IV: 15Hrs

Human genome project- an introduction, Cloning: technology , merits and demerits. Cloning of buffalo in India, Biotechnology in space research, Artificial cell: synthesis, types and applications.

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Module V: 15 Hrs

Nanobiotechnology, applications ofnanobiotechnology in medicine and health, Classification of nanomaterials, application of nano crystals, DNA chip, nanobiosensors - DNA sensors, Quantum dots.

References:

1. Biotechnology - B. D Singh, Kalyan Publishers, New Delhi
2. A Text Book of Biotechnology - R. C Dubey, S Chand and Company Pub:
3. Biotechnology - U. Sathyanarayana, Books and Allied Pvt. Ltd. Kolkata.
4. Presscott/Harley/Klein's Microbiology - Joanne Willey, Linda Sherwood and ChrisWoolverton.
5. Cell and Molecular Biology. 8th Edition. - EDP De Robertis and EMF De Robertis, Lippincott Williams and Wilkins Publication
6. Biotechnology and Ethics: A blueprint for the future, - Daniel Callahan President, Hastings Center, Center for Biotechnology, North Western University.
7. Biotechnology: Issues, Ethics and Regulation, - Tina M. Prow, Communication Specialist, Office of Agricultural Communication and Education
8. Biotechnology and Ethics: A blueprint for the future, - Daniel Callahan President, Hastings Center, Center for Biotechnology, North Western University
9. Nanobiotechnology :Concepts, Applications and Perspectives - C M Neimeyer and C. A. Mairkin, Wiley, US.
10. Biomaterial Science. An introduction to materials. - Ratner BD, Hoffman AS, Schoen FJ and Lemons JE. Elseviar, 2004.
11. Nanotechnology in Catalysis. Volume 3, - David J. Lockwood. Springer science, 2007
12. Introduction to Nanotechnology - John Wileg and Sons, 2008.

SEMESTER II

MAHATMA GANDHI UNIVERSITY

SYLLABI FOR COMMON COURSES - UG PROGRAMMES

2017 ADMISSIONS ONWARDS

COURSE 3 - Issues that Matter

Course Code	**EN2CC03**
Title of the course	**Issues that Matter**
Semester in which the course is to be taught	**2**
No. of credits	**4**
No. of contact hours	**90**

AIM OF THE COURSE

To sensitize the learners to contemporary issues of concern.

OBJECTIVES

By the end of the course, the learner should be able to:

1. Identify the major issues of contemporary significance
2. Respond rationally and positively to the issues raised
3. Internalise the values imparted through the selections.

COURSE OUTLINE

Module 1 **(18 hours)**

Luigi Pirandello: War

Judith Wright: The Old Prison

Arundhati Roy: Public Power in the Age of Empire

Module 2 **(18 hours)**

Bertolt Brecht: The Burning of the Books

W. H. Auden: Refugee Blues

Romila Thapar: What Secularism is and Where it Needs to be Headed

Module 3 **(18 hours)**

Zitkala- Sa: A Westward Trip

Bandhumadhav: The Poisoned Bread

Temsula Ao: The Pot Maker

Module 4 **(18 hours)**

Khushwant Singh: A Hosanna to the Monsoons

Ayyappa Paniker: Where are the woods, children?

Sarah Joseph: *Gift in Green* [chapter 2] - Hagar: A Story of a Woman and Water

Module 5 **(18 hours)**

Ghassan Kanafani: Six Eagles and a Child

Sanchari Pal: The Inspiring Story of How Sikkim Became India's Cleanest State

Indrajit Singh Rathore: Hermaphrodite

Core Text: *Issues that Matter*

Core 4 – BT2CRT03CELL BIOLOGY

Total hours of instruction: 72 Hours/ week: 4 Credit: 4

Module I: 8Hrs.

History and development of cell biology. Universal features of cell. Chemical components of cell.Celltheory.General organization of eukaryotic and prokaryotic cell.Evolution of eukaryotic cell.Plant cell and animal cell.

Module II: 15Hrs

Cell Membrane -.Chemical composition, ultra structure - fluid mosaic model, functions - Membrane transport - active, passive, facilitated - symport, antiport.Cell-cell interaction - selectins, integrins, cadherins, cell junction - tight junction, gap junction.

Module III:12Hrs.

Nucleus-structure and function, nuclear membrane, nucleolus, chromatin-euchromatin, heterochromatin, chromosomes - structure of a typical metaphase chromosome - centromere, telomere, chromomere, satellite DNA, nucleosome organization -histones, linker DNA, giant chromosomes, chromosome banding.

Module IV 22Hrs

Structure and functions of cell organelles - ER, Golgi complex, Ribosomes, Mitochondria, Chloroplast, Lysosome, Peroxisome. Cytoskeleton - Microtubules, Microtubular organelles, Microfilaments, Intermediate filaments.

Module V: 15Hrs.

Cell cycle - stages, Mitosis, Mieosis, Regulation of cell cycle - MPF, cyclins.Cell death - Necrosis and apoptosis. Cancer cells - characteristics of cancer cells, Cell Signaling - cyclic AMP, G protein, RTK receptors - convergence, divergence and cross talk.

References

1. Principles of Genetics, Snustad, Simmons and Jenkins, John Wiley And Sons Inc
2. Genetics, Robert Weaver and Philip Hendricks, WH.C. Brown Publishers, Iowa
3. Fundamentals of Genetics, B D Singh, Kalyani Publishers
4. Introduction to Genetic Analysis, Griffiths, Wessler, Lewontin, Gelbart,Suzuki and Miller, Freeman's and Co, New York
5. Principles of Genetics: A.G.Gardner, John Wiley and sons.
6. Cell and Molecular Biology by Gerald Karp, Academic Press
7. World of the Cell , Becker, Reece, Poenie, The Benjamin/Cumming's Pub.
8. Cell Biology , Lodish et al, W H Freeman and Co.,NewYork.
9. Cell Biology , Thomas D Pollard and W.C.Earnshaw, Saunder's Publishers

Core 5- BT2CRT04ELEMENTARY CHEMISTRY FOR BIOLOGY
Total hours of instruction: 72 Hours/ week: 4 Credit: 4

Module I: 12 Hrs
Bohr atom model, Limitations, De broglie Equation, Heisenberg uncertainty principle, Schodinger equation, Atomic orbitals. Quantum numbers and significance. Lattice energy of ionic compounds, applications

Module II: 15 Hrs
VSEPR theory, Hybridization involving s, p, d orbitals – sp, sp2, sp3, dsp2, sp3d, sp3d2. Molecular orbital theory, Hydrogen bonding in H_2O, structure of water molecule, intermolecular forces, ion-dipole, dipole-dipole, dipole-induced dipole, induced dipole-induced dipole interactions.

Module III: 20 Hrs
Mole concept, Determination of molecular weight by gram molecular volume relationship, problems based on mole concept, Solutions, colligative properties, Methods of expressing concentrations, strength, Normality, Molarity and Molality, ppm. Standardization of solutions, pH, buffer systems, dissociation constant, pK value, Preparation of standard solution of acids and bases, problems related to acid base titrations, volumetric experiments - acidimetry, alkalimetry, permanganometry, dichrometry, iodometry.

Module IV: 15Hrs
Rates of reactions - various factors influencing rate of reactions - Order and molecularity - zero, first, second and third order reactions. Derivation of integrated rate equations (single reactant only), fractional life time, its relation to initial concentration of reactants for various orders, units of rate constants. Influence of temperature on reaction rates, Arrhenius equation, calculation of Arrhenius parameters, Collision theory of reaction rate.

Module V: 15 Hrs
Structure of organic compounds - Conformation and configuration, Rotation about carbon-carbon single bond, conformations of ethane. Isomerism, types, Geometrical isomerism, Optical isomerism: explanation with examples.

References:

1. University General Chemistry. By C.N. R. Rao. McMillan India Ltd Publication.
2. Principles of Physical ChemistryBy B R Puri ,L R Sharma &M S Pathania, ISBN: 978-93-82956-01-3, ISBN: 978-93-82956-01-3ishal Pub. Co
3. A Text Book of Physical chemistryBy A.S.Negi&S.C.Anand, New Age International, New Delhi.
4. Principles of Physical Chemistry. By Maron and Pruton 4th Ed. Oxford and IBH publication.
5. Organic chemistry- A Bhal and B S Bhal, S Chand Pub.
6. Modern Inorganic Chemistry, R. D Madan, S. Chand and company, 13Th edition, 2005.
7. Concise Inorganic Chemistry5 th Ed., J.D. Lee, Blackwell Science Ltd

Core 6- BT2CRT05 EVOLUTIONARY BIOLOGY AND DEVELOPMENTAL BIOLOGY

Total hours of instruction: 36 Hours/ week: 2Credit: 2

Module I: 8Hrs.

History, theories on evolution, prebiotic environment and molecular evolution, origin of life, Miller - Urey experiment, Darwinian theory of evolution and its postulates.

References:

Module II: 6 Hrs.

Selection, speciation- allopatric and sympatric, adaptive radiation, role of mutation, modern theories of evolution, micro and macroevolution, Relationship among organisms and evidences of evolution.

Module III: 6 Hrs

Human evolution: Unique features of humans. Rama pithecus, Australopithecus afarensis,Homo erectus, Homosapiens(Neanderthals), Homo sapiens sapiens.

Module IV: 10Hrs

Plant development: Structure of flower, stages of flower development, androecium, gynoecium, micro and megasporogenesis, stages of seed germination, structure of monocot and dicot embryos, seed dormancy, polyembryoni.

Module V: 6Hrs.

Embryo development in animals; spermatogenesis, fertilization, Cleavage, morula, blastula,formation of germ layers, formation of gastrula, fatemap, parthenogenesis.

References:

1. Microbial Ecology.Fundamentals and Applications. Atlas and Bartha, Pearson Education , Benjamin Cummingspublishingcompany.Inc.New Jersy
2. Essential Environmental Studies - S. P. Misra, S. N. Pande, Ane Books Pvt.Ltd.
3. Ecology and environment - Sharma P.D , Rastogi publications.
4. Organic Evolution - N.Arumugam , ISBN 9788189941178 , Saras publication
5. A manual of Developmental biology - VijayakumarNair.K and Jeorge .P.V, Acadamia Publication, Javahar Nagar, TVM- 41
6. Developmental Biology- Muller, Springer Pub., Netherlands
7. Chordate embryolology, - P.S. Varma and V.K.Agarval, S Chand and Co.& Ltd

Core 3- BT1CRP01 PRACTICAL-BASIC BIOLOGY AND CHEMISTRY
Total hours of instruction: 36 Hours/ week: 2 Credit: 3

1. Cross section of Anther
2. Pollen tube germination
3. Demonstration of various developmental stages of chick embryo
4. Method of expressing concentration of solutions- calculations based on Normality and Molarity
5. Standardization of the concentration of acids/alkali based on volumetric titrations
6. Qualitative analysis of the organic compounds
7. Tests for –Hydrocarbons, alcohol, aldehydes, ketones, aniline, amide

References:

1. A practical guide to developmental Biology, - Melissa A. Gibbs, Oxford University Press
2. Practical Chemistry - A. O. Thomas

Core 7- BT2CRP02 PRACTICAL- CELL BIOLOGY
Total hours of instruction: 36 Hours/ week: 2 Credit: 2

1. Examination of different kinds of cells - Prokaryotic and eukaryotic cell
2. Blood grouping
3. Cell counting methods:
   a) Haemocytometer: WBC, RBC
   b) Differential counting using Leishman's stain
4. Micrometry:
   a) Calibration using ocular micrometer
   b) Finding out average cell size
5. Squash Preparation
   a) Study of mitotic stages
   b) Measurement of Chromosome length.
7. Staining of mitochondria.

References:

1. Laboratory investigation in cell and molecular biology. - AllynBregman, 1996. John Wiley & Sons.
2. Microbiology Laboratory Manual - Cappuccino, Sherman, Pearson Education
3. A Text book of Practical Physiology - CLGhai, Jaypee Brothers Publishers (P) LTD New Delhi.
4. Medical Laboratory Technology. Procedure Manual for Routine Diagnostic Tests - Volume I, Kanai L Mukherjee; Tata McGraw - Hill publishing Company. Ltd New Delhi

SEMESTER III

Core 8 - BT3CRT06 IMMUNOLOGY
Total hours of instruction: 90,Hours/ week: 5 Credit: 4

Module I: 20Hrs
Introduction to immunology. Types of immunity: nonspecific- physiological and cellular barriers, acquired immunity- characteristics, Antigen, Haptens and Adjuvants , Antibody. Structure and types of immunoglobulins, distribution and function.
Module II: 25Hrs
Organs of immune system - primary and secondary.Cells of immunsystem.Immuneresponse.Humoral and cell mediated immunity. MHC structure and function.Autoimmunity and hypersensitivity.

ModuleIII15Hrs
Antigen- antibody interactions: Affinity, avidity, cross reactivity, Precipitation reaction: radial immune diffusion, Ouchterlonydouble diffusion. Aagglutination reaction, agglutination titer, Incomplete agglutinins, complement fixation, ELISA,.Immunocytochemistry.
Module IV: 15Hrs
Transplant immunity.Immunology of malignancy.Immunohaematology.Blood groups and blood grouping.A, B, Rh antigens and antibodies, Rh typing. Bombay group,
Module V: 15Hrs
Immunization: Passive and active .Vaccines, types and applications. DNA vaccines, Polyclonal antibodies and monoclonal antibodies.

References:

1. Essential Immunology - Ivan M. Roitt and Peter J delves, Blackwell Publishing
2. Immunology - Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby, and Janis Kuby, W H Freeman and Co.
3. Immunobiology - Charles A. JanewayJr.,Paul Travers, Mark Walport and Mark J. Shlomchik, Garland Publishing.
4. Essential Clinical Immunology – Helen Chappel and ManselHaeney, ELBS/Blackwell Scientific Publications
5. Introduction to Immunology – John W, Kimball Maxwell, Mac Millan International Edition.
6. Text book of Microbiology – R. Ananthanarayanan and C K JayaramPanicker. Orient Longman.

Core 9- BT3CRT07 GENETICS

Total hours of instruction: 90, Hours/ week: 5Credit: 4

Module I: 20hrs

The birth of genetics, symbols and terminology, Mendel's experiments, Principle of segregation, Monohybrid cross, Principle of independent assortment, Dihybrid ratio, Dominance, Recessiveness, Codominance, Semidominance, lethal, multiple alleles, ABO blood typing, gene interactions - epistasis, pleiotropy, polygenic inheritance. Testcross, Back cross.

Module II: 15hrs

Linkage, crossing over, sex determination - autosomes and sex chromosomes, chromosomal basis of sex determination (XX-XY, XX-XO, ZZ-ZW types) mechanism of sex linked inheritance, sex influenced, sex limited gene expression, dosage compensation

Module III 15 hrs

Extrachromosomal inheritance - mitochondria and chloroplast, Types of Mutation - Mutagens, Variation in chromosome number - euploidy, aneuploidy, polyploidy, addition, deletion, transition, transversion, nonsense, missence mutation. Significance of mutation in evolution.

Module IV: 25 Hrs

Human genetics - Karyotype study & Pedigree analysis, Chromosomal anomalies and human disorders - autosomal anomalies - Down's syndrome and Edwards syndrome, Sex chromosome anomalies - Klinefelters syndrome, Turners syndrome, Genetic disorders - Sickle cell anaemia and phenyl ketonuria, Genetics of cancer .

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Module V: 15hrs

Population genetics - genetic variation, allele frequencies, random mating, Hardy Weinberg equilibrium, assertive mating, genetic equilibrium

References:

1. Principles of genetics - E J Gardner John Wiley India Publication
2. Genetics –M W Strick Berger , macmillan,
3. Fundamentals of Genetics - Peter. J. Russel, Harper Collins Pub.
4. Genetics, Principles and analysis- Daniel L. Hartin and Elizabath W. John , Jones and Bartlett Pub. US.
5. Human Genetics, - 2 nd& 3 rdEdn. S. D. Gangane. Elsevier/ Paras publications.
6. Essentials of Human Genetics, - 4 thEdn. S. M. Bhatnagar, M. L. Kothari and L. A. Mehta.

7.Text book of genetics, - Veer BalaRastogi, KNRN Pub

8. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, - P. S. Verma, V.K. Agarwal., S Chand pub
9. Genetics- - P. S. Verma, S Chand pub

CORE10 BT3CRT08 BIOSTATISTICS AND COMPUTER APPLICATION
Total hours of instruction: 36Hours/ week: 2Credit: 4

Module I: 8 Hrs
Nature, application and limitation of statistics in life science. Statistical population, Qualitative and quantitative data, Data collection: Primary and seconadary. Sampling , Classification,. Measures of asymmetry.Correlation and regression.

Module II 5 Hrs
Tabulation and representation of data.diagramatic and graphical representation, Analysis of data, Measures of central tendency.Measures of dispersion.

Module III 8 hrs
Probability theory and distribution.Binomial, Poison and Normal.Testing of hypothesis, t-test, Chi-square test, F-test.Non parametric tests.Analysis of variance -ANOVA.Concept of ANOVA, Basic principles, ANOVA technique.

Module IV: 8Hrs
Introduction to Computers.Low level and high level languages.Binary number system.Flow chart and programming techniques.Introduction to data structures and database concepts.Introduction to Internet and its applications.

Module V: 7Hrs
Introduction to MS office software, Word processing, spread sheet and software. Computer oriented statistical techniques. Frequency table of single discrete variable Bubble sort, Computation of mean variance and Standard deviation.

References:

1. Introduction to Biostatistics – Sokal&Rohif(1973) Toppan Co Japan
2. Fundamentals of biostatistics. VeerbalaRastogi. (2008) Ane books
3. Norman,T.J. Bailey (2007) Statistical methods in biology, 3rd edition. Cambridge university press
4. The programmer's Book of Rules. - Ladin BRC and Ledin V. Lifetime learning Publishers
5. Computer programming. - Rajaraman V. Prentice hall India Publication
6. Research Methodology - Methods and techniques. - C.R Kothari , New age international.
7. Biostatistics, Arora PN and PK Malhotra, Himalaya Publishing House.
8. Biostatistics, Computer application and Bioinformatics.V. Kumaresan , N. Arumugam, A. Gopi , A. Meena , R. Sundaralingam , ISBN 9789382459910
9. Introduction to Computers- peter Norton, Tata mac Graw Hill Pub.

Core11 BT4CRP03– Practical- Immunology

1. Slide agglutination test
2. Bacterial agglutination test
3. Haemagglutination test
4. Precipitation in tube-Capillary test
5. Precipitation in gel-Immunodiffution (Demonstration only)
6. Immunoelectrophoresis (Demonstration only)
7. Blood grouping by slide agglutination method

Reference

1. Introduction to Immunology – John W, Kimball Maxwell, Mac Millan International Edition.
2. Text book of Microbiology – R. Ananthanarayanan and C K JayaramPanicker. Orient Longman.

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SEMESTER IV

Core 12: BT4CRT09 MOLECULAR BIOLOGY

Total hours of instruction: 90 Hours/ week: 5 Credit: 4

Module I: 25Hrs

History of significant discoveries in Molecular Biology, Experiments demonstrating DNA as the genetic material, RNA as genetic material, Structure of DNA and RNA, Physico - chemical properties of DNA, Organization of DNA in viral, prokaryotes and eukaryotic chromosome

Module II: 10Hrs

Genes - Concept of gene, Gene structure, split genes, Structure of prokaryotic genes, eukaryotic genes -structure, reading frame and regulatory elements, micro satellites, C-value paradox. Cytoplasmic genome - chloroplast and Mitochondrial DNA.

Module III: 15Hrs

DNA replication - Meselson and Stahl experiment, Replication in prokaryotes and eukaryotes, Structure and function of enzymes involved in DNA replication.DNA repair: Mismatch repair, excision repair.

Module IV 20 Hrs

Transcription in prokaryotes and eukaryotes - initiation, elongation and termination, Transcription products, Types ofRNA - mRNA, rRNA, tRNA and sn RNA. Genetic code, properties of genetic code, start codon and termination codon. Wobble Hypothesis. Translation - translation of prokaryotic and eukaryotic mRNA - initiation, elongation and termination.

ModuleV: 20Hrs

Regulation of Gene expression - Regulatory protein, promoters, activators, repressors, operon concept, positive and negative regulation, Molecular details of Lac and Trp operon, Transposable elements - IS elements, composite and non compositetransposons, SINES and LINES.

References:

1. Introduction to Molecular Biology - P. Paolella; Mc. Graw Hill, New York
2. Fundamentals of Biochemistry, - J.L. Jain, Sanjay Jain, Nitin Jain, S. Chand Publishers
3. Genetics. A Molecular approach.2ndEdn. - Peter J. Russel.
4. Principles of genetics - Snustad and E J . Gardner, John Wiley publishers.
5. Molecular Biology of the gene - Watson, Baker, Ganu, Bell, Levene, Losiek (Pearson Publication)
6. Cell and Molecular Biology by Gerald Karp, Academic Press
7. World of the Cell , Becker, Reece, Poenie, The Benjamin/Cumming's Pub.
8. Cell Biology ,Lodish et al, W H Freeman and Co.,NewYork.
9. Cell Biology , Thomas D Pollard and W.C.Earnshaw, Saunder's Publishers

Core13- BT4CRT10 ENZYMOLOGY

Total hours of instruction: 72 Hours/ week: 4 Credit: 4

Module I: 15Hrs

Enzyme nomenclature and classification.Isolation of enzymes. Extraction of soluble and membrane bound enzymes. Purification of enzymes: precipitation, dialysis, chromatography and electrophoresis; criteria for enzyme purity.

Module II: 15Hrs

Structure and properties of enzymes, active site, specificity, specific activity, Multi enzyme complex, Enzyme unit, Mechanism of enzyme action.Coenzymes and their action, Factors affecting enzyme activity.

Module III: 12 Hrs

Kinetics of enzyme substrate reactions, Michaelis - Menton equation, MM plot, Lineweaver - Burk plot.Regulation of enzyme activity-methods.

Module IV: 15Hrs

Inhibition of enzymes, inhibitors, types of inhibition, Mechanism of inhibition -competitive, uncompetitive and noncompetitive and allosteric inhibition.Cooperativity, Ping-Pong mechanism.

Module V:15 Hrs.

Clinical and industrial application of enzymes, immobilization of enzymes, Biosensors, Synthetic enzymes, Ribozymes, Abzymes, Enzymes involved in genetic engineering and biodegradation , Enzyme engineering

References:

1. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins by Nicholas C. Price, Lewis Stevens, and Lewis Stevens (2000) Publisher:OxfordUniversityPress, USAISBN:019850229X ISBN-13: 9780198502296, 978-0198502296
2. Enzyme Kinetics and Mechanisms by Taylor Publisher:SpringISBN:8184890478 ISBN-13:9788184890471, 978-8184890471
3. Biochemistry (2004) by Donald Voet, Judith G. Voet **Publisher:** John Wiley & Sons
4. Enzyme Mechanism by P.K. Shivraj Kumar (2007) Publisher:RBSA Publishers ISBN:8176114235 ISBN-13: 9788176114233, 978-8176114233

5. Biochemistry 6th Edition (2007) by Jeremy M.berg John L.tymoczkoLubertStryer**Publisher:** B.i.publicationsPvt.Ltd**ISBN:**071676766X **ISBN-13:** 9780716767664, 978-716767
6. Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray Scrimgeour K **Publisher:** Pearson**ISBN:** 0131977369,
7. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry (second Edition) by Trevor Palmer, Philip Bonner (2007) Publisher:Horwood Publishing Limited

Core 14 - BT4CRT11 BIOPHYSICS AND BIOINFORMATICS

Total hours of instruction: 72 Hours/ week: 4Credit: 4

Module I: 25Hrs

Laws of thermodyanamics, Role of water in living organisms, Enthalpy, Entropy, Freeenergy Basic principles and biological significance of Osmosis, diffusion, adsorption, surfacetension, colloids, radioactivity. .

Module II: 10Hrs

Colorimetry and Spectrophotometry, spectroscopy - UV, visible, IR.GM counter, Scintillation counter.

Module III: 15 Hrs

Stabilizing forces in macromolecules, Protein conformation - primary, secondary, tertiary and quaternary structure, folding - chaperones, DNA conformation and Polymorphism.

Module IV: 10Hrs

Introduction to Bioinformatics, Definition, history, important Biological databases and their Sequence format: NCBI, GEN BANK, EMBL, SWISSPROT, PDB, Drug bank.

Module V:12Hrs

Tools for global and local alignment studies, FASTA, BLAST, CLUSTAL, MUSCLE Applications of bioinformatics: phylogenetic analysis, homology modeling, structure prediction.

References:

1. Bioinformatics - sequence and genome analysis, David W Mount, Cold Spring Harbor Laboratory.
2. Biophysics - Vasanthapattabhi, N. Gautham. Kluwer Aca. Pub: Narosa Pub. House.
3. Text book of Biophysics - R.N. Roy, New central Book Agency Pvt. Ltd.
4. Biophysical Chemistry - Upadhyay.
5. Biochemistry - Donald Voet and Judith G Voet: John Wiley Sons, Inc.
6. Biophysics- R N Roy, New Central Agency
7. Algorithms in Bioinformatics - Benson, Ane Books

Core–15 BT4CRP04 – PRACTICAL - MOLECULAR BIOLOGY

Total hours of instruction: 36 Hours / Week-4 Credit: 4

1. DNA Isolation
2. Separation of DNA by Agarose gel electrophoresis (Demonstration only)
3. Staining of barr body.
4. Problems in mendelian law, linkage, population genetics

References:

1. Molecular gene cloning - Sambrook and Maniatis, Cold Spring Harbour Laboratory.
2. Practical Skills in Biomolecular sciences - Rob Reed, Dand Holmes, JanathanWeyers, Allan Janes, Long man England.
3. Laboratory investigation in cell and molecular biology. - AllynBregman, 1996. John Wiley & Sons

Core–15 BT4CRP04 – PRACTICAL - ENZYMOLOGY

Total hours of instruction: 36 Hours / Week-4Credit: 4

1. Estimation of enzyme activity - amylase assay
2. Estimation of clinically important enzymes - SGPT, SGOT
3. Factors affecting enzyme activity
   a. effect of p H on enzyme activity
   b. effect of temperature on enzyme activity
   c. effect of metal ion on enzyme activity
   d. effect of inhibitors on enzyme activity
4. Immobilization of enzymes

References:

1. Practical Biochemistry - David Plummer
2. Modern experimental Biochemistry- Rodney Boyer, Pearson education.

SEMESTER-V

Core 16- BT5CRT12 RECOMBINANT DNA TECHNOLOGY

Total hours of instruction: 108 Hours/ week: 6 Credit: 4

Module I: 25Hrs

Introduction to genetic engineering.Steps of genetic engineering. Enzymes in genetic engineering - Restiction endonucleases, DNA ligases, Adapters, Linkers, alkaline phosphatase, polynecleotide kinase, Terminal transferase, S1 nuclease, RNAase H, DNA polI, Klenow fragment, Taq polymerase, Reverse transcriptase.

Module II: 20Hrs

Gene cloning vectors. Plasmid vectors - features, pUC and pBR322. Bacteriophage vectors - Lambda, M13. Cosmids.Vectors for animal and plant cell.Shuttlevectors.YAC.BAC.

.

Module III: 20 Hrs

Gene transfer methods - CaCl2 mediated, Electroporation, Microinjection, Lipofection. Particle Bombardment, *Agrobacterium* mediated gene transfer. Shotgun and cDNAcloning.Genomic library.

Module IV: 18 Hrs

Screening and Selection of recombinants, Colony hybridization, Marker genes, reporter genes, Insertional inactivation, Blue-white screening and Blotting techniques, Southern, Northern and Western.

Module V:25 Hrs.

DNA sequencing.Chromosomewalking.Application of genetic engineering -.Recombinant insulin. Transgenic plants - Herbicide and pest resistance. Super bug-calabolic plasmids, BT cotton.Molecularpharming.Gene therapy.

References:

1. Principles of Gene manipulation and Genomics. - S.B. Primrose and R.M. Twyman. Blackwell Publication
2. Biotechnology - Fundamentals and applications. - S.S. Purohit and S.K. Mathur.Agrobotanica publications.
3. Gene Cloning and DNA analysis. - T.A. Brown. Blackwell Publication.
4. Recombinant DNA - Genes and Genomes. - James D. Watson, Any A candy, Richard M.M, Jan A Witkowski. W.H. Freeman and Company Publication.
5. Genes X- Lewin, Jones and Bartlett learning.
6. Cell and Molecular Biology by Gerald Karp, Academic Press
7. Genomes: T A Brown, John Wiley & Sons

CORE 17- BT5CRT13- ENVIRONMENTAL BIOTECHNOLOGY

Total hours of instruction: 72 Hours/ week: 4 Credit: 3

Module I: 12Hrs

Concept, structure, components and function of ecosystem - producer, consumer, decomposer, abiotic components. Ecological succession, Food chains, food webs, energy flow in ecosystem. Biogeochemical cycles - nitrogen cycle, carbon cycle. Energy resources: Renewable and non renewable energy resources, use of alternate energy resources.

Module II: 15Hrs

Environmental pollution- air, soil and water pollution with suitable case studies, global warming, green house effect, acid rain, smog, hazards of nuclear fallout. Ozone layer depletion, depletion of natural resources, Pesticide pollution

Module III: 20Hrs

Characteristics of waste water –COD, BOD, TOC, Suspended solids, Total dissolved solids, chlorides, acidity, alkalinity. Bacteriological analysis of drinking water, presumptive, completed and confirmed tests, Coagulation, Disinfection by chlorination, Biodegradation of organic compounds. Types of reactions in biodegradation.Biodegradation of hydrocarbons, cellulose and lignin. Molecular biology of biodegradation,

Module IV: 15Hrs

Treatment of waste water, primary, secondary and tertiary treatment. Biological treatment of waste water- aerobic methods, floc and film based processes Activated sludge process, Trickling filter process, Aerobic pond. Anaerobic process- Methanogenesis, Single and double stage reactors.Solid waste management- anaerobic treatment and land filling.Composting.
Environmental laws: Environment protection act, Air and Water (Prevention and control of Pollution) Act, Wild life protection Act, Forest conservation Act.

Module V:10Hrs

Unit 1 - Human Rights

An Introduction to Human Rights, Meaning, concept and development –History of Human Rights-Different Generations of Human Rights- Universality of Human Rights- Basic International Human Rights Documents - UDHR ,ICCPR,ICESCR.-Value dimensions of Human Rights

Unit 2 - Human Rights and United Nations

Human Rights co-ordination within UN system- Role of UN secretariat- The Economic and Social Council- The Commission Human Rights-The Security Council and Human rights- The Committee on the Elimination of Racial Discrimination- The Committee on the Elimination of Discrimination Against Women- the Committee on Economic, Social and Cultural Rights- The Human Rights Committee- Critical Appraisal of UN Human Rights Regime.

Unit 3- Human Rights National Perspective

Human Rights in Indian Constitution – Fundamental Rights- The Constitutional Context of Human Rights-directive Principles of State Policy and Human Rights- Human Rights of Women-children –minorities- Prisoners- Science Technology and Human Rights- National Human Rights Commission- State Human Rights Commission- Human Rights Awareness in Education.

References:

1. Biocatalysts and biodegradation - Lowrence P Wackett and Daglas Hershberger. ASM Press, Washington
2. Environmental Chemistry - Anil Kumar. De Wiley Eastern Ltd. New Delhi
3. Microbial ecology: Fundamentals and Applications - Atlas and Bartha, Pearson Education
4. Biotechnology: The Science and Buissiness - V. Mopses and R.E. Capes
5. Environmental Science: Earth as living planet - Daniel B Bottein and Edward. A. Keller, John Wiley Sons.
6. Essential Environmental Studies - S. P. Misra, S. N. Pande, Ane Books Pvt.Ltd.
7. Ecology and environment - Sharma P.D

Core 18 - BT5CRT14 ANIMAL BIOTECHNOLOGY

Total hours of instruction: 108 Hours/ week: 6 Credit: 4

Module I: 10 Hrs

History of animal cell culture.Basic requirements of animal cell culture.Laboratory setupandequipment's.

Module II: 18Hrs

Culture media - natural, synthetic and serum containing media. Role of hormones.Preparation and sterilization of media.Importance of growth factors of the serum.

Module III: 25 Hrs

Primary cell cultures - Anchorage dependent and anchorage independent cells secondary cell cultures - Transformed animal cells, Established/continuous cell lines. Characteristics of cells in culture. Maintenance of cell lines, commonly used animal cell lines-their origin and characteristics.

Module IV: 25 Hrs

Cell differentiation. Stem cells. Organ culture or 3D culture. Large scale culture of cell lines - monolayer culture, suspension culture and immobilized culture. Bioreactors for large scale culture of cells. Insect and virus cell culture.

Module V: 30 Hrs

Application of animal cell culture - Production of monoclonal antibody, Production ofvaccines. Production of specific metabolites.Transgenic animals - Transgenic Mice, fish andcow. Knock-out and Knock-in Technology. Animal cell culture for medical and cancerresearch.

References:

1. Animal cell culture (IIIrd edition) A practical approach. - John R.W. Masters
2. Animal Biotechnology. - R. Sasidhara.
3. Animal biotechnology – Raja, Florence Periera. Dominant publishers New Delhi. 2006.
4. In vitro cultivation of animal cells. - Open University, Netherlands. New Delhi, Butter Worth - Heinemann, 1994.
5. Insect Cell Cultures: Fundamental and Applied Aspects. - Edited by Just M. Vlak, Cornelis D. de Gooijer, Johannes Tramper, Herbert G. Miltenburger. Kluwer Academic Publishers, New York.

BT5OPT01- Open Course - Paper -I (A/B/C)

BT5OPT01A -TISSUE CULTURE TECHNIQUES

Total hours of instruction: 72 Hours/ week: 4 Credit: 3

Module I: 12Hrs
Introduction to plantcell and tissue culture Construction, Design and basic requirements of plant tissue culture lab

Module II: 15Hrs
Introduction to animal cell culture. Construction, Design and basic requirements of animal cell cultureLaboratory.

Module III: 15Hrs
Plant cell culture medium - Media preparation and methods of sterilization and standardization. Surface sterilization of explants. Factors affecting plant cell culture. Callus culture

Module IV: 15Hrs
Animal cell culture medium - Media preparation and methods of sterilization. Surface sterilization of primary explants. Factors affecting animal cell culture.

ModuleV:15Hrs
Animal cloning, Medical, industrial and agricultural applications of animal cell and plant cell culture.

References:

1. Animal cell culture: A Practical Approach - John R.W. Masters. Pub
2. A text book of Animal Biotechnology- B Singh • S K Gautam • M S Chauhan • S K Singla. The energy and resources Institute.
3. Animal biotechnology – Raja, Florence Periera. Dominant publishers New Delhi, 2006.
4. In vitro cultivation of animal cells - Open University, Netherlands. New Delhi, Butter Worth - Heinemann, 1994
5. Plant tissue culture Theory and Practice - S.S Bhojwani and M.K. Razdan., Elsevier
6. Plant tissue culture - S.P. Misra.Ane Books India
7. Plant biotechnology - Ignacimuthu, Oxford and IBH pub.
8. R.Sasidhara, Animal Biotechnology MJP publishers-Chennai.
9. Plant biotechnology – J Hammond, et. al., Springer Verlag.
10. Practical application of plant molecular biology – R J Henry, Chapman & Hall.

BT5OPT01B - BIOTECHNOLOGY FOR SUSTAINABLE DEVELOPMENT

Total hours of instruction: 72Hours/ week: 4 Credit: 3

Module I: 15 Hrs

Natural raw materials: classification, physicochemical and biological properties, exploitation ofthe natural waste materials through biotechnology, preparation of nutritive and cost effectivesubstrates for industrial application.

References:

1. **Module II: 15Hrs**

Chemical fertilizers - disadvantages. Biofertilizers- advantages, types. Nitrogen fixing organisms, *Azospirillum, Azolla, Rhizobium*, Lichens, *Cyanobacterium. Mycorrihza*

References:

Module III: 15Hrs

Solid waste management - Composting, types, different stages in composting, types of composting - pile, windrow composting, microorganisms in composting, temperature profile in composting, advantages of composting, vermicomposting.

References:

1. Waste water Microbiology - Gabriel Bittan
2. Text Book of Biotechnology - R.C. Dubey
3. Essentials of Biotechnology - R.C. Sobi and Suparna S. Pachauri. Ane Books

Module IV: 15Hrs

Biopesticides, biofilters, biopolymers, biofuels, biosurfactants, mushroom cultivation, Biogas production, Waste to energy,

1. Essentials of Biotechnology - R.C.Sobi&Suparna S. Pachauri. Ane Books
2. Biotechnology: fundamentals and Applications - Purohith and Mathur, Agrobotanical Publishers, India.

Modul V: 12Hrs

Biotechnology in aqua culture , development of probiotics, diagnostic probes, extraction of marine natural products through biotechnology.

References

1. Biotechnology - An introduction by Susan R Barnum, Thomsun Publishers.
2. Biotechnology: fundamentals and Applications - Purohith and Mathur, Agrobotanical Publishers, India.
3. Waste water Microbiology - Gabriel Bittan
4. Applied Zoology - Zoological Society of India
5. Essentials of Biotechnology - R.C.Sobi&Suparna S. Pachauri. Ane Books
6. Biotechnology: fundamentals and Applications - Purohith and Mathur, Agrobotanical Publishers, India.
7. Environmental biotechnology - R.A Sharma
8. Text Book of Biotechnology - R.C. Dubey
9. Advanced Environmental biotechnology - S.K. Agarwal
10. Biotechnology: fundamentals and Applications - Purohith and Mathur, Agrobotanical Publishers, India.
11. Comprehensive Biotechnology. Second edition, Elsevier, 2011, Murray Mor. Young (Editor in chief). ISBN-978-0-08-088504-9

BT5OPT01C -IPR AND PATENTS

Total hours of instruction: 72Hours/ week: 54 Credit: 3

Module I: 12Hrs
General guidelines for DNA research, containment facilities and biosafety practices, specialguidelines in India.

Module II: 15Hrs
Forms of IPR - patent, design and copyright: Patents:different types of intellectualproperty, Introduction to patent law and conditions for patentability; Procedure forobtaining patents; Rights of a patentee; Patent infringements; Biotechnology patents andpatents on computer programs; Patents from an international perspective.

Module III: 15Hrs
Copyright: Registration procedure and copyright authorities; Assignment and transfer ofcopyright, Copyright infringement and exceptions to infringement; Software copyright.

Module IV: 15Hrs
Contents of patent specification and the procedure for patents; (a)Obtaining patents; (b) Geographical indication; (c) WTO; Detailed information on patentingbiological products; Plant breeders' and farmer's rights; Biodiversity; Budapest treaty;Appropriate case studies.

Module V:15Hrs
IPR laws**:** Rights/protection, infringement or violation, remedies against infringement: civil and criminal; Indian Patent Act 1970 and TRIPS; IPR forms, IPR in India, patents, process of patenting, Indian and International agencies involved in patenting, GATT

References:

1. P. Narayanan, Intellectual Property Laws, Eastern Law House.2001
2. Meenu Paul, Intellectual Property Laws, Allahabad Law Agency.2009
3. Intellectual Property Law containing Acts and Rules, Universal Law Publication Company.
4. John E. Smith,Biotechnology,3rdEd.CambridgeUniversity Press.
5. Prithipal Singh**,An Introduction to Biodiversity,** Ane Books India, 2007.
6. B R Goel,**An Introduction to Biodiversity,** Arise Pub, 2006.
7. Nirmal Chandra Pradhan,**Basics of Biodiversity,**Anmol, 2008.
8. **Biodiversity and Environmental Biotechnology-** PadmanabhDwivedi; S K Dwivedi and M C Kalita,Scientific, 2007.Chapman and Reiss, Ecology principles and applications. Cambridge University.
9. Environmental biologyJobes A. M.,,Routledge, London.
10. Fundamentals of ecologyOdum E. P and Barret G W. W. B Saunders company, Philadelphia.

Core 19- BT5CRP05 PRACTICAL

RECOMBINANT DNA TECHNOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY

Total hours of instruction: 90 **Hours/ week: 4** **Credit: 3**

1. Competent cell preparation
2. Transformation of the competent cell
3. Isolation of Plasmid
4. Enumeration of Total number of heterotrophic bacterial population in water samples
5. Bacteriological analysis of drinking water- Presumptive, completed and confirmed tests
6. Estimation of alkalinity
7. Estimation of acidity
8. Estimation of total solids, suspended and dissolved solids
9. Estimation of Dissolved oxygen
10. Estimation of Chemical oxygen demand
11. Estimation of Biological oxygen demand

References:

1. Biotechnology: Fundamentals and applications - S.S. Purohit and S.K Mathur, Agrobotanica publications.
2. Recombinant DNA: Genes and Genomes - James D Watson, Any A candy,Richard M.M, Jan A Witkowski. W.H. Freeman and Company Publication.
3. Gene Cloning and DNA analysis - T.A. Brown. Blackwell Publication.

SEMESTER VI

Core 21 BT6CRT15 PLANT BIOTECHNOLOGY

Total hours of instruction: 90 Credit:4 Hours/ week: 5

Module I: 15 Hrs

Plant tissue culture- a historical approach. Basic requirements and setting up of a plant tissue culture lab, hardening centre/green house.

Module II: 25Hrs

Tissue culture media.Media preparation. Role of growth hormones.Totipotencyandcyto-differantiation, Various stages of micropropagation.

Module III: 20 Hrs

Types of culture-Callus culture, Suspension culture and single cell culture. Somaclonalvariation.Organogenesis and Embryogenesis. Artificial seeds, Meristem culture. Haploidproduction-ovary, ovule, anther and pollen culture.

Module IV: 20 Hrs

Plant protoplast–isolation,cultureandsomatichybridization.Cybridsandhybrids.Applications of protoplast culture.Maintenance and storage of plant cell.Germplasm conservation and gene bank.

Module V: 10 Hrs

Applications of plant cell culture. Gene transfer techniques in plants, Role of *Agrobacterium* in genetransfer. Ti plasmid, Binary vector, Ri plasmid

References:

1. Plant tissue culture Theory and Practice - S.S Bhojwani and M.K. Razdan., Elsevier
2. Plant tissue culture - S.P. Misra.Ane Books India
3. Plant Breeding - B.D. Singh.
4. Plant cell and tissue culture - S. Narayanaswamy
5. Plant biotechnology - Ignacimuthu, Oxford and IBH pub
6. Plant biotechnology – J Hammond, et. al., Springer Verlag
7. Practical application of plant molecular biology – R J Henry, Chapman & Hall

Core 22– BT6CRT16 INDUSTRIAL BIOTECHNOLOGY

Total hours of instruction: 90 Hours/ week: 5 Credit: 4

Module I: 15Hrs

Introduction to industrial biotechnology, Advantages of bioprocess over chemical process, Fermentation - definition, types -submerged and solid state, applications of fermentation. Industrially important microbial metabolites.

References:

1. Principles of Fermentation technology - Stanbury et al. Wiley publishers
2. Industrial Microbiology - Prescot

Module II: 20Hrs

Isolation and screening of industrially important microorganisms, primary and secondary screening.Methods of screening. Identification of the selected organism. Methods of strain improvement - Mutation, Protoplast fusion and Genetic Engineering.

References:

1. Principles of Fermentation technology - Stanbury et al. Wiley publishers
2. Industrial Microbiology - Prescot

Module III: 15Hrs

Medium designing in fermentation, Defined and undefined medium, carbon and Nitrogen sources.Precursors, inducers, inhibitors and antifoam agents.Effect of pH, temperature and salt concentration in fermentation.Optimization of the process of fermentation.

References:

1. Principles of Fermentation technology - Stanbury et al. Wiley publishers
2. Industrial Microbiology - Cassida

Module IV: 20Hrs

Bioreactor, typical bioreactor, Criteria for the designing of a bioreactor, parts of a bioreactor, Instrumentation of the bioreactor, types of bioreactors – Airlift fermenters, CSTR, Deep bed,Cyclonecolumnand Tower reactors, Mode of culturing of microorganisms -Batch, continuous, fed batch culture systems.

References:

1. Biotechnology: The biological Principles. - Trevan et al., Tata McGraw Hill Edn.

ModuleV: 20Hrs

Methods of downstream processing- centrifugation, filtration and chromatographic techniques. Fermentative production of enzymes - amylase, protease, antibiotics - Penicillin, organicacids – glutamic acid, citric acid, alcohol, Immobilization of microbial cells.

References:

1. Principles of Fermentation Technology, P.F.Stanbury, A Whitaker and S.J.Hall, , 2008. Elsevier
2. Bioprocess Technology, P.T.Kalichelvan and I Arul Pandi, , 2009,MJP Publishers, Chennai.
3. Bioprocess Engineering,M.Shuler&F.Kargi (2002). Prentice Hall (I) Ltd., N.Delhi.
4. Bioprocess Technology- Kinetics and reactors ,Antan Moser and Philip Manor,.1998, Springer
5. Fermentation Microbiology and Biotechnology ,E.M.T. Mansi, C.F.A . Bryce. A.L..Dmain, A.R.Alliman. ,2009, Taylor and Francis. New York
6. Industrial Microbiology, Cassida L.E. 1968.John Wiley and Sons Publishers.
7. Biotechnology: fundamentals and Applications - Purohith and Mathur, Agrobotanical Publishers, India
8. Biotechnology: The biological Principles. Trevan et al., Tata McGraw Hill Edn.
9. Biotechnology - An introduction by Susan R Barnum, Thomsun

Core 23- BT6CBT01- CHOICE BASED COURSE (A/B/C)
BT6CBT01A –BIOINFORMATICS
Total hours of instruction: 90 Hours/ week: 5 Credit: 4

Module I: 15 Hrs

Introduction to bioinformatics- definition, history andsignificance.Careers in bioinformatics, genomics, transcriptomics, proteomics.

Module II: 25Hrs

Collection and storage of database, Submission of sequences, biological databases, NCBI,EMBL, DDBJ, Genbank, PDB, Swissprot, Sequence formats- FASTA/Pearson and EMBL,
Genpept, Phylip formats.

Module III: 25Hrs

Alignment of pairs and sequences: definition of sequence alignment- global alignment, localalignment, alignment of sequence pairs- dot matrix analysis, FASTA and BLAST, multiplesequence alignment CLUSTALW

Module IV: 15 Hrs

Computational biology, Rasmol, phylogenetic analysis, homology modeling, Protein function-structure prediction.

Module V : 10Hrs

Applications of Bioinformatics: pharmaceutical industry, immunology, agriculture, forestry, basic research, chemiinformatics in biology, geoinformatics.

References:

1. Beginning Perl for Bioinformatics - James D. Tisdall; Paperback.Bioinformatics: Sequence and Genome Analysis - David W Mount. Cold Spring Harbour Lab Press, New York.
2. Bioinformatics and Molecular Evaluation - Paul G Higgs and Teresa K. Attwood, Blackwell Publishers
3. Algorithams in Bioinformatics – Benson, Anne books
4. Developing Bioinformatics Computer Skills - Cynthia Gibas, Per Jambeck.
5. Molecular Biophysics- Volkenstain M.V, Academic Press
6. Stephen Misener and S. A. Krawetz. Bioinformatics Methods and Protocols. Humana Press. 2000.
7. Rastogi, S.C, N. Mendiratta, P. Rastogi. Bioinformatics Methods and Applications. Prentice Hall of India, 2004.

CHOICE BASED COURSES

BT6CBT01B NANOTECHNOLOGY

Total hours of instruction: 90Hours/ week: 5 Credit: 4

Module I: 20Hrs

Nanotechnology-definition, advantages applications, material science, nanomedicine emerging trends, scope, research potential, Nanotechnology in India.

Module II: 25Hrs

Nanomaterials, types, examples, nanoemulsions, poly amino acid micelles, dendrimers, albumin designing of nanomaterials, selection of nanomaterials, physicochemical and biological properties, interaction of the drug with nanomaterials

Module III: 15Hrs

Drug delivery- principle, receptor mediated endocytosis, delivering systems, method of targeting, labeling of the carrier, mechanism and site of drug action, Blood brain barrier

Module IV: 15Hrs

Targeted diseases, cancer, respiratory disorders, cardiovascular problems, diabetics, AIDS. Enhanced permeability and retention effect, applications of short interfering RNA

Module V: 15 Hrs

Nanotechnology in clinical diagnostics and therapeutics- nanowires, nanoshells, quantum dots, dendrimers, liposomes, nanopyramids, nanogels.

References:

1. An Introduction to materials - B.D. Ratner, A.S. Hoffman, F.J. Schoen and J.E. Lemons. Biomatrial Science. Elsevier 2004.
2. Nanomaterials and Nanochemistry - C. Brechignas, P. Hoody and M. Lemani. Springer-Verlag. 2007.
3. Nanotechnology in Catalysis - David J. Lockwood. Volume 3, Springer Science, 2007.
4. Nanomaterials: Synthesis, Properties and applications. - A.S. Eddstein and R.C. Cammarate. Institute of Physics, U.K. 1998.
5. Introduction to Nanotechnology - John Wiley & sons 2008.
6. Microfabrication and Nano manufacturing - Jackson MJ, Taylor and Francis, Boca Raton, 2006.
7. Peptide - derivatized biodegradable nanoparticles able to cross the blood brain barrier. - Costantino L, Gandolfi F, Tosi G, Rivasi F, Vandelli MA, Forni F (2005). J Control Release 1981: 84-96.
8. Michaelis K, Hoffmann MM, Dries S, Herbert E, Alyautdin RN, Michaelis M, Kreuter J, Langer K (2006). Covalent linkage of aplipoproteine to albumin nanoparticles strongly enhances drug transport into the brain. J PharmacolExpTher 3: 1246-1253
9. Zhang D, Tan T, Gao L, Zhao W, Wang. P. (2007). Preparation of azithromycin nanosuspensions by high pressure homogenization and its physicochemical characteristic studies. Drug DevInd Pharm 33: 569-575.
10. Nanoscience and Nanotechnology - V.S. Muralidharan and A. Subramania. Anne Book Pvt. Ltd, New Delhi.

CHOICE BASED COURSES
BT6CBT01C DISEASES AND DIAGNOSTIC BIOTECHNOLOGY
Total hours of instruction: 90 Hours/ week: 5 Credit: 4

Module I: 15 Hrs

Microbes and parasites: Historical introduction; Bacteria, Fungi, Viruses, Protozoas, Helminthes and Arthropods, Prions; Host-parasite relationship; Infection-mode of transmission in infection, factors predisposing to microbial pathogenecity, types of infectious diseases.

Reference:

1. Medical Microbiology (1997). Edited by Greenwood. D, Slack. R and Peutherer. J, ELST Publishers.
2. Bailey and Scott's Diagnostic Microbiology (2002). Betty A. Forbes, Daniel F. Sahm, Alice S. Weissefeld, Ernest A Trevino. Published by C.V. Mosby

Module II: 15 Hrs

Molecular genetics of Genetic Disorders-Heamoglobinopathies-Sickle cell aneamia, Beta Thalassemia.Musculardisordrers-Duchenne's Muscular dystrophy.Triplet disorders-Fragile X syndrome, Huntington's disease, Myotonic dystrophy. Genetic disorders-cystic fibrosis, Alzheimers disease. Chromosomal disorders-autosomal,sex chromosomal.

Reference :

Module III: 20 Hrs

DNA diagnostics of genetic and Chromosomal disorders. Identifying disease genes-position independent strategies,positionalcloning.PCR based diagnostics. Ligation chain reaction.Southern blot diagnostics. Array based genetic profiling. single nucleotide polymorphism. Karyotyping analysis,G-banding, FISH. Comparative genomic hybridization (CGH).

Reference:

1. Forensic DNA typing 2nd Edn by John M Butler.Academic Press
2. Human Molecular Genetics 2.Tom Strachen and Andrew P read.Garland Publishers

Module IV: 20 Hrs

DNA typing- Specimen collection, acquisition processing and analysis. Disputed paternity analysis.Ancestry- Mitochondrial. Forensic Science-Standard STR testing, Y-STR testing, Mitochondrial sequencing, SNP testing.

Module V :20Hrs

Cancer diagnostics- Special karyotyping, Molecular testing of BRCA1 and BRCA 2.Tumor markers. Viral disease diagnostics-HIV, Avian Flu, Chikungunya, Swine fever-RT-PCR, ELISA, F-Ab testing, Immunoarrays, Electron microscopy.

Reference:

1. Cancer Diagnostics with DNA microarrays. Steen Knudsen.Wiley Publication
2. Current Medical diagnostics and treatment.Stephen J McPhee and Maxine A Papadakis. McGraw Hill Lange Publishers
3. Emerging infectious diseases By Felissa R. Lashley, Jerry D. Durham. Springer Publishing Company.Infectious disease epidemiology byNelson. Jones and Bartlett Publishers, Inc.

4. Genetics. A Molecular approach.2nd Edn. Peter J Russel.
5. Molecular diagnostics for the clinical laboratarian by William B Coleman and Gregory J Tsongalis.Humana Press Publishers.
6. Genes in Medicine Molecular biology and human genetic disorders.**Rasko, I., Downes**, C.S.Springer Publication.
7. Genes and Disease by Bathesda.NCBI.www.ncbi.nlm.nih.gov/books.
8. Essential Medical Genetics, 5th Edition.Michael Connor, M. Ferguson Smith.Wiley Publication.

Core 24 - BT6CRP06 -PRACTICAL

INDUSTRIAL BIOTECHNOLOGY AND PLANT BIOTECHNOLOGY

Total hours of instruction: 90 Hours/week:5 Credit: 4

1. Preparation of medium for plant tissue culture
2. Surface sterilization of explants
3. Inoculation and callus initiation of plant tissue culture
4. Meristem culture
5. Determine the potability of provided water sample by MPN technique.
6. Separation of plasmid by agarose gel electrophoresis
7. Isolation of industrially important microorganism
8. Secondary screening of industrially important microorganism
9. Fermentative production of microbial metabolites-Submerged
10. Immobilization of bacteria for metabolite production.
12. Screening of the amylase producing isolates from soil.

References:

1. Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom Cultivation - K.R. Aneja; WishwaPrakashan, New Delhi.
2. Biotechnology Fundamentals and application - Purohit and Mathur, Agro botanical Publishers, New Delhi.
3. Biotechnology: Fundamentals and applications - S.S. Purohit and S.K Mathur, Agrobotanica publications
4. Practical Skill in Biomolecular Sciences - Rob Reed, David Holmes, Jonathan Weyers, Allan Jones. Logman publishers, U.K.
5. Microbiological Applications: A Laboratory Manual in General Microbiology - Harold. J. Benson, WCB publishers.
6. Plant, Cell, Tissue and Organ Culture Fundamental Methods - Gamborg and Phillips, Narosa Publishers.

Syllabus for B.Sc. Biochemistry as a Complementary Course

Consolidated scheme for courses (Model I, II & III) having Biochemistry as a complementary course

Theory

Semester	Title with Course Code	Course Category	Hours/ week	Credit	Total Credit	Marks	
						Internal	External
First	BC1CMT01-Elementary Biochemistry	Complementary	2	2	10	15	60
Second	BC2CMT02- Biomolecules	Complementary	2	2		15	60
Third	BC3CMT03-Enzymology and Metabolism	Complementary	3	3		15	60
Fourth	BC4CMT04- Nutritional and Clinical Biochemistry	Complementary	3	3		15	60

Practical

Semester	Title with Course Code	Course Category	Hours/ week	Credit	Total Credit	Marks %	
						Internal	External
First	Practical I-Elementary Biochemistry	Complementary	2	1	4	No Exam	
Second	BC2CMP01- Practical II-Biomolecules	Complementary	2	1		10	40
Third	Practical III-Enzymology and Metabolism	Complementary	2	1		No Exam	
Fourth	BC4CMP02- Practical IV-Nutritional and Clinical Biochemistry	Complementary	2	1		10	40

FIRST SEMESTER

Complementary course I: BC1CMT01-Elementary Biochemistry

Total hours of instruction: 36 Hours/week: 2 Credit: 2

Objective: To introduce the student basic principle of different types of chemical interactions in biological systems, an understanding on the basics of membrane biochemistry, importance of biochemistry of blood and to have a basic understanding of biochemical separation techniques.

Unit-I Physical Aspects of Biochemistry (10 hours)

Structure of water, Interactions in aqueous systems- covalent bond, hydrophobic interactions, Ionic interactions, hydrogen bond and van der Waals interactions. Ionization of water, strong and weak acids and bases and their dissociation, Henderson-Hasselbalch equation with derivation. Concepts of pH and Buffers. Buffersin biological systems – Phosphate buffer, Bicarbonate Buffer, Hemoglobin buffer.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain, (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7 p: 230, 244, 269,

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and, Company, New York p:43-64.

Unit-II - Membrane Biochemistry (8 hours)

Fluid mosaic model of membrane. Types of membrane proteins (peripheral, integral and amphitropic). Solute transport across membranes (passive transport—simple diffusion and facilitated diffusion, active transport- primary and secondary, uniport, symport, antiport). Osmosis. Fundamental study of Donnan equilibrium-application in biological system.

Ref: Biochemistry fifth edition by campbell farrell (2006) Thomson Brooks cole Ltd p: 34-54

Ref: Biochemistry by J. M. Berg, J. L.Tymoczko, L. Stryer6th edition(2007)W. H. Freeman and Company, New Yorkp: 510-555

Unit-III - Plant Biochemistry (8 hours)

Basic ideas of photosynthesis- Structure of chloroplast, light reaction, cyclic and noncyclic photophoshorylation, dark reaction, fixation of CO_2 and formation of carbohydrate (brief treatment only) C3 and C4 plants, Biological nitrogen fixation.
Distinction between primary and secondary metabolites.
Importance of secondary metabolites-Protection of the producer plant from predators and insect. Give examples of the compounds and the plants in which present and their importance.

Ref: Plant Metabolism: H.D. Kumar and H.N. Singh. Affiliated East-West Press Pvt. Ltd., New Delhi, Madras, Hyderabad and Bangalore. (1993; 2nd edition)

Ref: Plant Biochemistry: P.M. Dey and J.B. Harborne. (Editors.) Harcourt Asia PTE Ltd. Academic Press. (Indian Edition, 2000)

Unit-IV- Techniques in Biochemistry (10 hours)

Colorimetry and spectrophotometry
Chromatography- Paper, TLC, HPTLC, Gel Filtration, Affinity chromatography
Electrophoresis- PAGE, AGE
Blotting Techniques- Western, Southern and Northern Blotting
Introduction to proteomics-MALDI-TOF MS

Ref: Practical Biochemistry Principles and Techniquesby Keith Wilson and John Walker 5th edition (2005), Cambridge University Press, p: 580-681

Ref: Biophysical Chemistry Principles and Techniques by Upadhyay, Upadhyay, Nathhimalaya publishing house (2002), p: 175-270, 344-421, 422-478.

Suggested Readings

1. A Text Book of Biochemistry, E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, Oxford and IBH Publishing Co., New Delhi, 1974
2. Textbook of Medical Biochemistry (third Edition) (Paperback-2001) by S. Ramakrishnan. Publisher: Orient Longman ISBN: 8125020713 ISBN13: 978812502071 4, 8125020714
3. Introduction to Biophysics by Pranab kumar banarjee, S. chand & company Ltd. 2008 Biochemistry third edition by mathews, van Holde, Ahernpearson education
4. Human Physiology by C C Chatterjee 11thedition 1987
5. Biochemistry by Debajyoti das. Academic publishers. Kolkata.
6. Introduction to Biophysics by Pranab kumar Banarjee (2008) S. Chand & Company Ltd

Complementary course Practical I- Elementary Biochemistry

Total hours of instruction: 36 Hours/week: 2 Credit:1

Objective: To resolve quantitative problems concerning preparation of solutions andbuffers and to have an understanding of basic separation techniques.

1. Preparation of solutions:
   Percentage solutions
   Molar solutions
   Normal solutions
   Dilution of Stock solutions
2. Preparation of buffers using the Henderson Hasselbach equation
3. Determination of pH using pH meter (Demonstration)
4. Biochemical separation Techniques

a. Chromatographic techniques (**Any one to be performed**)

Separation of amino acids and simple sugars by Paper chromatography (Descending or ascending)
Separation of amino acids and lipids by Thin Layer chromatography
Separation of Plant pigments by Column/ Thin layer chromatography

b. Electrophoretic techniques (Demonstration)

Analysis of proteins and nucleic acids (PAGE, AGE)

5. Colorimetry and Spectrophotometry techniques
   Verification of Beer Lambert's law

References

1. Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi p 10- 15.
2. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande, I.K International Pvt. LTD, New Delhi, ISBN 81-88237-41-8, p 13- 17, p 39-43.
3. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 1- 15, 195-303
4. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 12 - 18

SECOND SEMESTER

Complementary course II: BC2CMT02-Biomolecules

Total hours of instruction: 36 Hours/week: 2 Credit:2

Objective: To describe structural characteristics of simple organic biomolecules andtheir biologically important derivatives indicating the constituent units, linkage between them etc.

Unit I: Carbohydrates (10 hours)

Isomerism of carbohydrates, D and L forms of glyceraldehyde , epimers, mutarotation and its explanation by ring structures, anomers, Structure (linear and cyclic) of glucose, galactose, mannose and fructose. Reducing action of sugars, Structure ((Haworth perspective formula) of disaccharides - maltose, sucrose, lactose) (elucidation of the structures of mono-, di-, and polysaccharides is not included). Structure and important properties of the following Homopolysaccharides – Starch, glycogen, cellulose and chitin. Heteropolysaccharides-hyaluronic acid, heparin.

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain, (2008) Publishers: S. Chand &Co Ltd ISBN: 81-219-2453-7 p:73

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and, Company, New York p: 239-255

Unit II: Lipids (6 hours)

Basic ideas about classification and physiological functions of lipids, Fatty acids – classification, structure of the following fatty acids – stearic acid, oleic acid, linoleic acid. Structure of triacylglycerol. Structure of: phosphatidic acid, lecithin, cephalin, and phosphatidyl serine. Functions of Sphingolipids. Chemical structure and functions of cholesterol and ergosterol. Definition of saponification number, acid number and iodine number of fats.

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New Yorkp: 345-356

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand &Co Ltd ISBN: 81-219-2453-7 p: 230

Unit III: Aminoacids and Protein (10 hours)

Name (with one letter and three letter code) and structures of the 20 standard aminoacids occurring in proteins, Representation of amino acid in the zwitter ionic form.Classification and function of Proteins. Elementary study of primary, secondary, tertiary and quaternary structure of proteins.Denaturation of proteins. Specialised proteins – structure and functions of Collagen

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company,

New York. p: 75-90, 127-129

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand &Co Ltd ISBN: 81-219-2453-7 p:132

Unit IV: Nucleic acids (10 hours)

Chemical nature of nucleic acids- Structure of purines and pyrimidines, deoxyribose, ribose, nucleosides, nucleotides. Formation of phosphodiester linkages, Watson-Crick model of DNA-Chargaff rule, Different forms of DNA-A, B and Z DNA. Denaturation of nucleic acids-hyperchromiceffect,*T*m-values and their significance, Structure and function of mRNA, rRNA and tRNA.

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008) 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freemanand Company, New York. p: 273-300

Ref: Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand &Co Ltd ISBN: 81-219-2453-7 p:280

Suggested Readings

1. A Text Book of Biochemistry by E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, Oxford and IBH Publishing Co., New Delhi, 1974
2. Biochemistry by Donald Voet, Judith G. Voet Publisher: John Wiley &Sons Inc(2004) ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500
3. Principles Of Biochemistry by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: Mcgraw-hill Book Company – Koga(1995) ISBN:0697142752 ISBN-13: 9780697142757, 978-0697142757
4. Principles Of Biochemistry, 4/e by Robert Horton H , Laurence A Moran, Gray ScrimgeourK Publisher: Pearsarson(2006) ISBN: 0131977369, ISBN13:978013197736 5, 978-0131977365
5. Biochemistry (6thEdition) by JeremyM.berg John L.tymoczko Lubert Stryer Publisher:B.i.publicationsPvt.Ltd (2007) ISBN:071676766X ISBN13: 978071676 7664,978716767664
6. Biochemistry by Rastogi Publisher: McgrawHill (2008) ISBN:0070527954 ISBN13: 978 0070527959, 978-0070527959
7. Textbook of Biochemistry for medical studentsby Vasudevan, D. M., Sreekumari, S., &Vaidyanathan, K. (2010). Jaypee Brothers Publishers. p: 76

Complementary course Practical II- BC2CMP01- Biomolecules

Total hours of instruction: 36 Hours/week: 2 Credit:1

Objective: To provide the students an opportunity to develop their qualitative skillsand to have a sound knowledge on basic protocols for identification of biomolecules.

1. Qualitative analysis of a given unknown sample (Carbohydrates/proteins/amino acids/lipids/NPN substance)

i. Reactions of Carbohydrates, Amino acids, Proteins, Lipids and NPN substance

a. Carbohydrates: (Glucose, fructose, Maltose, Lactose, Sucrose, Starch, Dextrin maybe given for analysis).

Molisch test, Iodine test, Test for reducing sugars (Fehling's test, Benedict's test, Barfoed's test), Seliwanoff's test, Bial's test, Mucic acid test, Acid hydrolysis of Sucrose, Osazone test

b. Amino acids: (tyrosine, tryptophan,cysteine, cystine, methionine, arginine, proline, histidine may be given for analysis)

Ninhydrin test, Xanthoproteic test, Istatin test, Pauly'sdiazo test, sakaguchi test, Ehrlich's test, Sodium nitroprusside test, Millon's test, Sullivan's test

c. Proteins: (Casein, Albumin, Gelatin, peptone may be given for analysis).

Biuret test, Ammonium sulfate precipitation test, Sulphosalicylic acid test, Heat coagulation test, test for inorganic phosphate

d. Lipids: Fats (tristearin), Fatty acids (palmitic acid, stearic acid, oleic acid), Glycerol, Steroids, and cholesterol

Solubility in Organic solvents, saponification test, Acrolein test, Test for unsaturation: with bromine water or dilute potassium permanganate or Hubl's iodine test, Salkowski test, Zak's test

e. Non Protein nitrogenous compounds: (Urea, Uric acid, Creatinine)

Urease test, Phosphotungstic acid test and Jaffe's test

ii. Identification of Monosaccharide, Disaccharide, Polysaccharide following a systematic scheme of analysis (Single component from among the above mentioned carbohydrates to be given).

iii. Identification of amino acids and proteins following a systematic scheme for analysis (single components only need be given

iv. Identification of lipids following a systematic scheme for analysis (single components only need be given)

v. Identification of NPN following a systematic scheme for analysis (single components only need be given)

References

1. Hawk's Physiological Chemistry, Bernard L. Oser (ed) TATA McGRAW Hill Publishing Company LTD, New Delhi p 10- 15. , p 60 – 127, 1317- 1334
2. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande, I.K International Pvt. LTD, New Delhi, ISBN 81-88237-41-8, p 13- 17, p 49-72
3. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9 p 15- 23, 33- 35, 50 -57.
4. Practical Biochemistry, R.C. Gupta & S. Bhargava (eds) CBS Publishers and Distributors, New Delhi, ISBN 81-239-0124-0 p 9 - 27

THIRD SEMESTER

Complementary course III: BC3CMT03-Enzymology and Metabolism

Total hours of instruction: 54 **Hours/week: 3** **Credit: 3**

Objective: To introduce the student basics of enzyme catalysis and explain the majorpathways of carbohydrate, protein and lipid metabolism.

Unit I -Enzymology (16 hours)

Classification of enzymes- six major classes of enzymes with one example each. Cofactors and coenzymes. Elementary study of the factors affecting velocity of enzyme catalysed reactions- effect of substrate concentration, enzyme concentration, temperature and pH.Michaelis-Menten equation(without derivation). Km and its significance.The Lineweaver-Burk plot.Enzyme specificity- an example each for group specificity, optical specificity, geometrical specificity and cofactor specificity of enzymes.

Ref: Biochemistry by U. Satyanarayana and U. Chakrapani. Fourth Edition, co-published by Elsevier Books and Allied (P) Ltd, ISBN: 978-81-312-3601-7, p:86-101

Ref: Lehninger Principles of Biochemistry by Nelson, D. L., Lehninger, A. L., & Cox, M.M. (2008) 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman andCompany, New York, p:184-220.

Unit –II Carbohydrate metabolism (16 hours)

Glycolysis (with structure). Fates of pyruvate, lactic acid fermentation, alcohol fermentation. Pyruvate dehydrogenase reaction, Citric acid cycle (with structure), substrate level phosphorylation, electron transport chain and oxidative phosphorylation. Glycogen metabolism-glycogenesis and glycogenolysis.

Ref: Biochemistryby U. Satyanarayana and U. Chakrapani.Fourth Edition, co-published by Elsevier and Books and Allied (P) Ltd, ISBN: 978-81-312-3601-7,p:225-265.

Ref: Lehninger Principles of BiochemistrybyNelson, D. L., Lehninger, A. L., & Cox, M. M. (2008)5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York, p:528-707.

Unit-III Protein metabolism (12 hours)

General aspects of aminoacid metabolism-Decarboxylation, deamination and transamination of aminoacids (without molecular mechanism).Urea cycle (with structure).Glucogenic and Ketogenic amino acids with examples.

Ref: Biochemistry byU. Satyanarayana and U. Chakrapani. Fourth Edition, co-published by Elsevier and Books and Allied (P) Ltd, ISBN: 978-81-312-3601-7, p:144-375.

Ref: Lehninger Principles of BiochemistrybyNelson, D. L., Lehninger, A. L., & Cox, M. M. (2008), 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and

Company, New York, p: 677-878

Unit IV- Lipid metabolism (10 hours)

Fatty acid biosynthesis (with structure), Oxidation of fatty acids-Fatty acid activation, carnitine shuttle, β- oxidation (with structure) of fatty acids-explain using palmitic acid and ATP yield . Ketone bodies. Outline study of cholesterol biosynthesis (without structure).

Ref: Biochemistry byU. Satyanarayana and U. Chakrapani. Fourth Edition, co-published by Elsevier and Books and Allied (P) Ltd, ISBN: 978-81-312-3601-7, p: 287-309.

Ref: Lehninger Principles of Biochemistry byNelson, D. L., Lehninger, A. L., & Cox, M. M. (2008), 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York, p:650-831

Suggested Readings

1. A Text Book of Biochemistryby E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, Oxford and IBH Publishing Co., New Delhi, 1974
2. Harper's Biochemistry by Robert K. Murray , Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell, Publisher: Appleton & Lange; 25th Revised edition edition (1 July 1999), ISBN-10: 0838536840, ISBN-13: 978-0838536841
3. Biochemistry Seventh Edition by Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, Publisher: W. H. Freeman; Seventh Edition edition (December 24, 2010), ISBN-10: 1429229365, ISBN-13: 978-1429229364
4. Biochemistry by Donald Voet, Judith G. Voet, Publisher: John Wiley & Sons (2011), Fourth Edition,ISBN-10: 0071737073, ISBN-13: 978-0071737074
5. Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain, Nithin Jain (2008), Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7

Complementary course Practical - Enzymology and Metabolism

Total hours of instruction: 36 Hours/week: 2 Credit: 1

Objective: To make the student understand the basic steps involved in extraction anddetermination of enzyme activity.

1. Extraction of enzymes: (Minimum of 2 experiments to be done)

Acid phosphatase from Fresh Potato (*Solanumtuberosum*)
β- amylase from Sweet potato (*Ipomoea batatas*)
Urease from Jack bean (*Canavaliaensiformis*)

2. Enzyme Assay: (Minimum of 2 experiments to be done, enzymes extracted from above experiment can be used)

Acid phosphatase
β- amylase
Urease from Jack bean

References

Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p: 173-187

Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p: 110 – 155
Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p: 49- 181, 184 – 255

FOURTH SEMESTER

Complementary course IV: BC4CMT04- Nutritional and Clinical Biochemistry

Total hours of instruction: 54 Hours/week: 3 Credit: 3

Objective: To explain and schematize the nutritional and biological importance of vitamins and minerals. Explain the clinical significance of organ based function tests and describesthe biochemical basis of some important metabolic disorders.

Unit I- Nutritional biochemistry (12 hours)

Concepts of nutrition, Nutritional requirements, Principle foods-Cereals,pulses, vegetables, fruits, nuts, milk, egg, meat, fish. Calorific value of foods, Respiratory quotient, Basal metabolic rate. Biological value of proteins, essential and non-essential amino acids and essential and non-essential fatty acids.Sources, nutritional importance and deficiency disorders of vitamin A, D, E, K, C, B1, B2, pyridoxine, nicotinic acid, B12 and folic acid (structure not required). Biological and nutritional importance of macro and micro minerals-calcium, magnesium, sodium, potassium, iron, copper, selenium and their deficiency disorders.

Ref: Textbook of Biochemistry for Medical Students byVasudevan, D. M., Sreekumari, S, &Vaidyanathan, K. (2010). Jaypee Brothers Publishers. p: 74,196, 271-281, 300-315, 317, 320,321, 322.

Unit-II Blood (10 hours)

Constituents of Blood, types of blood cells, components of plasma, types of plasma proteins and functions. Mechanism of blood clotting (Extrinsic and Intrinsic pathway). anticoagulants, fibrinolysis. Structure of hemoglobin.-Types of hemoglobin, sickle cell anemia.

Ref: Essentials of Medical physiology by Sembulingum, Prema sembulingum 5th edition Jaypee (2010) p: 49-150

Ref: Harper"s illustrated Biochemistry by R.K Murrayet al 25th edition (1999) Publisher: Appleton & Langep: 588-632

Unit III- Clinical biochemistry (18 hours)

Basic concepts of clinical biochemistry. Definition and scope of clinical biochemistry in diagnosis. Sample collection and preservation of blood, plasma, serum and urine. Chemical analysis of blood, urine and CSF. Liver function tests - total protein, albumin, globulin, albumin-globulin ratio. Total and conjugated bilirubin, AST, ALT, ALP, GTT. Thyroid function tests- T3 and T4, TSH. Renal functiontests-Urea, creatinine, urea clearance test and creatinine clearance test (Normal values of the above tests must be included).

Ref: Text book of Medical Biochemistry by M.N. Chatterjee and Rana Shinde, Jaypee Brothers,Medical Publishers Pvt Ltd. New Delhi. p: 168 - 202.

Ref: Text Book of Biochemistry by D M Vasudevan and Sreekumari S. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi.p: 517 - 525.

Ref: Clinical Biochemistry Principles and Practices by Praful B Godkar, Bhalani publishing house. Bombay. India. p: 87- 93

Unit IV- Biochemical basis of Metabolic disorders (14 hours)

Biochemical basis of Lactose intolerance, Diabetes mellitus, hypoglycaemia, galactosemia, hyperlipidemia, atherosclerosis, ketosis, obesity.

Ref: Clinical Biochemistry Principles and Practices by Praful B Godkar, Bhalani publishing house. Bombay. India. p: 258 – 271, 233 – 251, 92 – 117.

Ref: Text Book of Biochemistry by D M Vasudevan and Sreekumari S. Jaypee Brothers, Medical Publishers Pvt Ltd. New Delhi. p: 428 – 451, 480 – 484, 537 - 549.

Ref: - Text book of Medical Biochemistry by M.N. Chatterjee and Rana Shinde, JaypeeBrothers, Medical Publishers Pvt Ltd. New Delhi. p: 668 - 808.

Suggested Readings

1. Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson Michael M. Cox. Publisher: W. H. Freeman; (2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392
2. A Text Book of Biochemistry by E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, Oxford and IBH Publishing Co., New Delhi, 1974
3. Biochemistry (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500
4. Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: Mcgraw-hill Book Company Koga ISBN:0697142752 ISBN-13: 9780697142757, 978-0697142757
5. Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray ScrimgeourK Publisher: Pearsarson ISBN: 0131977369, ISBN-13:9780131977365, 978-0131977365
6. Biochemistry 6th Edition (2007) by Jeremy M.berg John L.TymoczkoL Ubert Stryer Publisher: B.I.publicationsPvt.Ltd ISBN:071676766X ISBN13: 9780716767664, 978-716767664
7. Biochemistry (2008) by Rastogi Publisher: McgrawHill ISBN**:**0070527954 ISBN13**:** 978 0070527959**,** 978-0070527959
8. Notes on Clinical Biochemistry by John K. Candlish (1992) publisher: World Scientific Publishing Company ISBN: 9810210663 ISBN-13: 9789810210663, 978-9810210663
9. Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephan K. Bangert, Elizabeth S.M. Ed. S.M (ed) Marshall (2008) Publisher: Elsevier Science Health Science Div ISBN: 0443101868 ISBN-13: 9780443101861, 978-0443101861
10. Biochemistry by John K. Joseph (2006) Publisher: Campus Books International ISBN: 8180301109 ISBN -13: 9788180301100, 978-8180301100
11. Basic Medical Biochemistry: A Clinical Approach by Dawn B PH.D. Marks, Allam D. Marks colleen M. Smith (1996) Publisher; Lippincott Williams & Wilkins; illustrated edition ISBN -10: 068305595X ISBN-13: 978-0683055955

Complementary course Practical II- BC4CMP02- Nutritional and Clinical Biochemistry

Total hours of instruction: 36 Hours/week: 2 Credit:1

Objective: To introduce the student protocols of quantitative analysis ofbiomolecules using colorimetric technique and to familiarize qualitative analysis of body fluids

1. Estimation of Carbohydrates: (Colorimetric) (Any 2 to be done)
   Quantitation of total sugars by phenol sulphuric acid method
   Estimation of reducing sugars by dinitrosalicylate method
   Determination of fructose by Roe's resorcinol method

2. Separation and Estimation of Lipids: (Colorimetric) (Any 1to be done)
   Estimation of Cholesterol by Zak's method
   Determination of saponification value of fats
   Determination of iodine number of oils

3. Estimation of Proteins and Amino acids: (Colorimetric) (Any 2 to be done)
   Estimation of protein by Lowry's method
   Determination of protein by Biuret method
   Estimation of tryptophan by Spies and Chamber's method

4. Estimation of Minerals and Vitamins (Colorimetric) (Any 1 to be done)
   Colorimetric estimation of iron in foodstuffs by ά άdipyridyl method
   Quantitative determination of thiamine in cereals and food
   Estimation of ascorbic acid in Lemon juice

5. Qualitative tests of urine: Abnormal constituents) (Any 2 to be done)
   Proteins (Coagulation test, sulfosalicylic acid test, test for Bence-Jones proteins)
   Sugars (Benedicts test)
   Haemoglobin (Benzidine test)
   Ketone bodies (Rothera test, Gerhardt's test)
   Bile pigments (Fouchet's test, Gmelin's test) Bile salts (Hay's test)

References

1. Experimental Biochemistry: A Student Companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81-88237-41-8, p: p 81-126.
2. Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p: 15 – 109.
3. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p: 49- 181, 184 – 255.

Syllabus for Microbiology as a Complementary Subject in UG programmes

Consolidated scheme for courses (Model I, II & III) having Microbiology as a complementary subject

Theory papers

Semester	Title with Course Code	Course Category	Hours/ week	Credit	Total Credit	Marks %	
						Intl	Extl
First	MB1CMT01 Fundamentals of Microbiology-1	Complementary	2	2	8	20	80
Second	MB2CMT02 Fundamentals of Microbiology-II	Complementary	2	2		20	80
Third	MB3CMT04 Applied Microbiology	Complementary	2	2		20	80
Fourth	MB4CMT05 Medical Microbiology	Complementary	2	2		20	80

Practical papers

Semester	Title with Course Code	Course Category	Hours/ week	Credit	Total Credit	Marks %	
						Intl	Extl
First and Second	MB2CMP03 Microbiology Practical-I	Complementary	2	2	4	20	80
Third and Fourth	MB4CMP06 Microbiology Practical-II	Complementary	2	2		20	80

FIRST SEMESTER

Complementary course I: MB1CMT01 Fundamentals of Microbiology-1

Total hours of instruction: 36 Hours/week: 2 Credit: 2

Unit I

Microbial world.Diversity of Microbial World.History of microbiology.Beneficial and harmful microbes. Differentiate between prokaryote & Eukaryote. Scope and different fields of Microbiology- Medical, Industrial, Agricultural, Food, Immunology etc., Principles and methods of bacterial classification. Ultrastructure of bacteria-cell wall, cytoplasmic membrane,inclusions, flagella, endospore. Differentiate between archaebacteria and Eubacteria

References

1. Prescott/Harley/Klein's Microbiologyby Joanne Willey, Linda Sherwood, and Chris Woolverton
2. Microbiology Pelczar, Chan and Krieg.
3. General microbiology Vol 2 Powar&Daginawala

Unit II

Microscopy – optical, phase contrast, fluorescent, darkfield, electron (TEM & SEM) - Principle Pathway of Light.

References

1. Prescott/Harley/Klein's Microbiologyby Joanne Willey, Linda Sherwood, and Chris Woolverton
2. Microbiology Pelczar, Chan and Krieg.
3. General microbiology Vol 2 Powar&Daginawala
4. Biophysics R.N.Roy

Unit III

Staining – preparation of specimens for staining, simple staining, differential staining & negative staining. Microscopic examination of microorganisms- hanging drop, simple, differential and negative staining

References

1. Prescott/Harley/Klein's Microbiologyby Joanne Willey, Linda Sherwood, and Chris Woolverton
2. Microbiology Pelczar, Chan and Krieg.
3. General microbiology Vol 2 Powar&Daginawala

SECOND SEMESTER

Complementary course 2: MB2CMT02 Fundamentals of Microbiology-II

Total hours of instruction: 36 Hours/week: 2 Credit: 2

Unit I

Bacterial Nutritional requirements& Sources, Culture Media, Culture Methods, Anaerobic culture methods, Isolation of Pure Culture.Sterilisation and disinfection-Physical and chemical methods.Principles and Application. Antibiotics mode of action of β - Lactum antibiotics, antibiotics act on protein synthesis & DNA replication – Antibiotic Sensitivity Test – Disc Diffusion.

References

1. Microbiology Pelczar, Chan and Krieg
2. Prescott/Harley/Klein's Microbiologyby Joanne Willey, Linda Sherwood, and Chris Woolverton
3. General microbiology Vol. 2 Powar&Daginawala
4. Ananthanarayan and Paniker's Textbook of Microbiology R. Ananthanarayan,
5. C.K. JayaramPanikar

Unit II

Factors affecting growth of bacteria. Growth curve. Nutritional Types of Bacteria – Classification.- Autotrophs, Heterotrophs, chemotrophs, lithotrpohs and organotrophs

Microbial metabolism- Glycolysis, AlchoholicFermantation, TCA Cycle, Glyoxalate cycle, Pentose phosphate pathway.

References

1. Microbiology Pelczar, Chan and Krieg
2. Prescott/Harley/Klein's Microbiologyby Joanne Willey, Linda Sherwood, and Chris Woolverton
3. General microbiology Vol 1 & 2 Powar&Daginawala

Unit III

Bacterial genetics - Genetic exchange- transformation, transduction and conjugation. Extra chromosomal genetic material-Plasmid. Genetic mechanisms of drug resistance in bacteria based on plasmid.

References

1. Microbiology Pelczar, Chan and Krieg
2. Prescott/Harley/Klein's Microbiologyby Joanne Willey, Linda Sherwood, and Chris Woolverton
3. General microbiology Vol. 2 Powar&Daginawala
4. Microbial Genetics Stanley R. Maloy, Freifelder and Cronan
5. Molecular Genetics of Bacteria Snyder and CharminessologyM.J.Pelczar,Jr. ECSChan and N.R.Krieg Tata McGraw-Hill

Complementary course 3- MB2CMP03 Microbiology Practical-I

Total hours of instruction: 72 Hours/week: 2 Credit:2
(36 in semester I and36 in Semester II)

Study the parts and usage of a compound microscope

Study the parts and working and uses of

Autoclaves

Hot air oven

Membrane Filter

Safety Cabinet

Anaerobic Jar

Incubator

Preparation of culture Media (NB, NA, MA) and dispensing media in test tubes, bottles, petridishes.

Preparation and examination of Hanging drop mount for studying the motility of bacteria.

Preparation of slide smears for staining.

Staining techniques

- Simple staining

- Gram Staining

- Negative Staining.

Cultivation of Bacteria on nutrient Agar for obtaining isolated colonies. Study of cultural colony characters- Size, shape, colour etc.

Viable Count of bacteria by pour plate/ spread plate method.

Demonstration of antibacterial activity by disc diffusion method

References:

1. Microbiology – Concepts and Application – Pelzer Jr. Chang Kreig Mac Graw Hill Inc
2. Microbiology – Prescott, Harley and Klein Wim.C.Brown Publishers.
3. Practical Microbiology – R.C Dubey, D.K Maheshwari, S Chand and Company, New Delhi.
4. Microbiology Laboratory Manual – Cappuccino, Sherman, Pearson Education.

THIRD SEMESTER

Complementary course 4: MB3CMT04 Applied Microbiology

Total hours of instruction: 36 Hours/week: 2 Credit:2

Unit I

Food as substrate for microorganisms. Principles of food preservation-High temperature,Low temperature, drying, chemical preservation- Production of edible mushrooms-Pleurotus,Agaricus,Volvariella, milk products-Butter, Cheese. Oriental fermented Food products-Miso,tempeh. Single cell protein,Probiotics. Microbiological examination of milk. Spoilage –milk,meat

References

1. Principles of Fermentation Technologyby Peter F. Stanbury, Stephen J. Hall, and Allan Whitaker
2. Manual of Industrial Microbiology and Biotechnologyby Ronald M. Atlas
3. Prescott and Dunn's Industrial Microbiologyby Gerald Reed
4. Industrial Microbiologyby Samuel C. Prescot
5. Food Microbiology Frazier

Unit II

Soil microbiology- Microorganisms & interactions. Biogeochemical cycles- Nitrogen and Phosphorous**.** Biofertilizers-Rhizobium, Biodegradation of pesticides, Biopesticides, biogas production.

References

1. Agricultural Microbiology Bagraja&Rangaswami
2. Soil Microorganisms & Plant Growth - N.S. Subba Rao
3. MicrbialEchology – Atlas &Bartha
4. Environmental aspects of Microbiology – Joseph C. Daniel
5. Bioremediation Baker &Herson

Unit III

Microbial assessment of water quality, water purification. Aeromicrobiology – definition, Microbilogical assessment of air quality. A brief account of microbial production of useful products-antibiotics, alcohol, organic acids and enzymes

References

1. Micrbialechology – Atlas &Bartha
2. Environmental aspects of Microbiology – Joseph C. Daniel
3. Microbiology Pelczar, Chan and Krieg.

FOURTH SEMESTER

Complementary course5: MB4CMT05 Medical Microbiology

Total hours of instruction: 36 **Hours/week: 2** **Credit: 2**

Unit I

Sources of infection. Methods of transfer of infections. Factors determining pathogenic potentials of microbes. A brief study on bacterial pathogens-*Staphylococcus*, *Streptococcus*, *Corynebacteriumdiphtheria*, *E.coli*, *Salmonellatyphi*, *Shigella*, *Vibrio cholera* and *Mycobacteriumtuberculosis*

References

1. Ananthanarayanan and Paniker Textbook of Microbiology Orient Longman

Unit II

Introduction to virology – unique properties and structure of viruses. A brief study on viral diseases –Small pox, chicken pox, polio, influenza, hepatitis, rabies, influenza and AIDS

References

1. Aanthanarayan and Paniker's Textbook of Microbiology R. Ananthanarayan, C.K. JayaramPanikar
2. Prescott/Harley/Klein's Microbiology by Joanne Willey, Linda Sherwood, and Chris Woolverton
3. Microbiology Pelczar, Chan and Krieg

Unit III

Introduction to mycology, General characters of fungi, classification, cultivation, cultural characters, microscopic morphology. Mycotoxins. Abreif study on diseases caused by fungi. Pytiriasis, Dermatophytoses& Candidiasis

References

1. Ananthanarayanan and Paniker Textbook of Microbiology Orient Longman
2. Microbiology M.J.Pelczar,Jr. ECSChan and N.R.Krieg Tata McGraw-Hil

Complementary course 6- MB4CMP06 Microbiology Practical-II

Total hours of instruction: 72 Hours/week: 2 Credit:2
(36 in semester III and36 in Semester IV)

Isolation & Enumeration of microorganisms from soil sample

Study of microbial contamination in food products.

Analysis of milk quality by Methylene blue reductase test

Study of microorganisms in air exposed plate method.

Identification of common fungus like *Mucor*, *Rhizopus*, *Penicillium*, *Aspergillus* by Lactophenol cotton blue mount examination.

Preparation of fungal media

Cultivation of fungi study of colony characters of yeast and mold.

Microscopic morphology of yeast and molds.

References:

1. Practical Microbiology – R.C Dubey, D.K Maheshwari, S Chand and Company, New Delhi.
2. Experiments in Microbiology, Plant Pathology and Biotechnology- K R Aneja, New Age International Publishers
3. Microbiology Laboratory Manual – Cappuccino, Sherman, Pearson Education.
4. Bailey and Scott's Diagnostic Microbiology.

Syllabus for Biotechnology as a Complementary Subject in UG programmes

BT1CMT01 COMPLEMENTARY COURSE 1
Cell Biology

Total hours of instruction: 36 Hours/ week: 2 Credit: 2

Module I: 5hrs

History and development of Cell Biology, Discovery of cell, Cell theory.General organization of prokaryotic and eukaryotic cell.Plant cells and animal cells.

Module II: 7hrs

Cell membrane- Molecular models of cell membrane, Fluid mosaic model, Chemical composition, Functions-Membrane transport-Active, passive, facilitated-symport, antiport. Cell junction-Tight junction, gap junction.

Module III: 12hrs

Cell organelles-Nucleus,Endoplasmic reticulum, golgi apparatus, lysosomes and peroxisomes, , Cytoskeleton - microtubules, microfilaments and intermediate filaments.

Module IV: 5 hrs

Semi autonomous organelles-mitochondria: structure, oxidative phosphorylation, electrone transport, chemiosmotic coupling. Chloroplast: structure, LHC, photosystems, cyclic and noncyclic photophophorylation, Calvin cycle.

Module V: 7hrs

Cell cycle-Phases of cell cycle - G1, S, G2 & M. Mitosis–stages, Meiosis – stages, significance, synaptonemalcompex, Regulation of cell cycle - MPF and cyclins, Cell death - Necrosis and apoptosis

References

1. The world of the Cell, 6 thEdn. - Becker – Klein smith Hardin
2. Cell and Molecular Biology - Gerald Carp, John Wiley and Sons, Inc
3. The Cell - Geoffrey M Cooper
4. Cell Biology - Smith and Wood
5. Cell and Molecular Biology, 8th Edn - EDP De Robertis and EMF De Robertis, Lippincott**,** Williams and Wilkins publication.
6. Molecular Cell Biology 6 thEdn - Lodish, Berk, Kaiser, Kreiger. Scott, Bretscher, Pleogh, Matsudaria. W. H Freeman and company publication.
7. Principles of genetics - Snustad and A.G. Gardner, John Wiky Pub

BT1CMT02 COMPLEMENTARY COURSE 2
GENETICS

Total hours of instruction: 36 Hours/ week: 2 Credit: 2

Module I: 5Hrs

The birth of genetics, symbols and terminology genes, alleles, genotypes, phenotypes, Dominance, Recessiveness, Wild type, Mutant type, Test cross, Backcross , Reciprocal cross.

Module II: 8 Hrs

Mendelian Genetics- Mendel's experiments, monohybrid cross, principle of segregation, dihybrid ratio, principle of independent assortment, codominance. Semidominance.

Module III: 10 Hrs

Gene interactions-Epistasis, Pleiotropy, Polygenic inheritance- Skin colour in man, Multiple alleles-ABO Blood typing, lethal genes, Sex determination-autosomes and allosomes, chromosome basis of sex determination-XX-XY,XX-XO, Barr body and Lyon hypothesis.

Module IV: 8Hrs

Linkage, crossing over- mechanism- hollidaymodel , sex linked, sex influenced and sex limited inheritance, Chromosome- size, shape, structure and types of chromosomes, chromosome banding, giant chromosomes.

ModuleV 5 Hrs

Extra chromosomal inheritance- mitochondrial and chloroplast.Euploidy, Nondisjunction and aneuploidy, polyploidy in plants.Gene mutation- addition, deletion, translocation, inversion, missense and nonsense.

References

1. Genetics: A Molecular approach. 2ndEdn - Peter J Russel.
2. Principles of genetics - Snustad and A.G. Gardner, John Wiky pub
3. Genetics - Strick Berger
4. Text book of genetics - Veer BalaRastogi
5. Genetics - Daniel L. Hartin and Elizabath W. John 47

BT1CMT03 COMLPEMENTARY COURSE 3
MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY

Total hours of instruction: 36 Hours/ week: 2 Credit: 2

Module I: 5Hrs

Experiments demonstrating DNA as the genetic material, RNA as genetic material, Structure of DNA and RNA, Physico chemical properties of DNA, Packaging of DNA in eukaryotes - Histones and nucleosomes.

Module II: 10Hrs

Genes-concept of gene-introns and exons, structure of prokaryotic gene: operon, organization of operon, eukaryotic gene - structure, reading frame and regulatory elements - promoters and enhancers, Repair - direct, reversal, Base excision and nucleotide excision repair.

Module III: 10Hrs

Basics of recombinant DNA technology, restriction enzymes, steps in rDNA technology, vectors - pBR322,pUC,Lambda,M13.Ligation, Selection of recombinants - Insertional inactivation, Blue-white assay

Module IV: 7Hrs

Gene transfer methods - $CaCl_2$ mediated, Electroporation, Microinjection, Genomic library and C DNA library, Southern blotting. PCR, RFLP, RAPD techniques.

Module V: 4hrs

Applications of r DNA technology: Crop improvement, recombinant insulin, growth hormone,recombinant vaccine, superbugs, risks of GMO.

References

1. Gene Cloning and DNA Analysis - TA Brown, Blackwell publication.
2. Principles of Gene Manipulation and Genomics - SB Primrose RM Twyman, Blackwell publication.
3. Recombinant DNA: Genes and Genomes - James D Watson, Any A Candy, Richard MM, Jan A Witkoeski, WH Freeman and Company Publication.
4. Gene Biotechnology - SN Jogdand, Himalaya Publication

BT4CMT04 Plant and Animal Biotechnology

Total hours of instruction: 36
Hours/ week: 2 Credit: 2

Module I: 5Hrs

Plant tissue culture- a historical approach. Tissue culture media. Media preparation. Role of growth hormones..

Module II: 8 Hrs

Totipotency and cyto-differantiation .Types of culture-Callus culture, Suspension culture and single cell culture. Somaclonal variation. Organogenesis and Embryogenesis. Meristem culture.

Module III: 5 Hrs

Haploid production-ovary, ovule, anther and pollen culture.significance of haploid production, Application of Plant cell culture.

Module IV: 10 Hrs

History of animal cell culture, Basic requirements of animal cell culture, Culture media –types and preparation, Importance of growth factors of the serum.

Module V: 8 Hrs

Primary cell cultures - Anchorage dependent and non anchorage dependent cells secondary cell cultures. Transformed animal cells, Established/continuous cell lines. Commonly used animal cell lines-their origin and characteristics. Application of Animal cell culture-vaccine production and secondary metabolites.

References

1. Animal cell culture (IIIrd edition) A practical approach - John R.W. Masters
2. Animal Biotechnology - R. Sasidhara.
3. Animal biotechnology – Raja, Florence Periera. Dominant publishers New Delhi. 2006
4. In vitro cultivation of animal cells - Open University, Netherlands. New Delhi, Butter Worth-Heinemann, 1994
5. Plant tissue culture: Theory and Practice - S.S Bhojwani and M.K. Razdan. Elsevier
6. Plant tissue culture - S.P. Misra.
7. Plant cell and tissue culture - S. Narayanaswamy
8. Plant Breeding - B.D. Singh.
9. Plant Tissue Culture –Kalyan Kumar De

COMPLEMENTARY PRACTICALS

BT1CMP01 PRACTICAL- BIOTECHNOLOGY 1

Total hours of instruction: 36 Hours/ week: 2

Credit: 1

1. Examination of different kinds of cells-Prokaryotic & eukaryotic cell
2. Squash preparation-study of mitotic stages
3. Cell fractionation

a) Homogenization of tissue

b) Organelle specific marker for mitochondria, chloroplast.

4. Staining of mitochondria

5. Cell counting methods: a) Haemocytometer: WBC, RBC b) Differential counting using Leishman's stain

References

1. Laboratory investigation in cell and molecular biology - Allyn Bregman, 1996.
John Wiley and Sons.
2. A Text book of Practical Physiology - CL Ghai, Jaypee Brothers Publishers (P) LTD New Delhi.
3. Medical Laboratory Technology. Procedure Manual for Routine Diagnostic Tests -Volume I - Kanai L Mukherjee; Tata McGraw-Hill publishing Company. Ltd New Delhi

BT2CMP02 PRACTICAL-BIOTECHNOLOGY 2

Total hours of instruction: 36 Hours/ week: 2 Credit : 1

1. Micrometry:

a) Calibration using ocular micrometer

b) Finding out average cell size

2.Staining of Barr body

3.ABO Blood grouping

4. Problems in mendelian law, crossing over and linkage

References

1. Laboratory investigation in cell and molecular biology - Allyn Bregman, 1996.
John Wiley and Sons.
2. Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom Cultivation - K.R. Aneja; Wishwa Prakashan, New Delhi.

BT3CMP03 PRACTICAL - BIOTECHNOLOGY 3

Total hours of instruction: 36 Hours/ week: 2 Credit: 1

1. Separation of DNA by agarose gel electrophoresis
2.Estimation of DNA
3.Estimation of RNA
4. Competent cell preparation
5. Transformation of the competent cell

References

1. Molecular Cloning: A Laboratory Manual 3rded. - Sambrook K.J, Fritsch E.F, Maniatis T. CHLS N.Y.
2. Practical Biochemistry 4thed - Keith Wilson and John Walker.
3. Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom Cultivation - K.R. Aneja; Wishwa Prakashan, New Delhi.

BT1CMP04 PRACTICAL - BIOTECHNOLOGY 4

Total hours of instruction: 36 Hours/ week: 2

Credit : 1

1. Preparation of medium for plant tissue culture
2. Surface sterilization of various explants
3. Inoculation and callus initiation of plant tissue culture
4. Rooting and Shoot development through tissue culture
5. Hardening of the tissue cultured plant

References

1. Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom Cultivation - K.R. Aneja; Wishwa Prakashan, New Delhi.
2. Plant, Cell, Tissue and Organ Culture Fundamental Methods - Gamborg and Phillips, Narosa Publishers.
3. Plant Biotechnology - S. Ignacimuthu, Oxford and IBH Pub.
4. Basic agricultural Biotechnology - Purohit, Kothari and Mathur, Agrobotanical Pub.
5. Laboratory investigation in cell and molecular biology - Alltyn Bergman, 1996. John Wiley and Sons.

BSc Biotechnology Model Question Paper
Semester I
BT1CRT01 BASIC LIFE SCIENCES

Time: 3 hrs **Max. marks : 60**

PART A
Answer any 10 questions. Each question carries one mark.

1. Gibberellins
2. micturition
3. BMR
4. Autotroph
5. Transpiration
6. Chlorophyll
7. Depolarisation
8. Photoperiodism
9. Alveoli
10. Microvilli
11. Macrophages
12. ADH

10 x 1 = 10 marks

PART B
Answer any 6 questions. Each question carries five marks.

13. Regulation of respiration.
14. Give notes on: PABA, Dopamine, serotonin.
15. CAM plants.
16. Effect of cytokinins and auxins on plant growth
17. Mechanism of Transpiration
18. Structure of neuron.
19. Micronutrients
20. Structure and function of hemoglobin.
21. Functions of lymph.

6 x 5 = 30 marks

PART C
Answer any 2 questions. Each question carries ten marks.

22. Explain the structure of nephron in relation to its functions.
23. Describe synaptic transmission.
24. Explain the types and functions of digestive juices.
25. Discuss the types of movements observed in plants.

10 x 2 = 20 marks

BSc Biotechnology Model Question Paper
Semester I
BT1CRT02 METHODOLOGY IN BIOTECHNOLOGY

Time: 3 hrs Max. marks : 60

PART A
Answer any 10 questions. Each question carries one mark.

1. Define fermentation.
2. Bermuda principles.
3. Trademark
4. Lactic acid bacteria
5. Chimeric DNA.
6. Nanocrystal
7. Quantum dots.
8. Mention any four advantages of bioprocess.
9. NCBI
10. Minimal cell.
11. Marker gene.
12. HGP Write.

10 x 1 = 10

PART B
Answer any 6 questions. Each question carries five marks.

13. Restriction enzymes.
14. Buffalo cloning in India.
15. Marine fermented food.
16. Principle of cloning.
17. Discuss merits and demerits of GMO.
18. Nanotechnology in drug delivery.
19. Improvement of fish production through Biotechnology.
20. Biotechnology in space research..
21. Good manufacturing practices.

6 x 5 = 30

PART B
Answer any 2 questions. Each question carries ten marks.

22. Explain the term White biotechnology and its applications.
23. Describe the steps of patenting procedure.
24. Give an account on Human genome project.
25. Discuss the synthesis and applications of artificial cells..

2 x 10 = 20

BSc Biotechnology Model Question Paper

First Semester

Common Course - EN1CCT01 - ENGLISH - FINE - TUNE YOUR ENGLISH

(Common for all U.G Programmes)

2018 Admission Only

B27AC544

Maximum Marks: 80 **Time: 3 Hours**

Part A

Answer any **ten** questions.

Each question carries **2** marks.

1. Write two sentences containing adverb phrases
2. (a) He is not so clever_____. (b) He ran so fast _____(complete with an adverb clause)
3. (a) There _____ an art exhibition in the college tomorrow. (b) There _____ four choices to the question. (Use the appropriate form of "be")
4. (a)The boy teased the dog. (b) My father will write a letter.(Turn the sentences into passive voice)
5. I have to reach the office (by 9.30,usually). (Insert adverb in suitable positions)
6. (a) I like to live in open air. (b) Neil Armstrong was first man to walk on moon. (Insert article where necessary)
7. Write two animal cry words and use them in sentences of your own.
8. Use the following in sentences of your own to highlight their difference: carry out; carry over
9. Convert the following into their opposites by prefixation .(a) incline. (b) manage
10. Use the following in sentences of your own. (a) horse sense. (b) to go to the dogs
11. (a)He calls his mother everyday. (b) She knows how to knit. (Negate the sentences)
12. (a)She doesn't work in a hotel,_____? (b) You don't like spicy food,_____? (Add question tag)

(10×2=20)

Part B

Answer any **six** questions.

Each question carries **5** marks.

13. Choose the correct form of the verbs from the bracket to complete the given sentences (boil, close, cost meet,smoke) 1.Steve _____ ten cigarettes a day. 2. Water _____ at 100 degree Celsius. 3. These shoes _____ a lot of money. 4. Your job is interesting, you get to _____ a lot of people. 5. The City Museum _____ at 6 o' clock every evening.

14. Pick out the incorrect sentences. 1.One Hundred Years of Solitude are a masterpiece. 2. George has started having problems with his back. 3. I'm sad to hear that you fell off a tall ladder. 4. My child is in bed with flu. 5. We bought the jewellery from a jeweller in Thrissur.

15. (Use past continuous form of the verbs given) 1. The light went out while I (read). 2. When I saw him he (play) chess. 3. We (listen) to the radio all evening. 4. You (watch) TV when I called you last night. 5. The phone (ring) as he walked away.

16. Choose the suitable auxiliary for each pair. 1. You _____ improve your spelling. 2. We _____ love our neighbours. (must, ought to) 3. I don't _____ mention him. 4. One _____ be careful (dare, needs to)

17. Mark the adjectives in the given sentences. 1. Kolkatta is a large city. 2. I ate some rice. 3. We have had enough exersice. 4. He has little intelligence. 5. The foolish old crow tried to sing.

18. Use reflexive pronouns to complete the sentences. 1. She hurt_____.2. I will go _____. 3. We exerted _____4. We seldom see _____as others see us. 5. I was sitting by _____.

19. Whar are idioms? Explain with illustrations.

20. Change the following interrogative sentences into assertive form. 1. Is that the way a gentleman should behave? 2. What though we happen to be late? 3.Was he not a villain to do such a thing? 4. Why waste time reading trash? 5. Shall I ever forget those happy days?

21. Frame five exclamatory questions.

(6×5=30)

Part C

Answer any **two** questions.

Each question carries **15** marks.

22. Prepare an application for a motor vehicle agency.

23. (a) Write a conversation between a parent and the class teacher regarding the progress of a child in the first term examinations.. (b) Frame a short speech that you, as a primary school teacher, would deliver on the occasion of Children's Day in your school.

24. Write an essay on how Kerala battled the recent flood.

25. (a) Write a letter to a friend describing how you spent your summer vacation. (b) Write an essay on the influence of TV on our Lives.

(2×15=30)

BSc Biotechnology Model Question Paper

First Semester

Complementary Course - BC1CMT01 - BIOCHEMISTRY-ELEMENTARY BIOCHEMISTRY

(Common to B.Sc Biological Techniques and Specimen Preparation Model III, B.Sc Biotechnology Model III, B.Sc Botany and Biotechnology Model III Double Main, B.Sc Botany Model I, B.Sc Botany Model II Environmental Monitoring And Management, B.Sc Botany Model II Food Microbiology, B.Sc Botany Model II Horticulture and Nursery Management, B.Sc Botany Model II Plant Biotechnology, B.Sc Microbiology Model III, B.Sc Zoology and Industrial Microbiology Model III Double Main, B.Sc Zoology Model I, B.Sc Zoology Model II Aquaculture, B.Sc Zoology Model II Food Microbiology, B.Sc Zoology Model II Medical Microbiology)

2018 Admission only

F6CA1138

Maximum Marks: 60 **Time: 3 Hours**

Part A

Answer any **ten** questions.

Each question carries **1** mark.

1. Draw the structure of a water molecule.
2. State Henderson-Hasselbalch equation.
3. Define antiport system of solute transport
4. Name two phenomena involving Donnan equilibrium in biological systems.
5. Mention the products of photosynthesis.
6. What is a grana?
7. Define cyclic photophosphorylation.
8. Give the name of the enzyme responsible for biological nitrogen fixation.
9. Comment on retention time in chromatography
10. Name an analytical technique to detect specific proteins
11. Expand the term AGE.
12. Name the technique used to transfer proteins from gel on to a membrane.

(10×1=10)

Part B

Answer any **six** questions.

Each question carries **5** marks.

13. Explain the mechanism for regulation of extracellular fluid pH.

14. Explain the different types of membrane proteins with examples.

15. Compare C3 and C4 pathway.

16. Explain the principle of colorimetry.

17. Outline the parts of a spectrophotometer.

18. Discuss the applications of HPTLC.

19. Explain the techniques of southern blotting.

20. Describe western blotting.

21. Elaborate on MALDI TOF MS.

(6×5=30)

Part C

Answer any **two** questions.

Each question carries **10** marks.

22. Discuss ionisation of water and explain ionic product of water

23. Explain the Structure and functions of cell membrane.

24. Explain the major secondary metabolites and their functions in plants.

25. Give a detailed account on electrophoresis.

(2×10=20)

BSc Biotechnology Model Question Paper

First Semester

B.Sc Biotechnology Model III

Complementary Course - MB1CMT01 - MICROBIOLOGY - FUNDAMENTALS OF MICROBIOLOGY - I

2018 Admission only

32118636

Maximum Marks: 60 **Time: 3 Hours**

Part A

Answer any **ten** questions.

Each question carries **1** mark.

1. What is Microbiology?
2. Name two scientists who opposed spontaneous generation?
3. What is immunology?
4. What is molecular classification?
5. What is albert staining ?
6. Name the protein present in flagella ?
7. What is focal length ?
8. Name the microscope used to observe unstained microorganism.
9. What is freeze etching?
10. Name stains used for simple staining
11. Acid fastedness in Acid Fast Staining is due to?
12. Name two stains used in negative staining.

(10×1=10)

Part B

Answer any **six** questions.

Each question carries **5** marks.

13. Differentiate between prokaryotes and eukaryotes?
14. Explain different fields of microbiology?
15. Explain structures external to cell wall?

16. Peptidoglycan in bacterial cell wall

17. Briefly explain resolution power and magnification power of microscope

18. Briefly explain excited and barrier filter

19. Explain Principle and working ofSEM

20. Discuss staining techniques and application of staining technique in microbiology

21. Describe briefly Smear preparation from solid culture and liquid culture

(6×5=30)

Part C

Answer any **two** questions.

Each question carries **10** marks.

22. Write an essay on the beneficial roles of microorganisms in our society

23. Differentiate between archaebacteria and Eubacteria

24. Explain Working and principle of Electron Microscope

25. Write in detail methods used to study bacteria in live condition.

(2×10=20)