DEPARTMENT OF
BIOTECHNOLOGY

Curriculum and Syllabus for Postgraduate Programme in Biotechnology
Under Credit Semester System
(with effect from 2019 admissions)

St Berchmans College
Founded 1922
AUTONOMOUS | College with Potential for Excellence | Reaccredited by NAAC with A Grade
Affiliated to Mahatma Gandhi University, Kottayam, Kerala
Changanassery, Kottayam, Kerala, India-686101

DEPARTMENT OF BIOTECHNOLOGY

Curriculum and Syllabus for
Postgraduate Programme in
Biotechnology
Under Credit Semester System
(with effect from 2019 admissions)

St Berchmans College
Founded 1922
AUTONOMOUS | College with Potential for Excellence | Reaccredited by NAAC with A Grade
Affiliated to Mahatma Gandhi University, Kottayam, Kerala
Changanassery, Kottayam, Kerala, India-686101

MEMBERS OF BOARD OF STUDIES

1. Dr Scaria K Varghese (Chairman)
   Head and Associate Professor
   Department of Botany
   St Berchmans College
2. Dr Linu Mathew
   Assistant professor
   School of Biosciences
   Mahatma Gandhi University
3. Dr Baby Chakrapani PS
   Assistant professor
   Department of Biotechnology
   Cochin University of Science and Technology
   Kerala
4. Dr Deepthi Alex
   Assistant professor
   Department of Biotechnology
   Mar Ivanios College, Trivandrum
5. Mr. Krishna Chandran R
   ICMR senior Research Fellow
   Laboratory of cytogenetics and Molecular Diagnostics
   Division of Cancer Research, Regional Cancer Center
   Thiruvananthapuram
   Kerala
6. Mrs Tinu Mary Kuriakose
   Scientist Level-3
   Biocon Research Limited
   131 Jigani Road
   Bommasandra Industrial Area
   Bangaluru Karnataka-560099
7. Dr Lijy Jacob
   Assistant Professor
   Department of Biotechnology
   St Berchmans College

8. Dr Manju Antony
   Assistant Professor
   Department of Biotechnology
   St Berchmans College
9. Mrs Tessmol. P George
   Assistant Professor
   Department of Biotechnology
   St Berchmans College
10. Mr Shobin Varghese
    Assistant Professor
    Department of Biotechnology
    St Berchmans College
11. Miss Sreeja Raj
    Assistant Professor
    Department of Biotechnology
    St Berchmans College
12. Mrs Vijimol T Varghese
    Assistant Professor
    Department of Biotechnology
    St Berchmans College
13. Dr Reshma John
    Assistant Professor
    Department of Biotechnology
    St Berchmans College
14. Miss Shija Jacob
    Assistant Professor
    Department of Biotechnology
    St Berchmans College

Programme Objectives

Biotechnology is a research oriented science which covers a wide variety of subjects like Genetics, Biochemistry, Microbiology, Immunology, Environmental Biotechnology, Genetic Engineering and Fermentation Technology. It also has tight links and relationships with many other subjects like Health and Medicine, Agriculture and Animal Husbandry, Cropping system and Crop Management, Ecology, Cell Biology, Bio-statistics, and the like.

The syllabus has been formulated with an objective of equipping the students with thorough knowledge in all aspects of Biotechnology, sound practical training and to develop a strong appreciation for scientific research in theoretical and experimental areas.

Programme Outcome

Graduates will have a strong foundation to all essentials of the subjects enabling the students to mould themselves as competent individuals in an international pursuit of knowledge.

REGULATIONSFOR POSTGRADUATE (PG) PROGRAMMES UNDER CREDIT SEMESTER SYSTEM (SB-CSS-PG) 2019

1. SHORT TITLE

1.1 These Regulations shall be called St. Berchmans College (Autonomous) Regulations (2019) governing postgraduate programmes under Credit Semester System (SB-CSS-PG).

1.2 These Regulations shall come into force with effect from the academic year 2019-20 onwards.

2. SCOPE

2.1 The regulation provided herein shall apply to all regular postgraduate programmes, MA/MSc/MCom, conducted by St. Berchmans College (Autonomous) with effect from the academic year 2019-20.

3. DEFINITIONS

3.1 'University' means Mahatma Gandhi University, Kottayam, Kerala.

3.2 'College' means St. Berchmans College (Autonomous).

3.3 There shall be an Academic Committee nominated by the Principal to look after the matters relating to the SB-CSS-PG system.

3.4 'Academic Council' means the Committee consisting of members as provided under section 107 of the University Act 2014, Government of Kerala.

3.5 'Parent Department' means the Department, which offers a particular postgraduate programme.

3.6 'Department Council' means the body of all teachers of a Department in the College.

3.7 'Faculty Mentor' is a teacher nominated by a Department Council to coordinate the continuous evaluation and other academic activities of the Postgraduate programme undertaken in the Department.

3.8 'Programme' means the entire course of study and examinations.

3.9 'Duration of Programme' means the period of time required for the conduct of the programme. The duration of a postgraduate programme shall be four (4) semesters.

3.10 '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.

3.11 'Course' means a segment of subject matter to be covered in a semester. Each Course is to be designed under lectures/tutorials/laboratory or fieldwork/seminar/project/practical/ assignments/evaluation etc., to meet effective teaching and learning needs.

3.12 'Course Teacher' means the teacher who is taking classes on the course.

3.13 'Core Course' means a course that the student admitted to a particular programme must successfully complete to receive the Degree and which cannot be substituted by any other course.

3.14 'Elective Course' means a course, which can be substituted, by equivalent course from the same subject and the number of courses required to complete the programme shall be decided by the respective Board of Studies.

3.15 The elective course shall be either in the fourth semester or be distributed among third and fourth semesters.

3.16 'Audit Course' means a course opted by the students, in addition to the compulsory courses, in order to develop their skills and social responsibility.

3.17 'Extra Credit Course' means a course opted by the students, in addition to the compulsory courses, in order to gain additional credit that would boost the performance level and additional skills.

3.18 Extra credit and audit courses shall be completed by working outside the regular teaching hours.

3.19 There will be optional extra credit courses and mandatory audit courses. The details of the extra credit and audit courses are given below.

Semester	Course	Type
I	Course on Mendeley Reference Management Software	Optional, Extra credit Grades shall be given
	Course on Basic Life Support System and Disaster Management	Compulsory, Audit Grades shall be given
First summer vacation	Internship/Skill Training	Optional, Extra credit Grades shall be given
Any time during the programme	Oral Presentation in National/International seminar	Optional, Extra credit
	Publication in a recognized journal with ISSN number	

3.20 'Project' means a regular research work with stated credits on which the student conducts research under the supervision of a teacher in the parent department/any appropriate research centre in order to submit a report on the project work as specified.

3.21 'Dissertation' means a minor thesis to be submitted at the end of a research work carried out by each student on a specific area.

3.22 'Plagiarism' is the unreferenced use of other authors' material in dissertations and is a serious academic offence.

3.23 'Seminar' means a lecture expected to train the student in self-study, collection of relevant matter from books and Internet resources, editing, document writing, typing and presentation.

3.24 'Tutorial' means a class to provide an opportunity to interact with students at their individual level to identify the strength and weakness of individual students.

3.25 'Improvement Examination' is an examination conducted to improve the performance of students in the courses of a particular semester.

3.26 'Supplementary Examination' is an examination conducted for students who fail in the courses of a particular semester.

3.27 The minimum credits, required for completing a postgraduate programme is eighty (80).

3.28 'Credit' (C) of a course is a measure of the weekly unit of work assigned for that course in a semester.

3.29 'Course Credit': One credit of the course is defined as a minimum of one (1) hour lecture/minimum of two (2) hours lab/field work per week for eighteen (18) weeks in a semester. The course will be considered as completed only by conducting the final examination.

3.30 'Grade' means a letter symbol (A, B, C etc.) which indicates the broad level of performance of a student in a course/semester/programme.

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

3.32 'Credit Point' (CP) of a course is the value obtained by multiplying the grade point (GP) by the credit (C) of the course.

3.33 'Semester Grade Point Average' (SGPA) of a semester is calculated by dividing total credit points obtained by the student in a semester by total credits of that semester and shall be rounded off to two decimal places.

3.34 'Cumulative Grade Point Average' (CGPA) is the value obtained by dividing the sum of credit points in all the courses obtained by the student for the entire programme by the total credits of the whole programme and shall be rounded off to two decimal places.

3.35 'Institution average' is the value obtained by dividing the sum of the marks obtained by all students in a particular course by the number of students in respective course.

3.36 'Weighted Average Score' means the score obtained by dividing sum of the products of marks secured and credit of each course by the total credits of that semester/programme and shall be rounded off to two decimal places.

3.37 'Grace Marks' means marks awarded to course/courses, in recognition of meritorious achievements of a student in NCC/NSS/Sports/Arts and cultural activities.

3.38 First, Second and Third position shall be awarded to students who come in the first three places based on the overall CGPA secured in the programme in the first chance itself.

4. PROGRAMME STRUCTURE

4.1 The programme shall include two types of courses; Core Courses and Elective Courses. There shall be a project/research work to be undertaken by all students. The programme will also include assignments, seminars, practical, viva-voce etc., if they are specified in the curriculum.

4.2 Total credits for a programme is eighty (80). No course shall have more than four (4) credits.

4.3 **Project/dissertation**

Project/research work shall be completed by working outside the regular teaching hours except for MSc Computer Science programme. Project/research work shall be carried out under the supervision of a teacher in the concerned department. A student may, however, in certain cases be permitted to work in an industrial/research organization on the recommendation of the supervisor. There shall be an internal assessment and external assessment for the project/dissertation. The external evaluation of the Project/Dissertation shall be based on the individual presentation in front of the expert panel.

4.4 **Evaluations**

The evaluation of each course shall contain two parts.

i Internal or In-Semester Assessment (ISA)

ii External or End-Semester Assessment (ESA)

Both ISA and ESA shall be carried out using indirect grading. The ISA:ESA ratio is 1:3. Marks for ISA is 25 and ESA is 75 for all courses.

4.5 **In-semester assessment of theory courses**

The components for ISAare given below.

Component	Marks
Attendance	2
Viva	3
Assignment	4
Seminar	4
Class test	4
Model Exam	8
Total	**25**

4.6 Attendance evaluation of students for each course shall be as follows:

% of Attendance	Marks
Above 90	2
75 - 90	1

4.7 **Assignments**

Every student shall submit one assignment as an internal component for every course.

4.8 **Seminar**

Every student shall deliver one seminar as an internal component for every course. The seminar is expected to train the student in self-study, collection of relevant matter from the books and internet resources, editing, document writing, typing and presentation.

4.9 **In-semester examination**

Every student shall undergo at least two in-semester examinations one as class test and second as model examination as internal component for every theory course.

4.10 To ensure transparency of the evaluation process, the ISA mark awarded to the students in each course in a semester shall be published on the notice board according to the schedule in the academic calendar published by the College. There shall not be any chance for improvement for ISA. The course teacher and the faculty mentor shall maintain the academic record of each student registered for the course which shall be forwarded to the office of the Controller of Examinations through the Head of the Department and a copy shall be kept in the office of the Head of the Department for at least two years for verification.

4.11 **In-semester assessment of practical courses**

The internal assessment of practical courses shall be conducted either annually or in each semester. There shall be one in-semester examination for practical courses. The examination shall be conducted annually or in each semester. The components for internal assessment is given below.

Component	Marks
Attendance	2
Lab Test	15
Viva-Voce	5
Record	3
Total	**25**

Attendance evaluation of students for each course shall be as follows:

% of Attendance	Marks
Above 90	2
75 - 90	1

4.12 **End-semester assessment**

The end-semester examination in theory and practical courses shall be conducted by the College.

4.13 The end-semester examinations for theory courses shall be conducted at the end of each semester. There shall be one end-semester examination of three (3) hours duration in each lecture based course.

4.14 The question paper should be strictly on the basis of model question paper set by Board of Studies.

4.15 A question paper may contain short answer type/annotation, short essay type questions/problems and long essay type questions. Marks for each type of question can vary from programme to programme, but a general pattern may be followed by the Board of Studies.

4.16 Question Pattern for external theory examination shall be,

Science and Commerce

Section	Total No. of Questions	Questions to be Answered	Marks	Total Marks for the Section
A	14	10	2	20
B	8	5	5	25
C	4	2	15	30
			Maximum	**75**

4.17 Photocopies of the answer scripts of the external examination shall be made available to the students for scrutiny as per the regulations in the examination manual.

4.18 Practical examination shall be conducted annually or in each semester. Practical examination shall be conducted by one external examiner and one internal examiner. The question paper setting and evaluation of answer scripts shall be done as per the directions in the examination manual of the College. The duration of practical examination shall be decided by the Board of Studies.

4.19 Project/Dissertation evaluation shall be conducted at the end of the programme. Project/Dissertation evaluation shall be conducted by one external examiner and one internal examiner. The components and mark division for internal and external assessment shall be decided by the respective Board of Studies.

Components of Project Evaluation	Marks
Internal Evaluation	25
Dissertation (External)	50
Viva-Voce (External)	25
Total	**100**

4.20 Comprehensive viva-voce shall be conducted at the end of the programme. Viva-voce shall be conducted by one external examiner and one internal examiner. The viva-voce shall cover questions from all courses in the programme. There shall be no internal assessment for comprehensive viva-voce. The maximum marks for viva-voce is one hundred (100).

4.21 For all courses (theory and practical) an indirect grading system based on a seven (7) point scale according to the percentage of marks (ISA + ESA) is used to evaluate the performance of the student in that course. The percentage shall be rounded mathematically to the nearest whole number.

Percentage of Marks	Grade	Performance	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
40 to below 45	D	Pass	4
Below 40	F	Failure	0

4.22 **Credit Point**

Credit Point (CP) of a course is calculated using the formula

CP = C × GP

where C is the credit and GP is the grade point

4.23 **Semester Grade Point Average**

Semester Grade Point Average (SGPA) is calculated using the formula

SGPA = TCP/TCS

where TCP is the total credit point of all the courses in the semester and TCS is the total credits in the semester

GPA shall be rounded off to two decimal places.

4.24 **Cumulative Grade Point Average**

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

CGPA = TCP/TC

where TCP is the total credit point of all the courses in the whole programme and TC is the total credit in the whole programme

GPA shall be rounded off to two decimal places.

Grades for the different courses, semesters, Semester Grade Point Average (SGPA) and grades for overall programme, Cumulative Grade Point Average (CGPA) are given based on the corresponding Grade Point Average (GPA) as shown below:

GPA	Grade	Performance
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
4 to below 4.5	D	Pass
Below 4	F	Failure

4.25 A separate minimum of 40% marks each in ISA and ESA (for theory and practical) and aggregate minimum of 40% are required for a pass in a course. For a pass in a programme, a separate minimum of grade 'D' is required for all the individual courses.

5. SUPPLEMENTARY/IMPROVEMENT EXAMINATION

5.1 There will be supplementary examinations and chance for improvement. Only one chance will be given for improving the marks of a course.

5.2 There shall not be any improvement examination for practical courses and examinations of the final year.

6. ATTENDANCE

6.1 The minimum requirement of aggregate attendance during a semester for appearing the end semester examination shall be 75%. Condonation of shortage of attendance to a maximum of ten (10) days in a semester subject to a maximum of two times during the whole period of postgraduate programme may be granted by the College. This condonation shall not be counted for internal assessment.

6.2 Benefit of attendance may be granted to students representing the College, University, State or Nation in Sports, NCC, NSS or Cultural or any other officially sponsored activities such as College union/University union activities etc., on production of participation/attendance certificates, within one week from competent authorities, for the actual number of days participated, subject to a maximum of ten (10) days in a semester, on the specific recommendations of the Faculty Mentor and Head of the Department.

6.3 A student who does not satisfy the requirements of attendance shall not be permitted to appear in the end-semester examinations.

6.4 Those students who are not eligible even with condonation of shortage of attendance shall repeat the course along with the next batch after readmission.

BOARD OF STUDIES AND COURSES

6.5 The Board of Studies concerned shall design all the courses offered in the programme. The Board shall design and introduce new courses, modify or re-design existing courses and replace any existing courses with new/modified courses to facilitate better exposure and training for the students.

6.6 The syllabus of a programme shall contain programme objectives and programme outcome.

6.7 The syllabus of a course shall include the title of the course, course objectives, course outcome, contact hours, the number of credits and reference materials.

6.8 Each course shall have an alpha numeric code which includes abbreviation of the course in two letters, semester number, course code and serial number of the course.

6.9 Every programme conducted under Credit Semester System shall be monitored by the Academic Council.

7. REGISTRATION

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

7.2 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.

7.3 A student may be permitted to complete the programme, on valid reasons, within a period of eight (8) continuous semesters from the date of commencement of the first semester of the programme

8. ADMISSION

8.1 The admission to all PG programmes shall be as per the rules and regulations of the College/University.

8.2 The eligibility criteria for admission shall be as announced by the College/University from time to time.

8.3 Separate rank lists shall be drawn up for seats under reservation quota as per the existing rules.

8.4 There shall be an academic and examination calendar prepared by the College for the conduct of the programmes.

9. ADMISSION REQUIREMENTS

9.1 Candidates for admission to the first semester of the PG programme through SB-CSS-PG shall be required to have passed an appropriate degree examination of Mahatma Gandhi University or any University or authority, duly recognized by the Academic council of Mahatma Gandhi University as equivalent thereto.

10. MARK CUM GRADE CARD

10.1 The College under its seal shall issue to the students, a Mark cum Grade Card on completion of each semester, which shall contain the following information.

i. Name of the Student
ii. Register Number
iii. Photo of the Student
iv. Degree

v. Programme
vi. Semester and Name of the Examination
vii. Month and Year of Examination
viii. Faculty
ix. Course Code, Title and Credits of each course opted in the semester
x. Marks for ISA, ESA, Total Marks (ISA + ESA), Maximum Marks, Letter Grade, Grade Point (GP), Credit Point (CP) and Institution Average in each course opted in the semester
xi. Total Credits, Marks Awarded, Credit Point, SGPA and Letter Grade in the semester
xii. Weighted Average Score
xiii. Result
xiv. Credits/Grade of Extra Credit and Audit Courses

10.2 The final Mark cum Grade Card issued at the end of the final semester shall contain the details of all courses taken during the entire programme including those taken over and above the prescribed minimum credits for obtaining the degree. The final Mark cum Grade Card shall show the CGPA and the overall letter grade of a student for the entire programme.

10.3 A separate grade card shall be issued at the end of the final semester showing the extra credit and audit courses attended by the student, grade and credits acquired.

11. AWARD OF DEGREE

The successful completion of all the courses with 'D' grade shall be the minimum requirement for the award of the degree.

12. MONITORING COMMITTEE

There shall be a Monitoring Committee constituted by the Principal to monitor the internal evaluation conducted by the College. The Course Teacher, Faculty Mentor, and the College Coordinator should keep all the records of the continuous evaluation, for at least a period of two years, for verification.

13. GRIEVANCE REDRESS COMMITTEE

13.1 In order to address the grievance of students relating to ISA, a two-level grievance redress mechanism is envisaged.

13.2 A student can approach the upper level only if grievance is not addressed at the lower level.

13.3 Department level: The Principal shall form a Grievance Redress Committee in each Department comprising of course teacher and one senior teacher as members and the Head of the Department as Chairman. The Committee shall address all grievances relating to the internal assessment of the students.

13.4 College level: There shall be a College level Grievance Redress Committee comprising of Faculty Mentor, two senior teachers and two staff council members (one shall be an elected member) and the Principal as Chairman. The Committee shall address all grievances relating to the internal assessment of the students.

14. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Principal shall, for a period of three years 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.

REGULATIONS FOR EXTRACURRICULAR COURSES, INTERNSHIP AND SKILL TRAINING

COURSE ON BASIC LIFE SUPPORT SYSTEM AND DISASTER MANAGEMENT (BLS & DM)

i. The course on BLS & DM shall be conducted by a nodal centre created in the college.
ii. The nodal centre shall include at least one teacher from each department. A teacher shall be nominated as the Director of BLS & DM.
iii. The team of teachers under BLS & DM shall function as the trainers for BLS & DM.
iv. The team of teachers under BLS & DM shall be given intensive training on Basic Life Support System and Disaster Management and the team shall be equipped with adequate numbers of mannequins and kits for imparting the training to students.
v. Each student shall under go five (5) hours of hands on training in BLS & DM organised by the Centre for BLS & DM.
vi. The training sessions shall be organised on weekends/holidays/vacation during the first semester of the programme.
vii. After the completion of the training, the skills acquired shall be evaluated using an online test and grades shall be awarded.
viii. Nodal centre for BLS & DM shall conduct online test and publish the results.
ix. Students who could not complete the requirements of the BLS & DM training shall appear for the same along with the next batch. There shall be two redo opportunity.
x. For redressing the complaints in connection with the conduct of BLS & DM students shall approach the Grievance Redress Committee functioning in the college.

COURSE ON MENDELY REFERENCE MANAGEMENT SOFTWARE

i. College shall arrange workshop with hands on training in Mendely reference management software during the first semester.
ii. Students completing the course can enrol for an evaluation and those who pass the evaluation shall be given one credit.

INTERNSHIP/SKILL TRAINING PROGRAMME

i. Postgraduate student can undergo an internship for a minimum period of five days (25 hours) at a centre identified by the concerned department. In the case of disciplines where internship opportunities are scanty (e.g. Mathematics) special skill training programmes with duration of five days (25 hours) shall be organised.
ii. Each department shall identify a teacher in charge for internship/skill training programme.
iii. The department shall select institutions for internship/organising skill training programme.
iv. Internship/skill training programme shall be carried out preferably during the summer vacation following the second semester or during the Christmas vacation falling in the second semester or holidays falling in the semester.
v. At the end of the stipulated period of internship each student shall produce an internship completion cum attendance certificate and an illustrated report of the training he/she has underwent, duly certified by the tutor and Head of the institution where the internship has been undertaken.
vi. Students undergoing skill training programme shall submit a training completion cum attendance certificate and a report of the training he/she has underwent, duly certified by the trainer, teacher co-ordinator of the programme from the concerned department and the head of the department concerned.
vii. Upon receipt of the internship completion cum attendance certificate and illustrated report of the training or a training completion cum attendance certificate and a report of the training, the teacher in charge of internship/skill training programme shall prepare a list of students who have completed the internship/skill training programme and a list of students who failed to complete the programme. Head of the department shall verify the lists and forward the lists to the Controller of Examinations.

PAPER PRESENTATION

i. During the period of the programme students shall be encouraged to write and publish research/review papers.
ii. One research/review paper published in a UGC approved journal or oral presentation in an international/national seminar which is later published in the proceedings shall fetch one credit.

VIRTUAL LAB EXPERIMENTS/MOOC COURSES

i. During the tenure of the programme, students shall be encouraged to take up Virtual Lab Experiments and/or MOOC Courses.
ii. College shall arrange dedicated infrastructure for taking up Virtual Lab experiments and/or MOOC courses.
iii. There shall be a Nodal Officer and a team of teachers to coordinate the logistics for conducting Virtual Lab experiments and MOOC courses and to authenticate the claims of the students regarding the successful completion of the Virtual Lab experiments and or MOOC courses.
iv. Students who are desirous to do Virtual Lab experiments and or MOOC courses shall register with the Nodal Officer at the beginning of the experiment session/MOOC course. Students also shall submit proof of successful completion of the same to the Nodal officer.
v. Upon receipt of valid proof, the Nodal Officer shall recommend, to the Controller of Examinations, the award of extra credits. In the case of Virtual Lab experiments, 36 hours of virtual experimentation shall equal one credit and in the case of MOOC courses 18 hours of course work shall equal one credit.

Model Mark cum Grade Card

St Berchmans College
Founded 1922
AUTONOMOUS College with Potential for Excellence | Reaccredited by NAAC with A Grade
Affiliated to Mahatma Gandhi University, Kottayam, Kerala
Changanassery, Kottayam, Kerala, India-686101

MARK CUM GRADE CARD

Date:

Name of the Candidate :

Permanent Register Number (PRN) :

Degree :

Programme :

Name of Examination :

Faculty :

Photo

Course Code	Course Title	Credits (C)	Marks						Grade Awarded (G)	Grade Point (GP)	Credit Point (CP)	Institution Average	Result
			ISA		ESA		Total						
			Awarded	Maximum	Awarded	Maximum	Awarded	Maximum					
	Total **SGPA: SG: WAS:** *****End of Statement*****												

***WAS: Weighted Average Score**

Entered by:

Verified by:

Controller of Examinations **Principal**

St Berchmans College
Founded 1922
AUTONOMOUS College with Potential for Excellence | Reaccredited by NAAC with A Grade
Affiliated to Mahatma Gandhi University, Kottayam, Kerala
Changanassery, Kottayam, Kerala, India - 686101, Tel: 91-481-2420025, 9961231314
E-mail: sbc@sbcollege.org Web: www.sbcollege.ac.in

CONSOLIDATED MARK CUM GRADE CARD

Name of the Candidate :
Permanent Register Number (PRN) :
Degree :
Programme :
Faculty :
Date :

Photo

Course Code	Course Title	Credits (C)	Marks						Grade Awarded (G)	Grade Point (GP)	Credit Point (CP)	Institution Average	Result
			ISA		ESA		Total						
			Awarded	Maximum	Awarded	Maximum	Awarded	Maximum					
SEMESTER I													
SEMESTER II													
SEMESTER III													

SEMESTER IV													
	End of Statement												

PROGRAMME RESULT

Semester	Marks Awarded	Maximum Marks	Credit	Credit Point	SGPA	Grade	WAS	Month & Year of Passing	Result
I II III IV									
Total					**FINAL RESULT: CGPA =**		**; GRADE =**	**;WAS =**	

*** Separate grade card is issued for Audit and Extra Credit courses.**
**** Grace Mark awarded.**

Entered by:

Verified by:

Controller of Examinations **Principal**

Reverse side of the Mark cum Grade Card (COMMON FOR 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 1:3 for all Courses. Grades and Grade Points are given on a seven (7) point scale based on the percentage of Total Marks (ISA + ESA) as given in Table 1. Decimals are corrected to the nearest whole number.

Credit Point and Grade Point Average

Credit Point (CP) of a course is calculated using the formula

CP = C × GP

where C is the Credit and GP is the Grade Point

Grade Point Average of a Semester (SGPA) or Cumulative Grade Point Average (CGPA) for a Programme is calculated using the formula

SGPA or CGPA = TCP/TC

where TCP is the Total Credit Point for the semester/programme and TC is the Total Credit for the semester/programme

GPA shall be rounded off to two decimal places.

The percentage of marks is calculated using the formula;

$$\% \text{ Marks} = \left(\frac{\text{total marks obtained}}{\text{maximum marks}}\right) \times 100$$

Weighted Average Score (WAS) is the score obtained by dividing sum of the products of marks secured and credit of each course by the total credits of that semester/programme and shall be rounded off to two decimal places.

Percentage of Marks	Grade	Performance	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
40 to below 45	D	Pass	4
Below 40	F	Failure	0

Table 1

Grades for the different Semesters and overall Programme are given based on the corresponding GPA, as shown in Table 2.

GPA	Grade	Performance
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
4 to below 4.5	D	Pass
Below 4	F	Failure

Table 2

Note: Course title followed by (P) stands for practical course. A separate minimum of 40% marks each for internal and external assessments (for both theory and practical) and an aggregate minimum of 40% marks is required for a pass in each course. For a pass in a programme, a separate minimum of Grade D for all the individual courses and an overall Grade D or above are mandatory. If a candidate secures Grade F for any one of the courses offered in a Semester/Programme, only Grade F will be awarded for that Semester/Programme until the candidate improves this to Grade D or above within the permitted period.

PROGRAMME STRUCTURE

	Course Code	Course Title	Hours/ Week	Total Hours	Credit	ISA	ESA	Total
Semester I	BMBT101	Biochemistry	4	72	4	25	75	100
	BMBT102	Cell and Molecular Biology	4	72	4	25	75	100
	BMBT103	Biophysics and Bioinformatics	3	54	3	25	75	100
	BMBT104	Bioanalytical Techniques and Biostatistics	4	72	4	25	75	100
	BMBT1P01	Laboratory Course – I (P)	10	180	4	25	75	100
	-	Industry Visit	Non evaluative					
		Total	**25**	**450**	**19**	**125**	**375**	**500**
Semester II	BMBT205	Microbiology	4	72	4	25	75	100
	BMBT206	Immunology and Immunological Techniques	4	72	4	25	75	100
	BMBT207	Genetics	3	54	3	25	75	100
	BMBT208	Metabolism and Enzymology	4	72	4	25	75	100
	BMBT2P02	Laboratory Course – II (P)	10	180	4	25	75	100
		Total	**25**	**450**	**19**	**125**	**375**	**500**
Semester III	BMBT309	Bioprocess Technology	4	72	4	25	75	100
	BMBT310	Recombinant DNA Technology	4	72	4	25	75	100
	BMBT311	Plant and Animal Biotechnology	3	54	3	25	75	100
	BMBT312	Environmental Biotechnology	4	72	4	25	75	100
	BMBT3P03	Laboratory Course – III (P)	10	180	4	25	75	100
		Total	**25**	**450**	**19**	**125**	**375**	**500**
Semester IV		Elective Course	5	90	4	25	75	100
		Elective Course	5	90	4	25	75	100
		Elective Course	5	90	4	25	75	100
	BMBT4P04	Laboratory Course – IV (P)	10	180	4	25	75	100
	BMBT4PJ	Project	-	-	4	25	75	100
	BMBT4VV	Viva-Voce	-	-	3	-	100	100
		Total	**25**	**450**	**23**	**125**	**475**	**600**
		Grand Total	**-**	**-**	**80**	**500**	**1600**	**2100**

ELECTIVE COURSES

Course Code	Course Title
BMBT4E01	Biotechnology and Forensic Analysis
BMBT4E02	Genomics, Proteomics and Nanotechnology
BMBT4E03	Cancer Biology
BMBT4E04	Biopharmaceutics and Applied Nanotechnology
BMBT4E05	IPR , Biosafety and Bioethics
BMBT4E06	Biotechnology and IPR
BMBT4E07	Microbial Food Safety
BMBT4E08	Food Biotechnology
BMBT4E09	Neurobiochemistry
BMBT4E10	Developmental Biology

SEMESTER I

BMBT101: BIOCHEMISTRY

Total Hours: 72 **Credit: 4**

Objective: To provide an advanced understanding of the principles and topics of Biochemistry and to acquire knowledge of the subject.

Outcome: To prepare students for future careers in various field of life science in which a core understanding of the chemistry of biological processes in important.

Module 1 Carbohydrates: structure and function of carbohydrates (16hrs)

Mono, di and Oligosaccharides**,** Glycosidic bonds; Classification: O-linked and N-linked glycoproteins, glycolipids.

Polysaccharides**:** Classification: Homopolysaccharides (Cellulose, Starch, Chitin, and Glycogen), Heteropolysaccharides (bacterial peptidoglycans, glycosaminoglycans, hyaluronicacid and heparin); Structural characteristics and functions of above mentioned polyasaccharides; Exopolysaccharides from bacterial systems and their uses; Purification and characterization of polysaccharides from biological systems.

Module 2 Lipids: Structure and functions of lipids (15hrs)

Glycerophopholipids: Structure and function of glycerophospholipids (Phosphatic acid, cardiolipin, Phosphatidyl serine, Phosphatidyl ethanolamine, Phosphatidyl Glycerol, Phosphatidylcholine, Phosphatidyl inositol, plasmalogens) CDP-diacylglycerol, Lung surfactants.

Glycosphingolipids: Structure and function of (Sphingosine, ceramides and sphingomyelins, cerebrosides, globosides, gangliosides, sulfatides)

Eicosanoids: Prostaglandins, Leukotrienes and Thromboxanes: Chemistry, formation and physiological function.

Steroids: Steroids in animal system: Glucocorticoids, mineralocorticoids and Sex hormones (Site of biosynthesis and functions).

Sterols in Plant system: Ergosterol and stigmasterol. Phytohormones: Brassinosterroids; Sterols in microbial system

Module 3 Protein structure and function (11hrs)

Primary, Secondary, Tertiary and Quaternary structure of Proteins, Globular proteins (Hemoglobin and Myoglobin), Fibrous protein (Collagen), Membrane Protein (ATP synthetase)**.**

Module 4 Nucleic acid structure and function **(12hrs)**

Nucleic acids- Forms of DNA, Watson Crick pairing, melting of the DNA molecule; RNA Structure: Types of RNA; structure of mRNA and tRNA with emphasis on importance of structure to its function.

Module 5 Vitamins and hormones **(18hrs)**

Fat soluble and water soluble vitamins: structure and function.

Hormones: Classification; site of formation, target organs; mechanism of action of peptide and steroid hormones: insulin, glucagon, epinephrine, norepinephrine, thyroid hormones, testosterone, estrogen, progesterone, pheromones, hormonal regulation of metabolism by mineralocorticoids.

References

1. David L. Nelson, Michael M. Cox (2005). Principles of Biochemistry, Fourth Edition
2. E. S. West, W. R. Todd, H. S. Mason, and J. T. Van Bruggen (1974). MacMillan, New York, 1966 A Textbook of Biochemistry, Oxford and IBH Publishing Co., New Delhi.
3. Donald Voet, Judith G. Voet (2004) Biochemistry (4th edition), John Wiley & Sons Inc **ISBN:** 047119350X
4. Geoffrey L Zubay, William W Parson, Dennis EVance (1995). Principles of Biochemistry**,** Publisher: **McGraw-Hill Book Company** Konga **ISBN**: **0697142752; ISBN-13**.
5. Robert Horton H, Laurence A Moran, Gray Scrimgeour Principles of Biochemistry, 4/e (2006) K **Publisher:** Peararson **ISBN:** 0131977369, **ISBN-13:**9780131977365, 978-0131977365
6. Jeremy M. Berg John L. Tymoczko, Lubert Stryer Biochemistry 6th Edition (2007) ,B.I. Publications Pvt. Ltd: **ISBN:** 071676766X **ISBN-13:** 9780716767664,978-716767664
7. Hiram. F. Gilbert (2002) Biochemistry: A Students survival Guide by Publishers: McGraw-Hill ISBN 0-07-135657-6

BMBT102: CELL AND MOLECULAR BIOLOGY

Total Hours: 72 **Credit: 4**

Objective: To have a comprehensive knowledge on cell structure and function, cell cycle, its regulation, cell signalling and cancer. To understand in detail the central dogma of molecular biology and the mechanism of gene regulation in prokaryotes and eukaryotes

Outcome: Students will be able to understand cellular structure and function at molecular and use this knowledge in pursuing further research in the field of life sciences

Module 1 Membrane structure and membrane transport (10hrs)

Membrane structure: Fluid mosaic model, membrane proteins and lipids, membrane fluidity, asymmetry, lipid raft.

Membrane transport: Simple diffusion, Facilitated transport: symport, antiport, uniport, Aquaporins. Active transport: proton pumps, Na+/K+ pumps .Ionic channels: Types of ionic channels. Receptor mediated endocytosis.

Module 2 Structural organization and function of intracellular organelles (15hrs)

ER: Rough and smooth ER functions, Golgi complex: structure and functions. Protein sorting and Vesicular transport, Protein trafficking. Lysosomes and peroxisomes: enzymatic components and functions, Cytoskeleton: Microtubule: structure and organization, microfilaments: Actin structure and assembly, Intermediate filaments, types. Mitochondrion: structural features and functions, Chloroplast structural features and functions, Cell junctions- Tight junctions, Desmosomes and gap junctions.

Module 3 Cell cycle and cell signalling (10hrs)

Cell cycle: Mitosis, Meiosis and Regulation of cell cycle.

Cell signalling: Signal reception, Types of receptors, second messengers: cAMP, Ca ions, signal transduction, cellular response. Molecular pathways- PIP3, Akt, MAP kinase. Cancer: Properties of cancer cells, Oncogenes, Proto-oncogenes and Tumour suppressor genes.

Module 4 DNA replication and DNA repair (12hrs)

DNA Replication: Messelson and Stahl experiment, Steps in initiation of replication, Ori site, Okazaki fragments, Termination of replication, DNA polymerases in eukaryotes and prokaryotes. End replication problem, telomerase.

Repair mechanisms: Excision Repair, BER, NER, mismatch repair, SOS repair, Recombination repair systems.

Module 5 Transcription and translation **(15hrs)**

Transcription: Promoters, Enhancers, stages in initiation, RNA polymerases in prokaryotes and eukaryotes, sigma factor in prokaryotes, elongation, Rho dependant and Rho independent termination, Transcription factors in Eukaryotes, CpG islands, monocisrtonic and polysistronic m-RNA. Post transcriptional modifications: mRNA processing- Polyadenylation, capping, Splicing. t-RNA processing & r-RNA processing.

Translation: Genetic code, wobble hypothesis, eukaryote and prokaryote ribosomes. Stages in translation, aminoacyl t-RNA synthatases, Initiation complex, peptidyltransferase, releasing factors.

Module 6 Molecular mechanism of gene regulation in prokaryotes and eukaryotes

(10rs)

Operon concept, Lac and Trp operon, Catabolic repression, Atteunation. Transcriptional and translational level of gene regulation in eukaryotes. RNA interference, Antisense RNA, SiRNA, MicroRNA.

References

1. Cooper GM and Hausman (2013), The Cell, a molecular approach, 6th Edition, Sinauer Associates, Sunderland
2. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P., (2002) Molecular Biology of the Cell (4th Ed.), Garland Science, New York.
3. Becker, W. M. and Klein smith, L. J., (2005), World of the Cell (6th Ed.), Benjamin Cummings.
4. Gupta, P. K. (2003), Cell and Molecular Biology (2nd Ed.), Rastogi Publication, Meerut17
5. Harvey, L., Arnold, B., Lawrence, S., Zipursky, Paul, M., David, B., and James, D (2000), Molecular Cell Biology (4th Ed.), W. H. Freeman, New York
6. Lodish et al. (2004). Molecular Cell Biology (Scientific American Book)
7. Stern, K.R. (2002), Introduction to plant Biology (8th Ed.), McGraw Hill, Boston

BMBT103: BIOPHYSICS AND BIOINFORMATICS

Total Hours: 54 **Credit: 3**

Objective: To emphasize an understanding of the underlying physical principles of the biological phenomena and to educate the interdisciplinary nature of advances in bioinformatics and computational biology providing practical training in bioinformatics methods by various software packages.

Outcome: On the completion of this course students will be familiar with various bioinformatics tools and approaches to extract information from different types of bioinformatics data (gene, protein, disease, etc.) and to analyse them in their area of research work.

Module 1 Thermodynamics (6hrs)

Laws of thermodynamics, concept of enthalpy, free energy, unavailable energy and entropy, thermodynamic equilibrium, redox potential, chemical kinetics – rate, order, molecularity of reactions and energy of activation.

Oxidation and reduction, redox potential -Nernst equation, examples of redox potential in biological system. Energy requirements in cell metabolism.

Module 2 Protein structure and interactions (14hrs)

Different levels of protein structure: Primary, secondary, tertiary and quaternary structure. Torsion angles. Alpha helix, beta sheet, turns. Ramachandran map - Allowed conformations for a pair of linked peptide units - (map for glycine and alanine residues), Motifs and domains-examples such as hairpin motif, Greek key motif, alpha helix bundles, alpha-beta barrels etc.

Protein-protein interactions, protein-nucleic acid interactions- Nucleosome and ribosomes. DNA binding motifs-HTH, Cys –His, Leucine zipper, Zn-finger motifs. DNA drug interaction. Peptide mass fingerprinting using MALDI-TOF, MASCOT database. Kinetic factors of protein folding. Burying of hydrophobic side chains. Chaperonins.

Module 3 DNA -structure and polymorphism (6hrs)

Structure of DNA - Watson and Crick model - base pairing and base stacking, DNA polymorphism - A, B, C, D and Z forms. Triple stranded DNA (H DNA)-Hoogsteen base pairing, G- quartet. Supercoiling of DNA. Structure of tRNA. GC content. DNA denaturation kinetics, Melting Temperature (Tm).Cot curve.

Module 4 Databases in bioinformatics (6hrs)

Introduction to bioinformatics. data mining. data formats (FASTA, PDB). Biological database: Nucleic acid databases – Genbank, NCBI, EMBL, DDBJ; Protein databases – PIR,

SWISSPROT, TrEMBL, PDB; Secondary protein databases – PROSITE, PROFILES; Structural classification databases – SCOP, CATH; Literature databases – PubMed, Genome databases (Ensembl, TIGR), Specialized databases (OMIM, GEO, KEGG,ZINC).

Module 5 Homology and alignment **(12hrs)**

Sequence analysis softwares - Sequence alignment: Global and local alignment: methods, scoring matrices (PAM, BLOSUM). Pair-wise sequence alignment, Dot plot. Database similarity searching- FASTA and BLAST. Multiple sequence alignment: methods, tools and applications. Phylogenetic analysis: type of phylogenetic trees, methods of its construction distance based methods and character based methods.

Module 6 Structural bioinformatics **(10hrs)**

Secondary and tertiary structure prediction- homology modelling, ab initio prediction. Computer aided drug design, steps in drug discovery- lead compounds, pharmacophore, ADME. Applications of Bioinformatics.

References

1. Bloomfield V A and Harrington R E, (1975) Biophysical Chemistry, W A Freeman and Co.
2. Cantor C R and Schimmel P R, (1980), Biophysical Chemistry, W A Freeman and Co.
3. P Narayanan Essentials of Biophysics (2008),New Age International Publishers.
4. A.L. Lehninger (1993) Principles of Biochemistry, D.L. Nelson and M.M. Cox, CBS Publishers, New Delhi.
5. L. Stryer (1997), Biochemistry W.H. Freeman and Co., New York.
6. Thomas E. Creighton (1992) Proteins Structure and Molecular Properties, W.H. Freeman.
7. Vasantha Pattabhi and N. Gautham (2002), Biophysics Narosa Publishing House, New Delhi.
8. David Mount (2004) Bioinformatics: Sequence and Genome analysis2nd edition, Cold Spring Harbour Lab Press, New York.
9. Paul G Higgs, Teresa K Attwood (2005) Bioinformatics and Molecular evolution Blackwell Publishers.
10. Rastogi, S.C. Mendiratta, N. and Rastogi P (2004) Bioinformatics-Methods and applications, Prentice-Hall of India Pvt. Ltd, New Delhi.
11. Jin Xiong (2006) Essential Bioinformatics-, Cambridge University Press.

BMBT104: BIOANALYTICAL TECHNIQUES AND BIOSTATISTICS

Total Hours: 72 **Credit: 4**

Objective: To give an overview of various techniques available to unravel the properties of biomolecules and to avoid the perception that statistics is just a series of formulas that students need to "get over with," but to present it as a way of thinking and analyze data so as to benefit from taking the required course.

Outcome: The course aims to develop competency and expertise into basic concepts related with techniques and instrumentation widely used in Biotechnology and statistical methods applied to biological data obtained in experimental techniques, methodology and the safe laboratory practice.

Module 1 Electrochemical and membrane techniques (6hrs)

Buffers, pH meter and ion selective electrodes, Potentiometry. Dialysis, Ultrafiltration and other membrane techniques, protein crystallization techniques.

Module 2 Microscopy and spectroscopy (18hrs)

Spectroscopy: Beer-Lamberts law. Principle, Instrument Design, methods and Applications of UV-Visible , IR , Raman , Fluorescence , NMR and ESR spectroscopic techniques. Principle, Instrument Design, methods and Applications of Polarimetry, ORD and CD. Light scattering, Refractometry, Flow cytometry, X-ray diffraction by crystals, Mass spectrometry.

Microscopy: Light, Phase contrast, Polarization, Confocal and Interference microscopy, Electron microscopy- SEM, TEM, STEM, CCD camera. Introduction to Atomic force microscopy.

Module 3 Radio isotopic techniques` (7hrs)

Use of radioisotopes in life sciences, Radioactive labeling, principle and applications of tracer techniques, Geiger- Muller and Scintillation counters, Autoradiography and its applications.

Module 4 Separation techniques (14hrs)

Chromatography- Principle, method and Applications of Ion exchange, Molecular sieve, Affinity chromatographic techniques. TLC, GC, HPLC.

Electrophoresis- Basic principles of electrophoresis, Paper Electrophoresis, Theory and application of native and denaturing PAGE, AGE, Isoelectric focusing, Capillary Electrophoresis.

Centrifugation and Ultra centrifugation, Types of centrifuge machines, preparative and analytical centrifugation, differential centrifugation, sedimentation velocity, sedimentation equilibrium, density gradient methods and their applications.

Module 5 Introduction to biostatistics (6hrs)

Scope of Biostatistics,. Variables in biology- collection, classification and tabulation of data, graphical and diagrammatic representation- scatter diagrams, histograms- frequency polygon, frequency curve-logarithmic curves. Probability and probability distribution analysis

Module 6 Measures of central tendency (12hrs)

Measures of central tendency, Arithmetic mean, median, mode, geometric mean, harmonic mean. Measures of dispersion, standard deviation, standard error, variance, coefficient of variation. Correlation and regression: Positive and negative correlation and calculation, ANOVA, one and two way classification.

Module 7 Test of significance (9hrs)

Basic idea of significance test- hypothesis testing, levels of significance, Chi-square test and goodness of fit, comparison of means of two samples, three or more samples. Statistical packages.

References

1. Keith Wilson and John Walker (2000) Practical biochemistry – Principles and Techniques5th Edition Cambridge University Press.
2. Rodney Boyer (2000) Modern experimental Biochemistry-, Third Edition Pearson education. ISBN: 978-81-7758-884-2
3. Bailey N.J.T (1995) Statistical methods in Biology- 3rd edition ISBN: 0521 47032 3
4. PN Arora and P K Malhan. (2012)Biostatistics, Himalaya PubISBN: 978-8183186919
5. R N Roy, (2001) A Text Book of Biophysics- New Central Book Agency. ISBN: 9788173811456
6. Gerald Karp (2013) Cell and Molecular Biology 7th Edition, Academic Press ISBN: 9781118473689
7. Voet and Voet (2010) Biochemistry 4th Edition ISBN 978-0470570951
8. Robert K. Scopes (1994) Protein Purification 3rd Edition Springer Verlag Publishers
9. David Home and Hazel Peck (1993) Analytical Biochemistry Second Edition Longman Publishers ISBN: 978-0582066946
10. David Sheehan (2009) Physical Biochemistry Second edition Wiley India ISBN: 9788126564842
11. Douglas Skoog and Donald West (2014) Fundamental of analytical chemistry 9th Edition Cengage Learning ISBN: 9781285056241

PRACTICAL

BMBT1P01: LABORATORY COURSE - I

Total Hours: 180 **Credit: 4**

Preparation of Solutions:

- Percentage solutions
- Molar solutions
- Normal solutions
- Dilution of Stock solutions

Quantitative Analysis

- Quantitative estimation of reducing sugars by Dinitrosalicylic acid method
- Estimation of sugar by o-Toluidine method
- Estimation of sugar by Anthrone method
- Estimation of Cholesterol by Zak's method
- Estimation of protein by Biuret method.
- Estimation of protein by Lowry's method
- Estimation of DNA by diphenylamine method
- Estimation of RNA by orcinol method

Extraction of Polysaccharides and Proteins

- From appropriate source, extraction and quantification of isolated polysaccharides (Anthrone method) and proteins (Lowry's method)

Chromatographic techniques

- Separation of amino acids by Paper chromatography (Descending or Ascending)
- Separation of Plant pigments/lipids/sugars/amino acids by Thin layer chromatography
- Separation of any biomolecule by column chromatography

Demonstration of stages of mitosis, meiosis and counting chromosome numbers

Familiarizing with the different data bank mentioned in the syllabus.

- Retrieve a document reporting recent work on a genomic analysis of human disease.
- Familiarizing with database retrieval systems.
- Familiarizing with different alignment tools.
- Retrieve nucleotide sequences and construct a distance tree.

Problems in biostatistics

Model Question Papers

ST BERCHMANS COLLEGE CHANGANASSERRY (Autonomous)
M.Sc. Biotechnology Examination (Model question paper)
First Semester
BMBT101: BIOCHEMISTRY

Time: 3 Hrs **Marks: 75**

PART A

I. Write Notes on any ten. Each question carries 2 marks

1. Glycosidic bond
2. Ceramide
3. Cardiolipin
4. Brassinosteroids
5. Hyaluronic acid
6. Scurvy
7. Pheromones
8. Epinephrine
9. t-RNA.
10. Classification of lipids
11. Prostaglandins
12. Mutarotation
13. Mucopolysaccharides
14. Vitamin D **(2x10=20 marks)**

PART B

II. Write short essay on any five. Each question carries 5 marks

15. Gangliosides
16. Leukotrienes
17. Sphingolipids
18. Phosphatidylinositol
19. T3 and T4 hormones
20. □ helix
21. Forms of DNA
22. Vitamin B6 **(5x5=25 marks)**

PART C

Answer any two in detail. Each question carries 15 marks

23. With a suitable example explain the mechanism of action of a peptide hormone.

24. Compare the structure and function of myoglobin and hemoglobin.
25. Give an account on DNA structure
26. What are vitamins? Give an account of the vitamins A and D with special reference to their role in the biological system. **(15x 2=30 marks)**

ST BERCHMANS COLLEGE CHANGANASSERRY (Autonomous)

M.Sc. Biotechnology Examination (Model question paper)

First Semester

BMBT102: CELL AND MOLECULAR BIOLOGY

Time: 3 Hours **Maximum: 75 Marks**

Part A

Write short notes on **any ten** questions. Each question has **2 marks**.

1. Glucose Porter
2. Lysosomal enzymes
3. LHC
4. DNA
5. Nucleolus
6. Wobble hypthesis
7. Eukaryotic ribosome
8. Riboswitches
9. Enhancers
10. Operator in an Operon
11. Antisense oligonuclotides
12. Split genes
13. Oncogenes
14. Sigma factor

(10×2=20)

Part B

Write short essay on **any five** questions. Each question has **5 marks**.

15. Asymmetry of protiens and lipids distribution in the plasma membrane
16. Microtubule structure and Organisation
17. Role of Cyclic AMP in signal transduction
18. Role of Rbtumour suppressor gene in induction of cancer
19. Mechanism of transcription termination
20. Arabinose Operon
21. Splicing mechanism of Group I introns
22. Structure of tRNA and its processing mechanism (5×5=25)

Part C

Answer **any two** questions. Each question has **15 marks**.

23. Give an account of various types of membrane transport

24. Give a detailed account of protein sorting and packaging in a cell

25. Explain the mechanism of translation in prokaryotes

26. Elaborate on various DNA repair mechanisms. **(15x 2=30 marks)**

ST BERCHMANS COLLEGE CHANGANASSERRY (Autonomous)

M.Sc. Biotechnology Examination (Model question paper)

First Semester

BMBT103: BIOPHYSICS AND BIOINFORMATICS

Time: 3 Hrs **Marks: 75**

PART A

I. Write Notes on any ten. Each question carries 2 marks

1. Second law of thermodynamics.
2. GENBANK.
3. G quartet.
4. Melting temperature.
5. PAM.
6. Cot curve.
7. Torsion angles.
8. Nernst equation.
9. Fasta format.
10. SWISSPROT.
11. DNA polymorphism
12. E value.
13. High energy molecules
14. OMIM

(2x10=20 marks)

PART B

II. Write short essay on any five. Each question carries 5 marks

15. Ramachandran plot
16. Write note on “Homology modeling”.
17. Secondary structure of proteins.
18. BLAST
19. DNA protein interaction.
20. Phylogenetic analysis.
21. Application of CLUSTAL W.
22. DNA supercoiling.

(5 x 5 =25 Marks)

PART C

III. Answer any two in detail. Each question carries 15 marks

23. . Give an account on Laws of Thermodynamics.

24. Explain peptide mass fingerprinting using MALDI-TOF.

25. Give a brief outline on the available online biological databases.

26. Discuss on the application of Bioinformatics in the field of drug designing.

(2 x 15 =30 Marks)

ST BERCHMANS COLLEGE CHANGANASSERRY (Autonomous)

M.Sc. Biotechnology Examination (Model question paper)

First Semester

BMBT104: BIOANALYTICAL TECHNIQUES AND BIOSTATISTICS

Time : 3 Hrs **Marks: 75**

PART A

I. Write Notes on any ten. Each question carries 2 marks

1. Probability
2. Beer- Lambert's law
3. Cation exchange resin
4. Dependent variable
5. Resolving power of a microscope
6. Arithmetic mode
7. Ultrafiltration
8. Specimen preparation for electron microscopy
9. Svedberg unit
10. Rf value
11. Geometric mean
12. Histogram
13. Autoradiography
14. Scintillation counter **(5 x 5 =25 Marks)**

PART B

II. Write short essay on any five. Each question carries 5 marks

15. Correlation and regression
16. HPLC
17. Write a note on Test of significance
18. GM counter
19. Density gradient centrifugation
20. Pulsed field gel electrophoresis
21. Immunoaffinity chromatography
22. Standard deviation **(5 x 5 =25 Marks)**

PART C

III. Answer any two in detail. Each question carries 15 marks

23. Write in detail on collection, classification and tabulation of data

24. What is SDS PAGE? Add a note on its working principles and significance.
25. Give an account of the different chromatrographic techniques used for separation.
26. Describe about different spectroscopic techniques. **(15x 2=30 marks)**

SEMESTER II

BMBT205: MICROBIOLOGY

Total Hours: 72 **Credit: 4**

Objective: This course guides the students to learn appropriate microbiology laboratory techniques. The paper surveys microbial growth characteristics as well as their morphology and metabolic pathways. This course fulfills the basic knowledge in microbiology for those students who wish to pursue career in allied health fields and other technical programs.

Outcome: Most of the techniques in biotechnology uses bacteria, viruses and fungi. This course will make the students adept in the structure and functions of these microbes which in turn will give them confidence to work using these organisms. The students will become competent for jobs in dairy, pharmaceutical, industrial and clinical research.

Module 1 Introduction to microbiology **(15hrs)**

The historical foundations and development of microbiology. Microbial diversity - Prokaryotic and eukaryotic microbial diversity .The bacteria and the archeae. Principles of bacterial taxonomy. Molecular methods in taxonomy. Morphology and structure of bacteria. Surface structures and inclusions of bacteria. Viruses- unique properties, morphology and structure. Virus, Viral replication. Viral diversity –bacterial, plant and animal viruses. Fungi– properties and classification.

Module 2 Microbial growth **(15hrs)**

Factors influencing microbial growth. Environmental and nutritional factors. Nutritional types of bacteria. Microbial locomotion – flagellar motility, gliding motility and amoeboid motion. Chemotaxis, Phototaxis and other taxes. Cultivation of bacteria- culture media and methods. Measurement of bacterial growth. Bacterial growth curve. Binary fission, Growth cycle, Thermophiles, mesophiles, halophiles, psychrophiles. Continuous cultures. Maintenance and transport of cultures.

Module 3 Identification and control of microorganisms **(15hrs)**

Identification of bacteria. Staining reactions. Cultural, physiological and biochemical characteristics. Sterilisation – Principles and methods, physical and chemical methods. Disinfectants – modes of action. Testing of disinfectants. Antibiotics – mechanism of action. Drug resistance in bacteria. Antibiotic sensitivity tests.

Module 4 Genetics of bacteria **(15hrs)**

Genetic materials in bacteria. Bacterial chromosome. Extrachromosomal genetic elements. Plasmid, Mutation, Mutant selection. Mechanism of gene transfer – transformation, transduction and conjugation and gene mapping using transformation, transduction and conjugation

Module 5 Microbial metabolism **(**12hrs)

Central pathways, Glycolysis, Pentose phosphate pathway, Entner Doudoroff pathway, TCA cycles, Electron transport chain, Aerobic and anaerobic respiration. Fermentation. Anaplerotic reaction. Peptidogycan synthesis, Bacterial photosynthesis.

References

1. Russel AD Hugo Ayliff (2011) Principles and practice of disinfection, preservation and sterilization –5th edition Blackwell scientific publications ISBN: 978-1444333251
2. Bryan LE, (1989) Antimicrobial drug resistance 1ST Edition, Academic press ISBN: 9780323144957
3. Topley W.W.C (1990) Toplely and Wilson's Principles of bacteriology, Virology and Immunology. Arnold Publishers ISBN: 978-0713145946
4. Bernard D. Davis (1981), Microbiology second revised edition. Harper International Edition ISBN: 978-0063201774
5. Zinsser (1992) Microbiology20th Edition Prentice Hall International Inc. ISBN: 9780838599839
6. Gerhadt P (1981) Manual of methods for General Bacteriology American Society for Microbiology. ISBN 978-0914826293
7. Pelczer J.M; Chan E C S. Creig N R (1997) Microbiology concepts and applications. Fifth Edition, McGraw Hill, Inc
8. Prescott, Harley and Klein Wim C Brown (1993) Microbiology.2nd Edition Wm. C. Brown Publishers

BMBT206: IMMUNOLOGY AND IMMUNOLOGICAL TECHNIQUES

Total Hours: 72 **Credit: 4**

Objective: The course describes the scientific principles in the interpretation of immunological responses and molecular and cellular basis of the development and function of the immune system in states of health and disease.

Outcome: On completion of this course, the student will be able to recall advanced knowledge of the underlying principles of immunology and its application in solving problems in biological systems with the help of recent immunological techniques.

Module 1 Introduction to immunology **(12hrs)**

Historical background, Types of infections. Types of Immunity- Innate (Mechanisms of innate immunity) and acquired, Passive and active. Components of immune system, cells, tissues and organs involved in immune system. Introduction to Humoral and cell mediated immune response. Haematopoiesis.

Module 2 Antigens and antibodies **(**12hrs)

Antigens, Antigenicity, Epitopes. Antibodies: Immunoglobulin – structure, classes and functions. Genetic basis of antibody diversity. Organization and Expression of Immunoglobulin Genes, V(D)J rearrangements; somatic hypermutation and affinity maturation Monoclonal antibodies and abzymes. Antibody genes and antibody engineering. Antigen processing and presentation.

Module 3 Immune response **(15hrs)**

Humoral and cell mediated immune response, Primary and secondary immune modulation, Clonal selection theory. Activation of T cells: MHC, receptors on T and B cells. T-cell function, Cell mediated immune response; CTL mediated, NK cells, ADCC. B-cell and T-cell maturation and differentiation.

Complement activation and pathways, Biological effects of complements. Role of cytokines in immune system. Properties and functions of Cytokines. Therapeutic uses of cytokines. Inflammation, Inflammatory Cells. Types of Inflammation- acute and chronic.

Module 4 Immunology in transplantation, tumours, blood transfusion **(14hrs)**

Immunology of organ and tissue transplantation, Allograft reaction and GVH reaction, Factors influencing allograft survival, MHC- General organization and inheritance of MHC. MHC molecules and genes. MHC and graft rejection. Immunology of malignancy, Tumor antigens, Immune response in malignancy, Immunotherapy of cancer, ABO and Rh blood group system, Immunology of blood transfusion.

Module 5 Autoimmunity, hypersensitivity, immunodeficiency (9hrs)

Immunological tolerance, Autoimmunity, Mechanisms of autoimmunization, Autoimmune diseases, Hypersensitivity –immediate and delayed reactions, Clinical types of hypersensitivity, Immunodeficiency diseases Congenital immunodeficiency diseases (SCID, WAS, CVI, Ataxia, CGD, LAD).Acquired Immunodeficiency Disease (AIDS).Immunoprophylaxis, Vaccines: types of vaccines, DNA vaccine, recent trends in vaccine development.

Module 6 Antigen–antibody interactions and immunological techniques (10hrs)

Antigen- antibody interactions: precipitation, agglutination and complement mediated immune reactions. Complement fixation, Radioimmuno assay, ELISA, Flow cytometry and fluorescence, Radioallergo sorbent Test (RAST). Immunoprecipitation, Immunodiffusion, Immunofluorescence, Immunoelectrophoresis.

References

1. Abbas, A.K., Lichtman, A.K and Pober, J.S. (1997). *Cellular and Molecular Immunology.*W.B. Saunders Co. New York
2. Ashim K. Chakravarthy. (1998) *Immunology*. Tata McGraw-Hill, New Delhi.
3. Chakraborty, A.K. (2006) *Immunology and Immunotechnology.* Oxford University Press, New Delhi
4. Darla, J, Wise and Gordeon, R. Carter (2004) *Immunology- A Comprehensive Review*. Iowa State University Press. A Blackwell Science Co, USA.
5. David Male, Jonathan Brostoff, David Roth and Ivan Roitt. (2006*) Immunology*. Mosby, Edinburgh, UK.
6. Goldsby, R.A., Kindt, T.J. and Osborne, B.A (2000) *Immunology* (4th edn.). W.H. Freemanand Co. NY, USA.
7. Hannigan, B. M., Moore, C. B. T. and Quinn, D. G (2010) *Immunology*. Viva Books, New Delhi.
8. Helen Chappel and Maused Harney (2006) *Essentials of Clinical Immunology* (5th edn.) Blackwell Scientific Publications.
9. Ivan M. Roitt (2002) *Essential of Immunology*. ELBS, New Delhi.
10. Khan. F.H (2009) *The Elements of Immunology*. Pearson Education. New Delhi.
11. Kuby J (2000) *Immunology* (7th edn.). WH Freeman & Co. New York.
12. Richard Coico and Geoffrey Sunshine (2009) *Immunology: A short course*. Wiley-Blackwell, CA, USA.

BMBT207: GENETICS

Total Hours: 54 **Credit: 3**

Objective: To understand the key concepts in mendelian genetics, gene mapping, genome organization, human genetics, population, evolutionary and quantitative genetics including: the basis of genetic variation; heritability; Hardy-Weinberg Equilibrium; roles of migration, mutation.

Outcome: Students will have a detailed knowledge on all the aspects of inheritance biology and will be able to perform genetic mapping, pedigree analysis and solve problems related to population genetics.

Module 1 Mendelian principles and extension of Mendelian principles (10hrs)

Mendel and his experiments, Mendel's Laws, Mono, di and trihybrid crosses. Chromosome theory of Inheritance.Chromosomal basis of segregation and independent assortment. Concept of alleles, complementation test,Codominance, incomplete dominance, lethal alleles, multiple alleles. Gene Interactions- Epistasis, Complementary genes, duplicate genes, polymeric genes. Pleiotrpy, Penetrance and expressivity, phenocopy, Cytoplasmic Inheritance, Maternal effect. Sex influenced and Sex limited genes.

Module 2 Linkage and genetic mapping (10hrs)

Linkage and Crossing over - Stern's hypothesis, Creighton and McClintock's experiments, single cross over, multiple cross over, two-point cross, three-point cross, map distances, gene order, interference and co-efficient of coincidence. Haploid mapping (Neurospora)

Module 3 Chromosome organisation and organisation of genome (10hrs)

Chromatin structure-Histones, Nucleosome and higher level organisation. Heterochromatin and euchromatin. Metaphase chromosome: centromere and kinetochore, telomere and its maintenance. Holocentric chromosomes and supernumerary chromosomes. Dosage compensation in *Drosophila* and mammals.

Genome organisation: split gene concept- exons, introns, intergenic DNA repetitive sequences-interspersed repeats-SINE, LINE transposons- types (IS elements, replicative transposons, retroposons) and significance, tandem repeats-micro, minisatellites

Module 4 Model organisms in genetics and techniques in study of chromosomes (8hrs)

Model organisms in Genetic studies- Brief life cycle & applications. Techniques in the study of chromosomes and their applications: karyotyping, banding, chromosome labeling, Fluorescence *in situ* hybridization, chromosome painting, comparative genome hybridization (CGH).

Module 5 Human genetics **(10hrs)**

Pedigrees - gathering family history; Pedigree symbols; Construction of pedigrees. **Single gene disorders in human - Autosomal Dominant inheritance (**Heterozygous affected phenotype, pedigree, Variable Expressivity, Late Onset, High Recurrent, Mutation Rate, Incomplete Penetrance), **Autosomal Recessive inheritance** (Carrier probabilities in a pedigree, effects of consanguinity), **X-linked Dominant inheritance** (pedigree, lethality in males), **X-linked Recessive inheritance** (pedigree, Bayesian probability, new mutations in genetic lethals), Sex-limited inheritance, Mitochondrial inheritance, imprinting.

Module 6 Population genetics **(6hrs)**

Gene pool, allele and genotype frequency. Hardy- Weinberg law and its applications. Factors that alter allelic frequencies; Mutation Genetic drift - Bottleneck effect and Founder effect, migration, selection, non-random mating, inbreeding coefficient. Inheritance of quantitative traits-Polygenic inheritance, Genetic variance, heritability (narrow sense and broad sense)

References

1. Daniel L. Hartl & Elizabeth W. Jones : Genetics – analysis of Genes & Genomes
2. Benjamin A. Pierce : genetics – a conceptual approach
3. D. Peter Snustad & Michael J. Simmons : Principles of Genetics
4. Tom Strachan & Andrew P. Read : Human Molecular Genetics
5. Benjamin Lewin, Gene IX, 9th Edition, Jones and Barlett Publishers, 2007.
6. J.D. Watson, N.H. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner; Molecular Biology of the Gene, 6th Edition, Benjamin Cummings Publishing Company Inc, 2007.
7. Alberts et al; Molecular Biology of the Cell, 4th edition, Garland, 2002.
8. Scott Freeman, John C. Hendon, Evolutionary Analysis, Fourth Edition, Pearson Education.
9. Hoelzel, Molecular Genetic Analysis of Populations, 2nd Edition, Oxford University, 1998.
10. Hartl and Jones, Genetics -Principles and Analysis, 5th edition Jones and Barlet. (2001)
11. Hartl & Clark, Principles of Population Genetics, Third Edition, Sinauer Associates, Inc. 1997

BMBT208: METABOLISM AND ENZYMOLOGY

Total Hours: 72 **Credit: 4**

Objective: To provide an in depth understanding of biologic processes and metabolic pathway which are basic to life.

Outcome:-To make students demonstrate an understanding of metabolic pathways, role of enzymes in the regulation of these pathways.

Module 1 Bioenergetics and metabolism of carbohydrates (15hrs)

Laws of thermodynamics, concept of enthalpy, free energy, unavailable energy and entropy, thermodynamic equilibrium, redox potential, chemical kinetics – rate, order and molecularity of reactions.

Glycolytic pathway, TCA cycle, Electron transport chain: structural components of the chain, complexes, substrate level phosphorylation, oxidative phosphorylation, chemiosmosis ATP synthesis: structural and functional properties of ATP synthesis, gluconeogenesis, glycogenolysis and glycogenesis, Regulation of pathways.

Module 2 Metabolism of proteins and nucleotides (12hrs)

Synthesis and degradation of amino acids, deamination, transamination, urea cycle, Synthesis of purines and pyrimidines, salvage pathway, degradation, regulation of pathways.

Module 3 Metabolism of lipids (10hrs)

Metabolism of lipids, β-oxidation, synthesis of fatty acids, Fatty acid synthase, synthesis of cholesterol, degradation of cholesterol.

Module 4 Introduction to enzymology and enzyme kinetics (15hrs)

Holoenzyme, apoenzyme, and prosthetic group; Interaction between enzyme and substrate- Features of active site, activation energy, Rate enhancement through transition state stabilization, Enzyme specificity and types; Enzyme Commission system of classification and nomenclature of enzymes. Measurement and expression of enzyme activity, Definition of IU, katals, enzyme turnover number and specific activity, Isolation of enzymes and the criteria of purity; Characterization of enzymes, study of the factors affecting the velocity of enzyme catalysed reaction, Derivation of Michaelis-Menten equation, Km value determination and its significance, Definition of Vmax and its significance, Line weaver- Burk plot; Bi-substrate reactions.

Module 5 Enzyme inhibition and regulation (12hrs)

Reversible and irreversible inhibition; Reversible- competitive, noncompetitive and uncompetitive inhibition; Allosteric regulation: example Aspartate trascarbamoylase

Structure—Activity Relationships and Inhibitor Design; Tight Binding Inhibitors: Identifying Tight Binding Inhibition, examples; Time-Dependent Inhibition: examples; Covalently modulated enzymes with examples of adenylation and phosphorylation; Zymogen form of enzymes and zymogen activation; Multienzyme complexes and their role in regulation of metabolic pathways.

Module 6 Application of enzymes (8hrs)

Isoenzymes: Lactate dehydrogenase and creatine phosphokinase. Industrial uses of enzymes (amylase, lipase, protease), Diagnostic and therapeutic enzymes (amylase, Glucose isomerase, alkaline phosphatase).

References

1. Nicholas C. Price, Lewis Stevens, and Lewis Stevens (2000) Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins Publisher: Oxford University Press, USA ISBN: 019850229X ISBN-13: 9780198502296, 978-0198502296.
2. Taylor (2004) Enzyme Kinetics and Mechanism Spring ISBN: 8184890478ISBN-13:9788184890471, 978-8184890471
3. Donald Voet, Judith G. Voet (2004) Biochemistry Publisher: John Wiley & Sons
4. P.K. Shivraj Kumar (2007) Enzyme Mechanism Publisher: RBSA Publishers ISBN: 8176114235 ISBN-13: 9788176114233, 978-8176114233
5. Jeremy M. Berg John L. Tymoczko Lubert Stryer (2007) Biochemistry, 6th Edition Publisher: B.I. Publications Pvt. Ltd ISBN: 071676766X ISBN-13:9780716767664, 978-716767
6. Robert Horton H, Laurence A Moran, Gray Scrimgeour (2006) Principles Of Biochemistry, 4/e K Publisher: Pearson ISBN: 0131977369, ISBN-13:9780131977365, 978-0131977365
7. Trevor Palmer, Philip Bonner (2007) Enzymes: Biochemistry, Biotechnology, Clinical Chemistry (second Edition) Publisher: Horwood Publishing Limited

PRACTICAL

BMBT2P02: LABORATORY COURSE - II

Total Hours: 180 **Credit: 4**

Microbiology and Immunology

- Microscopic examination of bacteria in living conditions
- Testing of motility
- Staining procedures- simple stain, differential staining- Gram staining, flagellar staining
- Sterilisation methods
- Cultivation of bacteria and fungi
- Study of cultural characteristics and biochemical reaction of bacteria
- Testing of disinfectants
- Antibiotic sensitivity tests
- Immunodiffusion in gel
- Serological tests for the diagnosis of microbial infections-RPR, RF, ASO.
- Agglutination and precipitation tests
- ELISA

Metabolism and Enzymology/Molecular Biology

- Estimation of enzyme activity ALP,ACP, sGOT, sGPT
- Determination of Km and Vmax
- Ammonium sulphate precipitation
- Dialysis
- Gel Filtration
- Ion Exchange chromatography
- PAGE/SDS – PAGE

Genetics Problems

Model Question Papers

ST. BERCHMAN'S COLLEGE CHANGANASSERRY (Autonomous)
M.Sc. Biotechnology Examination (Model question paper)
Second Semester
BMBT205: MICROBIOLOGY

Time: 3 Hrs **Marks: 75 marks**

I. Write Notes on any ten. Each question carries 2 marks

1. Insertion sequences
2. Thermophiles
3. Chemotaxis
4. Prions
5. Lyophilization
6. Photoreactivational repair
7. Lowenstein – Jensen media
8. Sterilization
9. Gram staining
10. Flagellar motility of bacteria
11. Binary fission
12. Halophiles
13. Functions of viral capsid
14. TDT **(10 x 2 =20 Marks)**

PART B

II. Write short essay on any five. Each question carries 5 marks

15. Conjugation
16. Replication of enveloped viruses
17. Anapleurotic reaction
18. Phenol Coefficient Test
19. EntnerDoudoroff pathway
20. Morphological classification of Fungi
21. Explain Flagellar Structure with a note on difference between prokaryotic & eukaryotic flagella.
22. Bacterial growth curve **(5 x 5 =25 Marks)**

PART C

III. Answer any two in detail. Each question carries 15 marks

23. Elaborate on the structure of bacterial cell wall with a note on peptidoglycan synthesis.
24. Explain bacterial photosynthesis

25. Give an account on the classification of fungi

26. What are the Principles of Taxonomy? Describe in detail. **(2 x 15 =30 Marks)**

ST. BERCHMAN'S COLLEGE CHANGANASSERRY (Autonomous)
M.Sc. Biotechnology Examination (Model question paper)
Second Semester
BMBT206: IMMUNOLOGY AND IMMUNOLOGICAL TECHNIQUES

Time: 3 Hrs **Max Marks: 75**

PART A

I. Write Notes on any ten. Each question carries 2 marks

1. IgA
2. Immunogen
3. Phagocytosis
4. MHC-1
5. Erythroblastosisfoetalis
6. Innate immunity
7. Thymus
8. AIDS
9. SLE
10. Interferon
11. Opsonization
12. DNA vaccine
13. Adjuvant
14. Hapten **(2x10 = 20 Marks)**

PART B

II. Write short essay on any five. Each question carries 5 marks

15. Describe Monoclonal antibody production and its applications.
16. What is the mechanism involved in Graft Rejection**?**
17. Explain the pathway of antigen presentation through Class I MHC.
18. Describe various steps involved in inflammatory response.
19. Comment on T-Cell activation and differentiation.
20. Explain the various autoimmune diseases.
21. Differentiate between ELISA, RIA and RAST.
22. Differentiate between class I and class II MHC molecules. **(5 x 5 =25 Marks)**

PART C

III. Answer any two in detail. Each question carries 15 marks

23. Explain Antibody structure. Elaborate on the molecular basis of Antibody Diversity. Write a note on class switching.

24. Describe the various Antigen- Antibody reactions in detail.
25. Describe the different types of Hypersensitivity reactions.
26. What are complements. What is their role in body defense against foreign antigens? Explain the various Complement activation pathways. **(15x 2=30 marks)**

ST BERCHMANS COLLEGE CHANGANASSERRY (Autonomous)
M.Sc. Biotechnology Examination (Model question paper)
Second Semester
BMBT207: GENETICS

Time: 3 Hours **Maximum: 75 Marks**

Part A

Write short notes on **any ten** questions. Each question has **2 marks**.

1. Dihybrid cross
2. Sex linkage
3. Maternal effect
4. Sex limited genes
5. Metaphase chromosome
6. SINE
7. Microsatellite
8. Tandem repeats
9. Imprinting
10. Split genes
11. Gene pool
12. Genetic drift
13. Heritability
14. Sigma factor in transcription

(10×2=20)

Part B

Write short essay on **any five** questions. Each question has **5 marks**.

15.Polygenic inheritance

15. Factors that alter allelic frequencies
16. Hardy- Weinberg law and its applications
17. Autosomal Dominant inheritance
18. X-linked Recessive inheritance
19. Karyotyping
20. Split gene concept
21. Dosage compensation in *Drosophila* (5×5=25)

Part C

Answer **any two** questions. Each question has **15 marks**.

22. Give an account of various types of techniques in study of chromosomes

23. Give a detailed account of various types of gene interactions

24. Write an essay on Model organisms in Genetic studies

25. What are transposons? Elaborate on various types of transposons. **(15x 2=30 marks)**

ST. BERCHMAN'S COLLEGE CHANGANASSERRY (Autonomous)
M.Sc. Biotechnology Examination (Model question paper)
Second Semester
BMBT208: METABOLISM AND ENZYMOLOGY

Time : 3 Hrs **Max Marks: 75**

PART A

Write Notes on any ten. Each question carries 2 marks

1. Michaelis-Menten constant
2. Turnover number
3. Co-enzymes
4. ATP synthase
5. Zymogens
6. Lactate dehydrogenase
7. Specific activity of enzymes
8. Oxidoreductases
9. Isoenzymes
10. Katal
11. Bisubstrate reactions
12. Creatine kinase
13. Allostery
14. Pyruvate dehydrogenase complex **(2x10 = 20 Marks)**

PART B

Write short essay on any five. Each question carries 5 marks

15. Active site of an enzyme
16. Multienzyme complex
17. Urea cycle
18. Substrate level phosphorylation
19. Industrial application of enzymes
20. Glycogenolysis
21. Competitive inhibition
22. Role of hormones in glycogen metabolism **(5 x 5 =25 Marks)**

PART C

III. Answer any two in detail. Each question carries 15 marks

23. Explain the process of cholesterol biosynthesis. Mention the role of fatty acid synthase complex in the process.

24. What is rate of a reaction? Describe the various factors that affect the velocity of an enzyme-catalysed reaction.
25. Explain allosteric regulation of enzymes with a suitable example.
26. Describe the steps involved in TCA cycle. **(15x 2=30 marks)**

SEMESTER III

BMBT309: BIOPROCESS TECHNOLOGY

Total Hours: 72 **Credit: 4**

Objective: The course aims to provide an understanding of the principles and application of fermentation technology and the principles of biochemical engineering in large scale cultivation of microorganism for production of important products.

Outcome: Students gain knowledge about the various principles involved in instrumentation and control of bioprocess for production of important products.

Module 1 Introduction to fermentation technology (12hrs)

Introduction to fermentation processes: The range and components. Media for industrial fermentation- Media sterilization. Solid state, submerged fermentations, Aerobic/anaerobic fermentations. Isolation, preservation and maintenance of industrial microorganisms. Applications of genetic engineering for strain improvement.

Module 2 Bioreactor – design and types (8hrs)

Bioreactor parts, function of each parts, probes, valves, agitators, aerators, baffles, types of bioreactors: CSTR, pneumatically driven fermentors, airlift fermentor, packed bedreactor, fluidized bed reactor.

Module 3 Bioprocess control and monitoring variables (10hrs)

Reactor performance, oxygen transfer in reactor system, Resistances against oxygen transfer, KLa, Reynold's number, types of fluids. Instrumentation of bioreactor online and offline control. pH probe, temperature probe, DO probe, tachometer, load cells. Control of Bioreactor.

Module 4 Microbial growth kinetics (14hrs)

Batch culture, specific growth rate, substrate saturation constant, yield coefficient, Monod kinetics, substrate affinity, continuous culture, Dilution rate, washing out, fed batch culture maintenance coefficient, product yield (solid state, submerged fermentations).

Module 5 Production strategies for industrial products (20hrs)

Primary metabolites, secondary metabolites. Fermentative production of alcohol, acetone, butanol, citric acid, acetic acid, lactic acid, amino acids, vitamins. Antibiotics-penicillin, streptomycin, cephalosporin, tetracycline. Microbial production of enzymes-amylase, protease, cellulose, pectinase, SCP production. Bread manufacturing, beer manufacturing,

cheese manufacturing, rennet preparation, fermented dairy products and production of distilled beverages- beer, wine and whiskey.

Module 6 Down-stream processing (8hrs)

Downstream processing filtration, centrifugation, cell disruption, liquid/liquid extraction, dialysis, purification, drying, packing and labelling.

References

1. P.F. Stanbury, A Whitaker and S.J. Hall (2008) Principles of Fermentation Technology, Elsevier
2. P.T. Kalichelvan and I Arul Pandi, (2009) Bioprocess Technology, MJP Publishers, Chennai.
3. M. Shuler & F. Kargi (2002) Bioprocess Engineering, Prentice Hall (I) Ltd., N. Delhi.
4. Antan Moser and Philip Manor (1998) Bioprocess Technology- Kinetics and reactors, Springer
5. E.M.T. Mansi, C.F.A. Bryce, A.L. Dmain, A.R. Alliman (2009) Fermentation Microbiology and Biotechnology, Taylor and Francis. New York
6. Murray Mor. Young (2011) Comprehensive Biotechnology. Second edition, Elsevier, (Editor in chief). ISBN-978-0-08-088504-9
7. Cassida L.E. John (1968) Industrial Microbiology Wiley and Sons Publishers

BMBT310: RECOMBINANT DNA TECHNOLOGY

Total Hours: 72 **Credit: 4**

Objective: The objective of the course is to familiarize the student with the basic concepts in genetic engineering. It helps the students to understand how the principles of molecular biology have been used to develop techniques in recombinant DNA technology. At the end of the course, the student will have enough background of recombinant DNA technology essential for taking up projects in the field of Biotechnology.

Outcome: This paper will equip the student with all the basic rDNA methods and protocols. Modern Biotechnology relies on rDNA technology. The students will be able to find a job in R&D laboratories/industries where rDNA works are being done.

Module 1 Introduction to recombinant DNA technology (12hrs)

History. Isolation of genetic material, Enzymes for *in vitro* manipulation – site specific recombinases, thermophilic polymerases, topoisomerases, Restriction Endonucleases, Kinases, Phosphatases, DNA Polymerases, Ligases, Terminal Transferases, Modification of Ends -Adapters, Linkers, Homopolymer Tailing. Genomic and cDNA library

Module 2 Cloning vectors (14hrs)

Plasmids- desirable properties, *E. coli* based vectors, pBR322, pSC, pUC, M13 vectors, Bacteriophage based vectors- λgt, λ EMBL, λ ZAP, λ FIST, λ DASH, Cosmids, Phasmid , Phagemids with special reference to pBluescript, ,pLITMUS, pGEM3Z, pEMBL, Gateway Cloning, TA cloning, Shuttle Vectors pCAMBIA, pCDNA. Vectors for Yeast - (YEP, YIP, YRP, YCP, YAC). Artificial Chromosomes- BAC, PAC, Viral vectors and their applications, Ti plasmid.

Module 3 Gene transfer, screening and selection methods (6hrs)

Gene transfer in prokaryotes and eukaryotes, Chemical transfection: Calcium phosphate mediated, Polyplexes mediated, Liposomes and lipoplexes mediated. Electroporation, Biolistics. Selection of recombinants- Blue white screening, Antibiotic resistance.

Module 4 Expression systems (10hrs)

Expression Vectors– Prokaryotes (Bacteria) and Eukaryotes (Yeast, Mammalian and, Insect cell lines).Maximizing protein expression in Bacteria, fungi and animal cells – Promoters, and reporter systems. Mammalian expression vectors, Fusion tagged expression system- FLAG, MYC and HIS tag for solubilisation and protein purification, Reporter Assay, studying the translation product- hybrid arrest and hybrid release translations. Inducible expression system and control of transgene expression through naturally inducible promoters

– lac and tet. Steroid hormones as heterologous inducers. Chemically induced dimerisation (CID) as inducible transgene regulation. Site specific recombination for efficient gene targeting.

Module 5 Molecular techniques in biotechnology (10hrs)

Blotting techniques: Southern, Northern, South Western. PCR types and applications, DNA foot printing, finger printing, gel shift analysis, DNA microarray, Molecular markersRFLP, RAPD,AFLP, Sequence-Tagged sites(STS); Polymorphic Sequence-Tagged sites: VNTRs-Mini and Microsatellite DNAs, Unique Sequence-Tagged Sites, chromosome walking, chromosome jumping. DNA sequencing, Site directed Mutagenesis: methods

Module 6 Applications of recombinant DNA technology (13hrs)

Recombinant hormones, Gene therapy, Metabolite engineering, imparting new agronomic traits to plants-resistance to abiotic and biotic stress, improving quality and quantity. Gene Silencing, RNA interference, antisense therapy, Gene Knockout, Gene Knock in, animal pharming, Nuclear transfer technology, nanoparticles for labeling, delivery of drugs and DNA, RNA. Bioethics: laws, possible dangers to society or nature.

Module 7 Gene transfer in plants (7hrs)

Agrobacterium mediated DNA transfer. Basis of tumour formation; Hairy root; Features and Use of Ti and Ri plasmids; Mechanisms of DNA transfer; Role of virulence genes; triparental mating, Binary vectors; Use of 35S and other promoters; Genetic markers;reporter genes; Reporter gene with introns Methods of nuclear transformation; Multiple gene transfers, Vector-less or direct DNA transfer, Transformation of monocots, Transgene stability and gene silencing.

References

1. Sandy B. Primrose, Richard Twyman, Bob Old (2001) Principles of gene manipulation, Edns 5th, 6th and 7th,Blackwell Scientific publishers.
2. Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten (2009) Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, DC: ASM Press, Washington.
3. Jeremy W. Dale, Malcolm von Schantz, Nick Plant, Nicholas Plant (2012) From Genes to Genomes: Concepts and Applications of DNA Technology, 3rd Edition, John Wiley & Sons, Ltd.
4. T A Brown (2016) Gene Cloning and DNA Analysis: An Introduction, 7th Edition, Wiley-Blackwell.

5. Susan R. Barnum (2005) Biotechnology: an introduction, 2nd Edition, Belmont, CA Thomson Brooks/Cole.
6. Michael R. Green, Joseph Sambrook (2012) Molecular Cloning: A laboratory Manual, 4th edition, Cold Spring Harbor Laboratory Press.
7. David A. Micklos, Greg A. Freyer, (1999) DNA Science: A First Course in Recombinant DNA Technology, Cold Spring Harbor Laboratory Press, U.S.
8. Tom Strachan, Andrew Read,(2010)Human Molecular Genetics**,** 4 edition, Garland Science, Taylor and Francis Group, CRC Press.

BMBT311: PLANT AND ANIMAL BIOTECHNOLOGY

Total Hours: 54 **Credit: 3**

Objective: To acquaint students with Techniques of Plant and Animal Tissue Culture

Outcome: Students will know how cell culture can be used for *in vitro* studies and commercial applications.

Module 1 Basics of animal cell culture **(12hrs)**

Animal cell; History of animal cell culture; Laboratory setup and equipment; Types of cell culture media, Selection of media, media constituents, CO_2& bicarbonate, buffering, Balanced salt solution, cell culture vessels; Preparation and sterilization of cell culture media, Different culture techniques, Secondary culture, Disaggregation of tissue, Trypsinization; cell separation, Continuous cell lines, Passaging number; characteristics of animal cells cultures; Maintenance of cell Lines, Suspension culture; Organ culture and Histotypic cultures; Embryonic and Adult stem cell culture

Module 2 Transgenics and application of animal cell culture **(12hrs)**

Transfection and Transformation of cell, Vectors for animal cells SV40, Adenovirus vectors, Baculovirus, lenti virus, poxyvirus, Measurement of viability & cytotoxicity; Cell cloning and selection; Cell synchronization; Application of cell culture technology in production of human and animal vaccines and pharmaceutical proteins. Hybridoma technology and its application; Three dimensional culture and tissue engineering. Transgenesis, transgenic mice, fish, cattle. Cryopreservation and Germplasm storage; Application of animal cell culture for in vitro testing of drugs and testing of toxicity of environmental pollutants; Animal Cell culture for the production of Biopharmaceuticals.

Module 3 Plant tissue culture **(15hrs)**

Conventional plant breeding. Introduction to cell and tissue culture; Requirements of tissue culture lab, Tissue culture media: Composition and Preparation. Sterilization and agents of sterilization used in tissue culture labs. Initiation and maintenance of callus and suspension cultures. Shoot tip culture; micropropagation, Rapid clonal propagation and production of virus-free plants. Embryo culture and embryo rescue; Single cell clones. Organogenesis; Somatic embryogenesis; Anther, pollen and ovary culture for production of haploid plants and homozygous lines. triploid production, Transfer and establishment of whole plants in soil (acclimatization and Hardening).Protoplast isolation, culture and fusion; Selection of hybrid cells and regeneration of hybrid plants; Symmetric and asymmetric hybrids, cybrids.

Chloroplast transformation, Sexual incompatibility, Slow growth cultures and DNA banking for germplasm conservation.

Module 4 Transgenics in crop improvement (15hrs)

Application of plant transformation for productivity and performance Herbicide resistance, insect resistance, Bt genes, Non Bt like protease inhibitors, alpha amylase inhibitor, virus resistance, coat protein mediated disease resistance, disease resistance, RIP, antifungal proteins, thionins, PR proteins, nematode resistance, abiotic stress resistance. marker aided breeding –an introduction – Advantages, Metabolic engineering and industrial products – Plant secondary metabolites.

References

1. R. Ian Freshney (2010) Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, Sixth Edition, John Wiley & Sons, Inc.
2. John Masters (2000) Animal Cell Culture: A Practical Approach, Third Edition, OUP Oxford.
3. Hammond, J., McGarvey, P., Yusibov, V. (2000) Plant Biotechnology: New Products and Applications, Springer Verlag.
4. S. H. Mantell, J. A. Matthews, R. A. McKee (1985) Principles of plant biotechnology: An introduction to genetic engineering in plants, Blackwell Science Inc.
5. Indra K. Vasil (2012) Cell Culture and Somatic Cell Genetics of Plants, Volume 5: Phytochemicals in Plant Cell Cultures, Academic Press.
6. R. Sasidhara (2006) Animal Biotechnology MJP publishers-Chennai.
7. M K Razdan (2003) An introduction to plant tissue culture, Science publishers.
8. P K Gupta (2005) Elements of biotechnology, Rastogi Publications.
9. Henry RJ (1997) Practical applications of plant molecular biology, Chapman & Hall.
10. H S Chawla HS (2002) Biotechnology in crop improvement, Science Publishers.
11. B. C. Currell, R.C.E. Van Dam Mieras, R.C.E. Van dam Mieras (1993) In Vitro Cultivation of Animal Cells, Butterworth-Heinemann Ltd.
12. L.A. Anderson, J. Berlin,C.A. Lambe, M. Misawa ,J.D. Phillipson ,M.F. Roberts, A. Rosevear, F. Sasse, (1985) Plant Cell Culture (Advances in Biochemical Engineering/Biotechnology) Springer.

BMBT312: ENVIRONMENTAL BIOTECHNOLOGY

Total Hours: 72 **Credit: 4**

Objective: The objective of this course is to give students proper knowledge about arising environmental problems and utilization of biotechnological methods to improve environmental quality. These improvements include treatment of contaminated waters and wastewaters, clean up of industrial waste streams, and remediation of soils contaminated with hazardous and toxic chemicals. Moreover students get a proper idea about new technologies that are constantly introduced that address very contemporary problems such as detoxification of hazardous chemicals, shortage of fuel environmental biomonitoring, and microbial genetic engineering for bioremediation of air, water, and soil.

Outcome: At the end of the course, the students will have sufficient scientific understanding of different types of biotechnological methods to improve environment value and new techniques used in Environmental Biotechnology.

Module 1 Biogeochemical cycles, biodegradation and bioremediation (12hrs)

Biogeochemical cycles, Biological Nitrogen fixation- molecular mechanism of Nitrogen fixation in root nodules, Non symbiotic fixation- Clostridium sp Chemistry of organic and inorganic chemicals polluting Environment (air, water and soil). Xenobiotics, biological impacts of polychlorinated biphenyls and dioxans, synthetic polymers, alkylbenzylsulphonates, hydrocarbons, chlorinated pesticides, heavy metals. Biomagnification of recalcitrant molecules. Concept of Microbial infallibility, biodegradation, biosorption, Biosurfactants, biofilms in the bioremediation of xenobiotics, petroleum hydrocarbons, pesticides and heavy metals, evolution of biodegradative pathways.

Module 2 Environmental pollution (12hrs)

Environmental Pollution; Types, Detection and Measurement of Pollutants; Environmental monitoring techniques Water Pollution: sources, measurement and management; Characterization of waste water-Chemical oxygen demand(COD), Biological oxygen demand(BOD),Total organic carbon, Nitrogen contents, suspended solids, Total heterotrophic bacterial population. Bacteriological analysis of drinking water-presumptive, completed and confirmed test. Global environmental problems: Ozone depletion, UV-B and greenhouse gases.

Module 3 Wastewater treatment (12hrs)

Waste Water Treatment systems: primary, secondary and tertiary treatments; Disinfection, Chlorination, Chlorination derived byproducts, Biological Treatment Processes, Biochemistry

and Microbiology of Aerobic and Anaerobic Treatment, Bioreactors for waste water treatment, Disinfection and Disposal. Trickling filter process, Rotating Biological contactor, UASB, Submerged aerobic filters, Fluidized Bed Reactors, Packed Bed reactor, Oxidation lagoons. Activated sludge process, different stages, types.

Module 4 Sludge and solid waste treatment (14hrs)

Types of Industrial Effluents, Treatment of Typical Industrial Effluents: Dairy, Distillery, Sugar, and Antibiotic Industries. Solid waste- types, problems, characterization and sorting of wastes. Management of municipal, biomedical and agricultural solid waste. Land fill. Composting- stages in composting, types of composting, Vermicomposting.

Module 5 Monitoring and control of pollutants (13hrs)

Pollution monitoring: chemical, biological and molecular methods; Environmental impact assessment. Environmental Pollution control: concepts of bioaugmentation, biostimulation. Biofouling, Bioleaching. Environment friendly technologies: Biosurfactants, biofertilizers, biopesticides, microbially enhanced oil recovery, resource management, integrated waste management; production of biomass, Methanogenesis- stages in anaerobic digestion, methanogens, anaerobic reactors, biogas and biofuel from waste.

Module 6 IPR, biodiversity and biosafety (9 hrs)

Biodiversity and its conservation, GMOs and Biosafety-laws and concerns at different levels(individual, Institution, Society).IPR forms, IPR in India, Patents, process of patenting, Indian and International agencies involved in patenting, GATT. GLP-Good laboratory practices, GMP-Good manufacturing practices.

References

1. Christopher. F Forster, D.A. John Wase, (1987) Environmental Biotechnology, Ellis Harwood.
2. Murray Mor. Young (2011) (Editor in chief). Comprehensive Biotechnology. Second edition, Elsevier ISBN-978-0-08-088504-9
3. Gabriel Bitton, (2005) Wastewater Microbiology, John Wiley and Sons, Wiley series in Ecological and Applied Microbiology.
4. Atlas and Bartha, (1989) Microbial Ecology- Fundamentals and Applications. Pearson Education, Benjamin Cummings publishing company Inc. New Jersey.
5. Wang, L.K., Ivanov V. Tayi, J.H and Hung Y.T (2010), Environmental Biotechnology, Series in Handbook of EnvironmentalEngineering.Vol.10 Humana Press.

PRACTICAL

BMBT3P03: LABORATORY COURSE - III

Total Hours: 180 **Credit: 4**

Bioprocess Technology/Animal and Plant Biotechnology/Environmental Biotechnology

- Bacteriological examination of water. MPN Method
- Bacteriological examination of food and milk sample
- Fermentative production of wine and estimation of alcohol content
- Fermentative production through Solid state fermentation
- Immobilisation of microbial cells for enzyme production
- Estimation of COD
- Estimation of BOD
- Bioreactor studies for waste management
- Biogas production
- Composting techniques
- Mushroom cultivation
- Fermentative production of industrially useful enzyme
- Plant tissue culture techniques
- Surface sterilization
- Callus culture
- Anther culture
- Embryo culture
- Protoplast isolation
- Somatic Hybridization

Model Question Papers

ST BERCHMANS COLLEGE CHANGANASSERRY (Autonomous)
M.Sc. Biotechnology Examination (Model question paper)
Third Semester
BMBT309: BIOPROCESS TECHNOLOGY

Time : 3 Hrs Marks: 75

PART A

I. Write Notes on any ten. Each question carries 2 marks

1. Fed batch culture
2. Sparger
3. Air lift fermentor
4. Reynold's Number
5. Thermal death time
6. Antifoams
7. Load cells
8. Secondary screening
9. Rennet
10. KLa
11. Media for industrial fermentation
12. Agitator
13. Submerged fermentation

14.Airlift fermentor

(2x10=20 marks)

PART B

II. Write short essay on any five. Each question carries 5 marks

15. Solid state fermentation
16. Factors affecting KLa
17. Down stream processing
18. Strain improvement
19. Types of fluids
20. Monod Kinetics
21. Microbial production of pectinases
22. Describe the methods of Control of bioreactors **(5x5=25 marks)**

PART C

III. Answer any two in detail. Each question carries 15 marks

23. Describe the Design of a typical Fermenter.
24. Elaborate on role of microbes in production of antibiotics with an example.
25. Discuss Fermented milk products and their nutritional value and safety aspects.
26. Describe the methods for isolation, preservation and maintenance of industrial microorganisms.

(15x 2=30 marks)

ST BERCHMANS COLLEGE CHANGANASSERRY (Autonomous)

M.Sc. Biotechnology Examination (Model question paper)

Third Semester

BMBT310: RECOMBINANT DNA TECHNOLOGY

Time : 3 Hrs **Max Marks: 75**

PART A

I. Write Notes on any ten. Each question carries 2 marks

1. RNaseH
2. Restriction endonucleases
3. Cosmids
4. Ti plasmid
5. Biolistics
6. cDNA library.
7. Knockout mice
8. VNTRs
9. Shuttle vectors
10. Sequence-Tagged sites
11. Linkers
12. Animal pharming
13. Adapters
14. Blue white screening **(2x10=20 marks)**

PART B

II. Write short essay on any five. Each question carries 5 marks

15. Site – Specific mutagenesis
16. RFLP
17. Chromosome walking
18. Blunt end ligation and cohesive end ligation
19. Characters of ideal cloning vectors
20. Agrobacterium mediated gene transfer to plants
21. BAC and YAC
22. Reporter genes **(5 x 5 =25 Marks)**

PART C

III. Answer any two in detail. Each question carries 15 marks

23. Methods for introduction of recombinant DNA into host cells

24. Applications of recombinant DNA technology.
25. Enzymes used in recombinant DNA technology
26. PCR and any four variants of the technique. Give its applications

(15x 2=30 marks)

ST BERCHMANS COLLEGE CHANGANASSERRY (Autonomous)

M.Sc. Biotechnology Examination (Model question paper)

Third Semester

BMBT311: PLANT AND ANIMAL BIOTECHNOLOGY

Time 3 hrs **Max Marks: 75**

PART A

I. Write Notes on any ten. Each question carries 2 marks

1. Primary cell culture
2. Totipotency
3. Cryopreservation
4. Synthetic media for animal cell culture
5. Surface sterilization
6. Somaclonal variation
7. Binary vector
8. Continuous cell lines
9. Trypsinization
10. Somatic embryogenesis
11. Anther culture
12. Cybrids
13. Meristem culture
14. Virus indexing

(2 x 10 =20 Marks)

PART B

II. Write short essay on any five. Each question carries 5 marks

15. Explain the kinetics of growth in cultured animal cells
16. Briefly explain the process of cell cloning and selection process
17. Different methods for production of somatic hybrids
18. In vitro production of haploids and triploids
19. Elaborate various methods employed in the preservation of germplasm
20. Production of virus-free plants
21. Applications of animal cell culture
22. Describe in detail the Principles and method of preservation of animal cells.

(5 x 5 =25 Marks)

PART C

III. Answer any two in detail. Each question carries 15 marks

23. Describe the points to be considered during the designing of a tissue culture lab
24. Gene transfer methods in animal cells
25. What are the applications of plant tissue culture? Describe in detail different steps in micropropagation of any one plant species.
26. What is the significance of transgenic plants? Describe vector mediated gene transfer in plants, citing few success stories

(15 x 2 =30 Marks)

ST BERCHMANS COLLEGE CHANGANASSERRY (Autonomous)
M.Sc. Biotechnology Examination (Model question paper)
Third Semester
BMBT312: ENVIRONMENTAL BIOTECHNOLOGY

Time : 3 Hrs Marks: 75

PART A

I. Write Notes on any ten. Each question carries 2 marks

1. UASB
2. Significance of Biological oxygen demand of water.
3. Bt toxin
4. Microbial consortium in biodegradation
5. Biofouling
6. Mycorrhiza
7. Microbes for enhancing soil fertility
8. Ozone depletion
9. Biosurfactants
10. IPR forms
11. Good manufacturing practices
12. Methanogenesis,
13. Vermicomposting.
14. Xenobiotics

(10 X2=20)

PART B

II Write Short Essay on Any Five.Each question carries 2 marks

15. Biosurfactants
16. Microbes used in bioleaching
17. Steps for disinfection of water
18. Biofilm formation & significance
19. Production of Bacterial biofertilizers
20. Stages of composting process. Give an account of activated sludge treatment.
21. Bacteriological analysis of drinking water
22. Mechanism of Biogas production by microbes (5x5= 25)

PART C

III. Answer Any Three in Detail. Each question carries 15 marks

23. Elaborate on the mechanism & genetics of biological nitrogen fixation. Explain Root nodulation.
24. Give in details the methods and strategies of Bioremediation.
25. What are Xenobiotic compounds? Give examples What are the mechanisms behind biological degradation of hydrocarbons and xenobiotic compounds.
26. Explain in detail about aerobic and anaerobic strategies used in the treatment of waste water (15x2= 30)

SEMESTER IV

ELECTIVE COURSES

BMBT4E01: BIOTECHNOLOGY AND FORENSIC ANALYSIS

Total Hours: 90 **Credit: 4**

Objective: The course ensure students to understand the applications of biotechnology tools in forensic analysis.

Outcome: After studying this course, student should be able to demonstrate an understanding of how forensic scientists operate and use scientific evidence in a legal context. It develop professional, ethical graduates whose competence in problem-solving, legal analysis and application, quantitative reasoning, investigation and scientific laboratory procedures can be applied to immediate employment or advanced study.

Module 1 Introduction to forensic analysis **(15hrs)**

Determination of human and animal origin from bones, hair, flesh, nails, skin, teeth body tissue, fluids/ stains viz. blood, menstrual blood, semen, saliva, sweat, tear, pus, vomit, etc., through immunodiffusion and immuno - electrophoresis, cross reactivity among closely related species. Individualization of blood stains: Determination of blood groups, sex age and racial origin from dried bloodstains

Module 2 Immunological methods in forensic analysis **(20hrs)**

Immunoglobulin- types, physico-chemical properties and function, raising of anti-sera, Lectins - their forensic significance. Buffers and serological reagents, methods of sterilization employed for serological work .Composition of blood, Formation of blood, Blood groups – history, biochemistry and genetics of ABO, Rh, Mn and other systems. Methods of ABO blood grouping (absorption-inhibition, mixed agglutination and absorption elution) from blood stains and other body fluids/stains viz. menstrual blood, semen, saliva, sweat, tear, pus, vomit, hair, bone, nail etc., blood group specific ABH substances. Secretors and non-secretors. Blood groups that make racial distinctions. Lewis antigen, Bombay Blood groups. HLA antigens and HLA typing. Role of sero-genetic markers in individualization and paternity disputes. Pitfalls in red cell typing.

Module 3 Enzyme technology in forensic analysis (10 hrs)

Red cell enzymes : Genetics , polymorphism and typing of PGM, GLO-I, ESD, EAP, AK, ADA etc. and their forensic significance. Serum proteins: Genetics, polymorphism and typing of - Hb, HP, Tf, Bf, C3 etc. and their forensic significance.

Module 4 Applications of biotechnology in forensic science (20hrs)

Concept of sequence variation - VNsTR, STRs, Mini STRs , SNPs. Detection techniques - RFLP, PCR amplifications, Amp-FLP, sequence polymorphism, Y-STR, Mitochondrial DNA. Evaluation of results, frequency estimate calculations and interpretation, Allele frequency determination, Match probability – Database, Quality control, Certification and Accreditation.

Module 5 Genetic markers (25hrs)

History of DNA profiling applications in disputed paternity cases, child swapping, missing person's identity, civil immigration, veterinary , wild life and agriculture cases . legal perspectives – legal standards for admissibility of DNA profiling – procedural & ethical concerns, status of development of DNA profiling in India& abroad. Limitations of DNA profiling. Population databases of DNA markers –STRs, Mini STRs, SNPs. New & Future technologies: Analysis of SNP, DNA chip technology- Microarrays Cell free DNA , Synthetic DNA.

References

1. Rudin, Norah (2002); An Introduction to Forensic DNA Analysis, CRC Leviw Publishers
2. Kobiinsky, Lawrence; (2005) DNA, John Wiley & Sons
3. Newton, David E.; DNA (2010) Evidence and Forensic Science, Viva books private limited
4. Kirby, Lorne; (1992) DNA fingerprinting, W H Freeman and Co
5. T. Burke, Terry ;(1991) DNA Fingerprinting: Approaches and applications.,Birkhauser Verlage
6. Singh, Yashpal ;(2006) DNA tests in Criminal Investigation Trial & Paternity Disputes, Alia Law Agency
7. J. Thomas Mcclintock ;(2008) Forensic DNA analysis, Lewis Publications
8. Boorman, Kathleen E, Churchill; (1977) Blood group serology Livingstone

BMBT4E02: GENOMICS, PROTEOMICS AND NANOTECHNOLOGY

Total Hours: 90 **Credit: 4**

Objectives: The course aims to appraise the students to basic and high throughput techniques in Genomics, Proteomics and Nanotechnology and their applications.

Outcome: On the completion of the course the student will be able to infer the basic concepts of genomics, proteomics and nanotechnology and they can suggest and outline solution to theoretical and experimental problems in Genomics and Proteomics fields.

Module 1 Genomics **(10hrs)**

Overview: Genomes of Bacteria, Archaea, and Eucarya; Genome and topology; chromatin, supercoiling and packaging; Study of genomes- Mapping; Genetic and Physical mapping, Single Nucleotide Polymorphism and RFLP's. Human Genome project.

Module 2 Databases and alignment **(25hrs)**

Biological information of macromolecules. The central dogma of molecular biology. Introduction to Databases, Types of Databases- Flat file database and Relational database. NCBI, Genome and organism specific database-retrieval, Entrez, SRS; Similarity search, amino acid substitution matrices- FASTA, BLAST. Various types of protein family-protein domain families.

Module 3 Sequence annotation **(20hrs)**

Gene finding and annotation; sequence annotation and bioinformatics tools for genomics and genome comparison; analyzing gene expression-DNA microarray-design, analysis and visualization of data. Application of DNA microarrays in prokaryotes, Microarray data analysis. Prediction tools, Bioinformatics in Drug discovery. ESTs.

Module 4 Proteomics **(25hrs)**

Protein structure and function- Methods to quantitative proteins; densitometry and classical methods; two dimensional gel electrophoresis, mass spectrometry - ESI, MS and MALDI; protein expression profiling, protein - protein interactions; RNA interference, Genetic analysis of biomedical diagnostics. Application of bioinformatics for development of vaccine.

Module 5 Nanoscience **(10hrs)**

Nanotechnology: Basic concepts and introduction; Nanomechanics- Nanotribology; Scanning probe microscopy; nanomaterials and its handling; nanobots and nanofuture, nano-fying Electronics, nanofibres and nanotubes.

References

1. Brown, T.A., (2002) Genomes. Wiley - Lis Publications
2. Mount David W. (2002). Bioinformatics Sequence and Genome Analysis. Cold Spring Harbor Lab Press, CSH New York
3. Stephen Misener and S. A. Krawetz (2000).Bioinformatics Methods and Protocols. Humana Press.
4. Rastogi, S.C, N. Mendiratta, P. Rastogi (2004) Bioinformatics Methods and Applications. Prentice Hall of India
5. Bharat Bhushan., (2002) Nanotribology and Nanomechanics - An introduction Ist edition, Springer.

BMBT4E03: CANCER BIOLOGY

Total Hours: 90 **Credit: 4**

Objective: The course ensure students to understand the mechanism and regulation of cancer.

Outcome: By the end of the course the student will be able to gain an understanding of the basic concepts of cancer and treatment strategies.

Module 1 Fundamentals of cancer biology (5hrs)

Introduction to Cancer Biology, Characteristics of cancer cells, Different forms of cancers, Hereditary and Sporadic forms of cancer

Module 2 Principles of carcinogenesis (10hrs)

Theory of Carcinogenesis (Multi-hit Model), Chemical carcinogenesis, principles of physical carcinogenesis, X-ray radiation-mechanisms of radiation carcinogenesis. Viral carcinogenesis. Diet and cancer.

Module 3 Principles of molecular cell biology of cancer (25hrs)

Genetic Basis of cancer: Oncogenes (identification of oncogenes, retroviruses and oncogenes, detection of oncogenes, Oncogenes/proto oncogene activity), Tumor suppressor genes- p53, Rb, BRCA1,BRCA2 (modulation of cell cycle in cancer), Care-taker genes; Signal targets and cancer, activation of kinases; Growth factors related to transformation, Developmental Signalling Pathways associated with cancer.

Telomerases and cancer

Module 4 Principles of cancer metastasis (10hrs)

Clinical significances of invasion, Metastatic cascade, Basement membrane disruption, proteinase and tumor cell invasion. Extra-cellular matrix and cell adhesion molecules

Module 5 Cancer and the immune system (20hrs)

Tumor Antigens, Immune Response to Tumours (immune surveillance theory), Tumour Evasion of the Immune System, Cancer Immunotherapy (Enhancing immunity against tumours, cytokines, monoclonal antibodies and immunotoxins)

Module 6 Cancer detection and treatment (20hrs)

Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer, prediction of aggressiveness of cancer, advances in cancer detection. Different forms of therapy, chemotherapy, radiation therapy, immunotherapy. Use of signal targets towards therapy of cancer. Gene therapy.

References

1. Maly B.W.J (1987) “Virology A Practical Approach”, IRLl Press, Oxford.
2. Dunmock N.J and Primrose S.B (1988) “Introduction to Modern Virology”, Blackwell Scientific Publications, Oxford.
3. David P Clark, Nanette J Pazdernik. (2012)Biotechnology- Applying genetic revolution. Elsevier, New York

BMBT4E04: BIOPHARMACEUTICS AND APPLIED NANOTECHNOLOGY

Total Hours: 90 **Credit: 4**

Objective: This course offers the students comprehensive information and insights in pharmaceutical biotechnology, development of biopharmaceuticals and applications of nanotechnology in pharmaceutical industry.

Outcome :The students will gain an understanding in both scientific knowledge of designing and producing navel biologics, and business challenges in biopharmaceutical companies, including regulatory issues.

Module 1 General pharmacology **(10hrs)**

Introduction of pharmacology, sources of drugs, route of administration, Pharmacodynamics and Pharmacokinetics: absorption, distribution, metabolism and excretion of drugs, GMP

Module 2 Drug discovery **(22hrs)**

Overview of the drug discovery process, Modern methods of drug discovery, Various phases of Drug discovery, Computer aided drug design, Drug Receptor interactions.

Module 3 Biopharmaceutical and novel drug delivery system **(18hrs)**

Various categories of therapeutics like vitamins, antibiotics, hormones and biological, Transdermal delivery system, liposomes and Nanoparticles.

Module 4 Production and characterization of nanoparticles **(20hrs)**

Introduction to Nanoscience Techniques used in Nanobiotechnology: Optical Microscopy, Atomic Force, Microscopy, SEM; Production of nanoparticles: Collision / Coalescence mechanism of primary particle formation, nanoparticles agglomerates & aerogels, Biological production of nanoparticles: fungi, bacteria, yeast and actinomycetes

Module 5 Applications of nanoparticles **(20hrs)**

DNA nanotechnology-structural DNA assembly-Nanopore, Use of nanoparticles as molecular imaging probes, Nano biotechnology for human health: nanoparticles for drug delivery, gene delivery, Understanding the mechanism of macromolecular interactions; Use of nanoparticles as sensors

References

1. Tripathi K.D., (2008) Medical pharmacology , 6th Edition, Jaypee Brothers, Medical Publishers

2. Satoskar R, S., Nirmala, N, R., Bhandarkar, S D., (2015) Pharmacology and therapeutics, 24th Edition, Elsevier
3. Liberman., Lachman, (1981) Pharmaceutical dosage forms: tablets Volume-2, Dekker, M
4. Lachman.(2013).Theory and practice of industrial pharmacy, 4th Edition, CBS
5. Ratner, M., Ratner, D., (2015) Nanobiotechnology- A Gentle Introduction to the next big idea, Prentice Hall

BMBT4E05: IPR, BIOSAFETYANDBIOETHICS

Total Hours: 90 **Credit: 4**

Objective: The course ensure students to introduce students to Intellectual Property Rights and Patenting in biology and re-emphasize the concepts of Biosafety.

Outcome: By the end of the course the student will be able to gain an understanding of the basic concepts of IPR and importance of Biosafety levels in various scenario.

Module 1 Introduction to intellectual property **(15hrs)**

Types of IP: Patents, Trademarks, Trademarks™, Copyright and Related Rights, Domain Names, Industrial Design, Geographical Indications; Classification of patents : Classification of patents in India and Classification of patents by WIPO; International framework for the protection of IP.

Module 2 Patent filing and grant of patent **(25hrs)**

Indian Patent Act 1970; Patent application- forms and guidelines, fee structure, time frames; Filing of a patent application; Precautions before patenting-disclosure/non-disclosure; Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures and costs; Financial assistance for patenting-introduction to existing schemes.

The patentability of microorganisms - IPR and WTO regime - consumer protection and plant genetic resources-GATT and TRIPS, Patenting gene.

Module 3 Biosafety **(20hrs)**

Introduction to Biosafety and Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Good Laboratory Biosafety Practices; Biosafety guidelines - Government of India.

Module 4 National and international regulatory mechanism for GMO **(20hrs)**

Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

Module 5 Bioethics **(10hrs)**

Introduction to Bioethics; Biological Weapons and Their Social and Ethical Implications; NGOs for Bioethics: Public Sector Organizations, Private Sector Organizations and National NGOs.

References

1. P. Narayanan (2001) Intellectual Property Laws, Eastern Law House.
2. DeepaGoel and Shomini Parashar (2013) IPR, Biosafety and Bioethics, Pearson Education India
3. Intellectual Property Law containing Acts and Rules, (2015) Universal Law Publication Company.
4. John E. Smith (1996) Biotechnology, 3rd Ed. Cambridge University Press.
5. Prithipal Singh (2007) An Introduction to Biodiversity, Ane Books India.
6. Meenu Paul (2009) Intellectual Property Laws, Allahabad Law Agency.
7. Nirmal Chandra Pradhan (2008) Basics of Biodiversity, Anmol.
8. Padmanabh Dwivedi; S K Dwivedi and M C Kalita (2007) Biodiversity and Environmental Biotechnology, Scientific.
9. Important Links

http://www.w3.org/IPR/

http://www.wipo.int/portal/index.html.en

http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html

www.patentoffice.nic.in

www.iprlawindia.org/ - 31k - Cached - Similar page

http://www.cbd.int/biosafety/background.shtml

http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm

http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html

BMBT4E06: BIOTECHNOLOGY AND IPR

Total Hours: 90 **Credit: 4**

Objective: The course ensure students to realize the applications and social implications associated with Biotechnology.

Outcome: By the end of the course the student will be able to gain an understanding of the basic concepts of Patents, Trademarks, Copy rights and importance of Biosafety levels at laboratory and industrial scale.

Module 1 GMOs: Concerns and challenges (10hrs)

GM crops- versus organic and traditional crops, global status of GM crops, genetic engineering of Bt brinjal and Bt cotton, advantages and disadvantages of GM foods, Biosafety and environmental safety concerns, Public perceptions, Regulatory bodies of India- RCGM and GEAC.

Module 2 Bioethics (20hrs)

Ethical and legal implications of biotechnology, Human genome project, genetic testing and screening, Gene therapy, edible vaccines, stem cell research, Vaccine trials. Antiviral Drug designing, phases of drug trials, Bioweapons and bioterrorism.

Module 3 Biosafety and risk assessment (28hrs)

Biosafety - definitions - biosafety levels - framework of biosafety regulation in India; Structure and functions of Committees; DBT guidelines on biosafety rules, regulations, guidelines and protocols. Guidelines in conducting research in biology / biotechnology. - Regulations of Genetically modified Organisms in India - Biosafety regulation for transgenic plants and animals - labeling of GM foods. Prevention Food Adulteration Act, Food and Safety Standard Bill and Seed Policy. Rules for the Manufacture and Storage of Hazardous Microorganism and GMO.

Module 4 Introduction to intellectual property (12hrs)

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP. Invention in context of “prior art”; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, India etc.); Analysis and report formation.

Types of patents; Indian Patent Act 1970; Recent Amendments; Patent application- forms and guidelines, fee structure, time frames; Filing of a patent application; Precautions before patenting-disclosure/non-disclosure; Patent application- forms and guidelines, fee structure,

time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures and costs; Financial assistance for patenting-introduction to existing schemes.

Module 5 IPR patents, policies and laws (20hrs)

IPR policy of Government of India, Indian & International Patent laws, Indian Patent Act 1970; Recent Amendments; Financial assistance for patenting-introduction to existing schemes. Role of patents in Biotechnology.

References

1. P. Narayanan (2001) Intellectual Property Laws, Eastern Law House.
2. Rajmohan Joshi (2006) Biosafety and Bioethics, Isha Books.
3. Deepa Goel, Shomini Parashar (2013), IPR, Biosafety and Bioethics, Pearson Education India
4. Meenu Paul (2009) Intellectual Property Laws, Allahabad Law Agency.
5. Intellectual Property Law containing Acts and Rules, (2015) Universal Law Publication Company.
6. John E. Smith (1996), Biotechnology, 3rd Ed. Cambridge University Press.

BMBT4E07: MICROBIAL FOOD SAFETY

Total Hours: 90 **Credit: 4**

Objective: Educating students towards improving food safety and reducing risks and behaviors commonly associated with foodborne illness and outbreaks.

Outcome: The course is structured to provide basic hygiene principles and to train food handlers in the health, industry and education sectors. The course is designed to provide industry-relevant knowledge and skills.

Module 1 Role of microbes in food **(20hrs)**

General concepts of food safety: adulteration, filth, microorganisms, chemical additives and genetically manipulated organisms; Types of microorganisms (yeast, bacteria, molds, viruses) and their possible roles (fermentation, bioreactors, disease, spoilage) in foods; Microbial growth in foods: intrinsic and extrinsic parameters.

Significance of food safety assessments & surveillance; emerging food safety challenges: new pathogens, emerging foodborne diseases, food safety of ready-to-eat (RTE) foods and minimally processed foods and antibiotic resistance.

Module 2 Microbiological hazards in food **(10hrs)**

Foodborne diseases: infections, poisoning, toxico-infections; Sources and transmission of bacteria in foods: human, animal, and environmental reservoirs; cross-contamination; Microbiological hazards: *Clostridium botulinum, Vibrio, Salmonella, Hepatitis A, E. coli* O157:H7,*Campylobacter, Listeria, Bovine Spongiform Encephalopathy*; Fungal Toxins.

Module 3 Control of microbes in food **(10hrs)**

Means of control: food formulations, cooking, preservatives, Hurdle Concept; Food Processing: Irradiation -Packaging - Bioprocessing of meat, fisheries, vegetables, dairy products; enzymes and chemicals used in food processing;

Module 4 Food quality regulations **(22hrs)**

Quality control; case studies on Biotechnology in the evolution of food quality, HFCS (High Fructose Corn Syrup) and mycoproteins. Microbial detection and indicator organisms: approach and techniques; pathogen indicators: indicators of human contamination;

Government regulatory agencies and food policies -Food and Drug Administration, The Centers for Disease Control and Prevention, The Environmental Protection Agency; significance of surveillance; HACCP concepts and risk assessment.

Module 5 Genetically engineered foods **(28hrs)**

GM food: Risks, public perception- facts and myths; labeling of GM food; Bovine Somatotropin in Milk; Chymosin -Lite beer; Transgenic plants-tomato; Methionine-enriched oil; Frost-resistant food; Insect Resistance-*Bacillus thuringiensis* toxin - B.t. maize; Fungal Resistance potatoes; Virus Resistance; Plant Pharmaceuticals -beta -carotene in rice - transgenic "heart-healthy" canola oil; Edible vaccines -Hepatitis B vaccine in maize-Cholera vaccine in potatoes; Transgenic Animals -Growth hormone gene in pigs - alpha-lactalbumin and lactoferrin in milk; Transgenic Fish -Atlantic salmon.

References

1. Potten N.M. (2002) "Food Science" The AVL Publishing Co.
2. Piefzer F.M. (1989)"Food Microbiology" Academic Press.
3. Lindsay (1988) Willis Biotechnology, "Challenges for the flavour and food industries", Elsevier Applied Science.
4. Roger A., Gorden B and John T., (1989) Food Biotechnology.
5. George J.B. (1987)"Basic Food Microbiology", CBS Publishers& Distributors.
6. James M.J (1987)"Modern Food Microbiology", CBS Publishers & Distributors.

BMBT4E08: FOOD BIOTECHNOLOGY

Total Hours: 90 **Credit: 4**

Objectives: This course will provide a broad grounding in concepts, techniques and issues involved in food products and their processing.

Outcomes: Students can identify the conditions under which the important pathogens are commonly inactivated, killed or made harmless in foods . Understand the principles involving food preservation via fermentation processes. Understand the principles that make a food product safe for consumption. Understand the principles and current practices of processing techniques , used of biotechnology in food industry and the effects of processing parameters on product quality.

Module 1 Fermented foods **(20hrs)**

Microorganisms in food production- Bread making, cheese production-process, starter culture, types of cheese, other fermented dairy products- buttermilk, acidophilus milk, yoghurt, butter, paneer, marine fermented foods, koji, tempeh, fermented bevarages- beer and wine.Applications of enzymes in food processing: amylase, protease, lipase, cellulase, hemicellulase, pectinase, pectin lyase, catalase, glycosidase, invertase, glucose oxidase, glucose isomerase

Module 2 Single cell proteins and mushrooms **(10hrs)**

Single cell protein- from bacteria and algae, probiotics, prebiotics, mushroom production, microbial production of vitamins-riboflavin, vitamin c.

Module 3 Genetically engineered foods (**25hrs)**

Food production through biotechnology- Bovine Somatotropin in Milk; Chymosin -Lite beer; Transgenic plants-tomato; Methionine-enriched oil; Frost-resistant food; - Starlink corn, B.t. maize; Fungal Resistant potatoes; Plant Pharmaceuticals, Biopharming -beta -carotene in rice; Edible vaccines -Hepatitis B vaccine in maize-Cholera vaccine in potatoes; HFCS (High Fructose Corn Syrup) and mycoproteins. Growth hormone gene in pigs - alpha-lactalbumin and lactoferrin in milk; Transgenic Fish -Atlantic salmon.

Module 4 Preservation techniques **(20hrs)**

Food preservation:, contamination of milk, Preservation of milk, microbial contamination and spoilage of food, foodborne illness- salmonellosis, listeriosis, botulism, staphylococcal infection, preservation methods: Effect of low temperature, freezing, effect of heat, drying, concentration, fermentation, canning, radiation, chemical preservatives.

Module 5 Food quality regulations **(15hrs)**

Significance of food safety assessments & surveillance GM food: Risks, possible danger to individuals, society or nature, labeling of GM food; Terminator genes, loss of biodiversity Government regulatory agencies and food policies -Food and Drug Administration, The Centers for Disease Control and Prevention, The Environmental Protection Agency; HACCP concepts and risk assessment.

Reference:

1. Currell B,C. (1991) Biotechnological innovations in food processing 1st Edition Butterworth-Heinman
2. Shakuntala, M,N, Shadakshara, S,M., (2007) Food-Facts and Principles II Edition New Age International Pub:
3. Kalaichelvan, P, T., Arul P, (2007) Bioprocess Technology Volume I: MJP Publishers.
4. George J.B.,(1987)"Basic Food Microbiology", CBS Publishers & Distributors
5. Roger A., Gorden B., and John T., (1989)" Food Biotechnology"

BMBT4E09: NEUROBIOCHEMISTRY

Total Hours: 90 **Credit: 4**

Objective: The course focus on aspects of chemical neurobiology and bio-neurochemistry including neurotransmitters and receptors; neuronal diseases and their pharmacological treatment.

Outcome: Upon completion of this course, the student would have acquired knowledge of the basic neurochemistry of the brain. They will be able to apply this knowledge to critical reading of primary literature and to form, express and explain opinions on selected topics on neurotransmitter systems.

Module 1 Neuron **(10hrs)**

Neurocellular anatomy, neural membrane, classification of neuron, nerve fibers, axonal transport, neural growth, neuroglia, nervous system, blood brain barrier, cerebrospinal fluid.

Module 2 Neuronal signaling **(10hrs)**

Membrane potentials, ion channels, recording neuronal signals, ionic basis of resting potential and action potential, propagation of action potential

Module 3 Synaptic transmission **(25hrs)**

Synapse, Electrical synapse transmission, chemical synaptic transmission, Synaptic transmitter release, synaptic potentials, synaptic delay, synaptic plasticity, molecular mechanism of synaptic transmission, myoneural junction

Module 4 Neurotransmitters **(20hrs)**

Chemistry, synthesis, storage, release, receptors and function- acetyl choline, catecholamines, serotonin, histamine, glutamate, asparatate, GABA, glycine, neuropeptides, nitric oxide

Module 5 Neural processing and neurodegenerative disorders **(25hrs)**

Molecular biology of hearing, vision, olfaction and taste. Learning and memory, neurochemical basis of drug abuse, neurodegenerative disorders, Parkinson's disorder, Alzheimer's disorder, Amyotrophic Lateral Sclerosis, Senile Dementia.

References

1. George J. Siegel, Bernard W. Agranoff, R. Wayne Albers, Stephen K. Fisher& Michael D (1999). Uhler Basic Neurochemistry. Molecular, Cellular and Medical aspects:6th ed".Philadelphia: Lippincott-Raven; ISBN-10: 0-397-51820-X
2. John G. Nicholls, A. Robert Martin, Bruce G. Wallace & Paul A. Fuchs (2000). From Neuron to Brain (4th ed.)Published by Sinauer Associates, USA

3. David J. Sidley & Peter R. Stanfield (1996).lon channels. Molecules in Action (1st ed). Cambridge University Press.
4. Gary G. Matthews(2001)Neurobiology Molecules, Cells and System(2nd ed.);published byWiley-Blackwell.**ISBN-13:** 978-0632044962
5. Yadin Dudai, (1989).The Neurobiology of Memory, Concepts, Findings, Trends. Oxford University Press. ISBN: 9780198542292.
6. David J Aidley The physiology of Excitable Cells (2nd ed): Cambridge University Press.ISBN-13**:** 978-0521219136

BMBT4E10: DEVELOPMENTAL BIOLOGY

Total Hours: 90 **Credit: 4**

Objective: Enable students to have a clear understanding of basic concepts of development and also embryonic and postembryonic development in plants and animals

Outcome: Students will gain knowledge on essential aspects of plant and animal development and will be able to use it for further research in the field of life sciences

Module 1 Basic concepts of development (15hrs)

Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development

Module 2 Gametogenesis, fertilization and early development (20hrs)

Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Module 3 Morphogenesis and organogenesis in animals (20hrs)

Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis – vulva formation in *Caenorhabditiselegans*, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.

Module 4 Morphogenesis and organogenesis in plants (20hrs)

Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum*

Module 5 Programmed cell death, aging and senescence (15 hrs)

Necrosis, Apoptosis, caspases, Extrinsic and intrinsic pathway, aging, theories of aging mitochondrial stress, senescence

References

1. Scott F. Gilbert, Developmental Biology, Seventh Edition (2003), Sinauer Associates, Inc., Sunderland, MA,ISBN 0-87893-258-5

2. John Gerhart and Marc Kirschner, Cells, Embryos, and Evolution, (1997), Blackwell Science, ISBN 0-86542-574-4
3. Fred H. Wilt & Sarah C. Hake (2004), Principles of Developmental Biology, , W.W. Norton& Company, Inc., New York, NY,ISBN 0-393-97430-8
4. Sally A. Moody,(1998) Cell Lineage and Fate Determination**,** Academic Press, Inc., ISBN 0-12-505255-3
5. Lewis Wolpert, Rosa Beddington, Thomas Jessell, Peter Lawrence, Elliot Meyerowitz, Jim Smith (2002) Principles of Development, Second Edition, Oxford University Press, ISBN 0-19-924939-3

PRACTICAL

BMBT4P04: LABORATORY COURSE - IV

Total Hours: 180 **Credit: 4**

- DNA isolation
- RNA isolation
- Conjugation
- cDNA preparation
- Competent cell preparation
- Transformation
- Plasmid isolation
- Restriction enzyme digestion
- Ligation
- Screening of recombinants
- Expression and purification of recombinant proteins
- Blotting techniques
- RFLP
- Amplification of selective gene by PCR
- Molecular marker studies: RAPD, SCAR, AFLP, SNP
- Critical Thinking and Analysis: Students should be given scientific papers to read and analyse data and ask questions to check their grasp of the design of experiments and results inferred. This could also be data interpretation problems derived from scientific papers to analyse critical thinking skill of the student.

St Berchmans College

Founded 1922

AUTONOMOUS | College with Potential for Excellence | Reaccredited by NAAC with A Grade

Affiliated to Mahatma Gandhi University, Kottayam, Kerala

Changanassery, Kottayam, Kerala, India-686101