DEPARTMENT OF
BIOCHEMISTRY

Curriculum and Syllabus for Postgraduate Programme in Biochemistry
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 BIOCHEMISTRY

Curriculum and Syllabus for
Postgraduate Programme in
Biochemistry
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

PROGRAMME OBJECTIVES

Biochemistry is the point where chemistry, biology and medicine meets and it deals with the molecular interactions between various intra and inter cellular compartments of living organisms and diseases.

Biochemistry also contributes to protecting the environment, by combating pollution and designing biocompatible products. The genetic engineering of plants has led to advances in agriculture, which include crop improvement and resistance to pest and diseases.

Emphasizing the importance of biochemistry in medicine, it helps in understanding of the cellular and molecular processes involved in both health and disease leading to the development of new treatments. Advances in biochemistry are largely responsible for the breakdown of traditional boundaries between cell biology, medicine, physics and chemistry as their applications become increasingly wide reaching.

Biochemistry provides the foundation of many disciplines, opening up huge potential for future career and placements for the students who successfully completes the degree. It helps in developing the skills needed to investigate both health and disease in biomedical research and hospital laboratory.

To understand physiology and physiopathology at the molecular level; the molecular basis of diagnosis, therapeutics, disease prevention and health promotion.

Become familiar with and understand the basic structures and functions of cells in the human body, applying biomedical concepts and terminology.

Apply biochemical analysis and reasoning in order to solve problems related to physiology and cellular physiopathology.

Learn to use a biochemical approach in the study of cellular functions that will provide an understanding of future advances in the molecular bases of physiology, physiopathology, diagnostics, therapeutics, disease prevention, health promotion and the continuous updating of knowledge.

PROGRAMME OUTCOME

The students are able to apply biochemical analysis and reasoning in order to solve problems related to biochemistry.

To provide an understanding of future advances in the molecular bases of physiology, physiopathology, diagnostics, therapeutics, disease prevention, health promotion and the continuous updating of knowledge.

Course includes 10hrs labs per week.

MEMBERS OF BOARD OF STUDIES

Chairman

Dr. Joe Prasad Mathew

Assistant Professor and Head

Dept. of Zoology

S B College, Changanassery

Dr. Anie Y

Assistant Professor

School of Biosciences

MG University, Kottayam

Dr. Mini S

Head and Associate Professor

Dept. of Biochemistry

University of Kerala

Kariavattom, Trivandrum

Dr. Rejiya C S

Assistant Professor

Dept. of Biochemistry and Industrial Microbiology

Sree Ayyappa College

Eramallikkara.

Dr. Ajith Joy K

Chairman and Managing Director

DDRC SRL Pvt. Ltd

Ernakulam

Mr. Venu Gopal R

Chief Biochemist

Amrita Institute of Medical Science

Kochi

Dr. Lijy Jacob
Assistant professor
Dept. of Botany and Biotechnology
S B College, Changanassery

Mrs. Biby Sara John
Assistant Professor
Dept. of Microbiology & Biochemistry
S B College, Changanassery

Mrs. Ramlath Beegum L
Assistant Professor
Dept. of Microbiology & Biochemistry
S B College, Changanassery

Mrs. Shema Jacob
Assistant Professor
Dept. of Microbiology & Biochemistry
S B College, Changanassery

Ms. Arsha Johns
Assistant Professor
Dept. of Microbiology & Biochemistry
S B College, Changanassery

REGULATIONS FOR 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 ISA are 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,

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.

7. BOARD OF STUDIES AND COURSES

7.1 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.

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

7.3 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.

7.4 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.

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

8. REGISTRATION

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

8.2 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.

8.3 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

9. ADMISSION

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

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

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

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

10. ADMISSION REQUIREMENTS

10.1 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.

11. MARK CUM GRADE CARD

11.1 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

11.2 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.

11.3 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.

12. AWARD OF DEGREE

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

13. 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.

14. GRIEVANCE REDRESS COMMITTEE

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

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

14.3 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.

14.4 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.

15. 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	BMBC101	Biochemistry	4	72	4	25	75	100
	BMBC102	General Microbiology	4	72	4	25	75	100
	BMBC103	Physiology and Biostatistics	4	72	4	25	75	100
	BMBC104	Cell Biology and Genetics	3	54	3	25	75	100
	BMBC1P01	Laboratory Course – I (P)	10	180	4	25	75	100
		Total	**25**	**450**	**19**	**125**	**375**	**500**
Semester II	BMBC205	Molecular Biology and Genetic Engineering	4	72	4	25	75	100
	BMBC206	Immunology	4	72	4	25	75	100
	BMBC207	Biophysics, Bioinstrumentation and Bioinformatics	4	72	4	25	75	100
	BMBC208	Metabolism and Bioenergetics	3	54	3	25	75	100
	BMBC2P02	Laboratory Course - II (P)	10	180	4	25	75	100
		Total	**25**	**450**	**19**	**125**	**375**	**500**
Semester III	BMBC309	Enzymology	4	72	4	25	75	100
	BMBC310	Plant Biochemistry	4	72	4	25	75	100
	BMBC311	Molecular Endocrinology	4	72	4	25	75	100
	BMBC312	Research Methodology	3	54	3	25	75	100
	BMBC3P03	Laboratory Course - III (P)	10	180	4	25	75	100
	BMBC3IN	Industrial training	-	50	1	100	-	100
		Total	**25**	**500**	**20**	**225**	**375**	**600**
Semester IV	BMBC413	Clinical Biochemistry	5	90	4	25	75	100
		Elective Course	5	90	4	25	75	100
		Elective Course	5	90	4	25	75	100
	BMBC4P04	Laboratory Course – IV (P)	10	180	4	25	75	100
	BMBC4PJ	Project	-	-	4	25	75	100
	BMBC4VV	Viva-Voce	-	-	2	-	100	100
		Total	**25**	**450**	**22**	**125**	**475**	**600**
		Grand Total	**-**	**-**	**80**	**600**	**1600**	**2200**

ELECTIVE COURSES

Course Code	Course Title
BMBC4E01	Nutrition in Health and Diseases
BMBC4E02	Environmental Sciences
BMBC4E03	Plant and Animal Cell Culture
BMBC4E04	Biochemical Toxicology

SEMESTER I

BMBC101: BIOCHEMISTRY

Total Hours: 72 **Credit: 4**

Objectives:

- To understand the chemical basis of life in plants and animals.
- To understand the structures, functions and interactions of biological macromolecules, such as proteins, nucleic acids, carbohydrates and lipids, which provide the structure of cells and perform many of the functions associated with life.

Outcome:

- Students will understand how life works in a fundamental way.

Module 1: Buffers, Biological Interaction and Free radicals (8 hrs)

Buffers: physiological buffer. Stabilizing interactions**:** Covalent bonds; Ionic bonds; Disulfide linkages; Non covalent interactions: Van der Waal's, electrostatic, hydrogen bonding, hydrophobic interaction etc. Free radicals in biological systems: Pro oxidants and antioxidants in biological systems.

Module 2: Carbohydrates (20 hrs)

Carbohydrates: Classification, detailed structure and function. Oligosaccharides: glycosidic bonds; classification: glycoproteins (O-linked and N-linked) glycolipids; nature of carbohydrate moiety attached; functions. Polysaccharides: classification – homopolysaccharides (cellulose, starch, chitin, and glycogen), heteropolysaccharides (bacterial peptidoglycans, glycosaminoglycans, hyaluronic acid, 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 3: Lipids (20 hrs)

Lipids: classification, basic structure and functions. Glycerophospholipids: structure and function of phosphatic acid, cardiolipin, phosphatidyl serine, phosphatidyl ethanolamine, phosphatidylglycerol, phosphatidylcholine, phosphatidyl inositol, plasmalogens, CDP-diacylglycerol and lung surfactants. Glycosphingolipids: structure and function of sphingosine, ceramides, sphingomyelins, cerebrosides, globosides, gangliosides and sulfatides. Eicosanoids: prostaglandins, leukotrienes and thromboxanes-chemistry, formation and physiological function. Steroids: Cholesterol and bile acids. Steroids in animal, plant

(brassinosteroids) and microbes- (detailed study not necessary).

Module 4: Amino acids and Proteins (10 hrs)

Amino acids: classification, basic structure and reactions; protein-classification and functions. primary, secondary, tertiary and quaternary structure of proteins w. r. t: globular protein (eg: hemoglobin and myoglobin), fibrous protein (collagen), membrane protein (ATP synthetase). Ramachandran plot. Protein structure and molecular approach to medicine: sickle cell anemia. Protein purification & sequencing: Chemical & Enzymatic methods. Mass Spectrometry.

Module 5: Nucleic Acids (14 hrs)

Structure and function: Types of DNA- A, B and Z. Supercoiling of the DNA molecule-topoisomers and superhelixes. Chromosomal organization of DNA: chromatin, histones and nucleosomes, conformation of chromatin fibers. DNA sequence organization: genes, pseudogenes, extragenic regions (beta globin gene and gene family) duplicated genes. RNA Structure-types of RNA, structure of mRNA, tRNA, rRNA, SiRNA, micro RNA with emphasis on importance of structure to its function; Ribozymes.

References

1. Gilbert, H. F. (2002). *Biochemistry: A Students Survival Guide*. McGraw-Hill, New York.
2. Banerjee, P. K. (2008). *Introduction to Biophysics*. Publishers: S. Chand & Company Ltd.
3. Nelson, D. L. & Cox, M. M. (2004). *Lehninger, Principles of Biochemistry*. 4th Edition. W. H. Freeman.
4. Voet, D. &Voet, J. G. (2004). *Biochemistry*. John Wiley & Sons Inc.
5. Moran, L. A., Horton R. A., Scrimgeour G. & Perry, M. (2011). *Principles of Biochemistry*. 5th Edition. Pearson Publisher.
6. Berg, J. M., Tymoczko, J. L. & Stryer, L. (2012). *Biochemistry*. 7th Edition. W. H. Freeman New York.
7. Rastogi, S. C. (2010). *Biochemistry*. 3rd Edition. Tata McGraw-Hill Education Pvt Ltd., New Delhi.
8. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. & Walter, P. (2008). *Molecular Biology of the Cell*. 5th Edition. Garland Science.
9. Lewin, B. (2008). *Genes IX*. Johns & Bartlett.

10. Watson, J. D. Baker, T. A. & Bell, S. P. (2008). *Molecular Biology of the Gene*. 5th Edition. Dorling Kindersley (India) Pvt Ltd.

11. Dr. J.L. Jain, (2010). *Fundamentals of Biochemistry*.6th Edition. S. Chand & Company Ltd.

BMBC102: GENERAL MICROBIOLOGY

Total Hours: 72 **Credit: 4**

Objectives:

- This focuses on general principles of microbiology, microbial cell structure and function and their growth and metabolism.

Outcome:

- Students will be able to Understand the basic microbial structure and functions of various physiological groups of prokaryotes and eukaryotes and also learn the theory and practical skills in microscopy handling and staining techniques
- Know various Culture media and their applications and understand various physical and chemical means of sterilization and also learn various techniques for isolation of pure cultures
- Comprehend the various methods for identification of unknown microorganisms and study microbial metabolism – Autotrophy and heterotrophy modes of nutrition.
- Understand the microbial physiology and know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.

Module 1: History of Microbiology and Microbial Taxonomy (8 hrs)

The historical foundations and development of microbiology. Microbial diversity - prokaryotic and eukaryotic microbial diversity. Principles of bacterial taxonomy. Molecular methods in taxonomy.

Module 2: Structure of Microorganism (18 hrs)

Morphology and structure of bacteria. Surface structures and inclusions of bacteria. Identification of bacteria - staining reactions, cultural, physiological and biochemical properties. Molecular methods for identification. Viruses - unique properties, morphology, structure and cultivation. Viroids and Prions. Viral replication. Viral diversity - bacterial, plant and animal viruses. Fungi - properties and classification.

Module 3: Microbial Growth (18 hrs)

Factors influencing microbial growth. Environmental and nutritional factors. Nutritional types of bacteria. Microbial locomotion - flagellar motility, gliding motility. Chemotaxis and photo taxis. Cultivation of bacteria - culture media and methods. Measurement of bacterial growth. Bacterial growth curve. Binary fission and growth cycle. Continuous cultures. Maintenance and transport of cultures.

Module 4: Control of Microorganisms (10 hrs)

Sterilization - Principles and methods (physical and chemical methods). Testing of disinfectants. Antibiotics - mechanism of action. Antibiotic sensitivity tests. Drug resistance in bacteria.

Module 5: Microbial Genetics (18 hrs)

Genetic materials in bacteria. Bacterial chromosome, extrachromosomal genetic elements. Plasmid - copy number, incompatibility and replication; episomes. Transposable element-IS elements, transposons, integrons and antibiotic resistance casettes. Mu-virus. Mutation-molecular basis of mutation, mutant selection and site directed mutagenesis. Mechanism of gene transfer - transformation, transduction and conjugation. Gene mapping. Bacteriophage genetics plaque formation & phage mutants.

References

1. Lim, D. (1998). *Microbiology*. 2nd Edition; McGraw-Hill Publication.
2. Ingraham, J. L. and Ingraham, C. A. (2004). *Introduction to Microbiology: A case history approach*. 3rd Edition. Thomson Brooks/Cole, Pacific Grove, Ca.
3. Madigan, M. T. and Martinko, J. M. (2006). *Brock's Biology of Microorganisms*. 11th Edition. Pearson Education Inc.
4. Pelczar, M. J. Jr., Chan, E. C. S. and Krieg, N. R. (1993). *Microbiology*, 5th Edition, Tata MacGraw Hill Press.
5. Prescott, L. M., Harley, J. P. and Klein, D. A. (2005). *Microbiology*. 6th Edition. MacGraw Hill Companies Inc.
6. Prescott, L. M., Harley, J. P. and Klein, D. A. (2006). *Microbiology*. 6th Edition. Edition, McGraw Hill Higher Education.
7. Willey, J. M., Sherwood, L. M. and Woolverton, C. J. (2013). *Prescott's Microbiology*. 8th Edition, McGraw-Hill Higher Education.
8. Salle, A. J. (1971). *Fundamental Principles of Bacteriology*. 7th Edition. Tata MacGraw Hill Publishing Co.
9. Stanier, R. Y., Adelberg, E. A. and Ingraham, J. L. (1987). *General Microbiology*, 5th Edition. Macmillan Press Ltd.
10. Tortora G. J., Funke B. R. and Case C. L. (2006). *Microbiology: An Introduction*. 8th Edition. Pearson Education Inc.

11. Russell, A. D., Hugo, W. B., and Ayliffe, G. A. J. (1999). *Principles and practice of disinfection, preservation and sterilization*, 3rd Edition. Blackwell Science, Oxford.
12. Black, J. G. (2013). *Microbiology: Principles and Explorations*. 6th Edition, John Wiley and Sons, Inc.

BMBC103: PHYSIOLOGY AND BIOSTATISTICS

Total Hours: 72 **Credit: 4**

Objectives:

- To introduce the students to the Physiological concepts of homeostasis and control mechanisms and to study the functions of body systems- with emphasis on clinical relevance.
- To understand how to effectively collect data, describe data, and use data to make inferences and conclusions in the field of research.

Outcome:

- Understand Anatomy & Physiology of various systems in Human which gives a clear picture about various systems and their respective disorders.
- Students will able to disentangle the data received and make valid inference that can be used to solve the problems in the field of research.

Module 1: Digestion and absorption, Excretory System (18 hrs)

Human Physiology

Introduction to physiology, scope of human physiology, homeostasis, blood buffers, acid-base balance.

Digestion, absorption and excretion: digestive secretions - composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids. Vitamins - classification and physiological functions.

Excretory system - structure of nephron. Formation of urine - glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion. Fluid electrolyte balance - regulation of water balance and sodium balance - role of renin- angiotensin and ADH.

Module 2: Respiration and Circulation (10 hrs)

Respiration and circulation: structure of lungs, mechanism and regulation of respiration. Transport of blood gases - O_2 and CO_2. Acidosis (metabolic and respiratory) and alkalosis. Composition and functions of blood and plasma. Blood groups, blood coagulation – mechanism, fibrinolysis and anticoagulants. Hemoglobin - structure, abnormal types, anemia. Structure of heart, cardiac cycle, heart sounds, ECG, coronary circulation, blood pressure. Lymph - normal composition and function.

Module 3: Neuromuscular System (16 hrs)

Neuromuscular function: structure and function of nerves, neurons, resting and action

potential, transmission of nerve impulses, molecular mechanism of synaptic transmission, compounds affecting synaptic transmission, synaptic delay synaptic plasticity, neuromuscular junction, Neurotransmitters: chemistry, synthesis, storage, release, receptors and functions- Ach, Catecholamines, Serotonin, Histamine, Glutamate, Aspartate, GABA, glycine, NO, neuropeptides. Neurodegenerative disorders- Parkinsons disorder, Alzheimer's disorder, ALS, Senile Dementia.

Composition and functions of cerebrospinal fluid, brain blood barrier - structure, function and clinical significance.

Structure of muscle cells and muscle contraction, molecular organization of muscle, proteins of contractile element - their organization and role in contraction, energy for contraction.

Module 4: Plant Physiology (18 hrs)

Autotrophy, heterotrophy, photosynthesis, xylem transport, phloem transport, transpirations, mineral nutrition, photorespiration. Phytohormones. Seed dormancy and Viability, senescence, physiological and biochemical changes during ripening.

Photoreceptors - UVR8, phytochromes, cryptochromes and phototropins. Stress physiology - water stress, physiological effects of biotic and abiotic stress on plants with special reference to temperature, drought, salinity and heavy metals. photomorphogenesis; photoperiodism (Long- day plants, Short-day plants and Day-neutral plants).

Module 5: Biostatistics (10 hrs)

Introduction and scope, collection, classification and tabulation of data, graphical and diagrammatic representations - scatter diagrams, histograms, frequency polygon, frequency curve, logarithmic curves, probability and probability distribution analysis. Measures of central tendency - Arithmetic mean, median, mode, geometric mean, harmonic means. Measures of dispersion, standard deviation, standard error, variance, coefficient of variation, correlation and regression. Principal component analysis, test of significance: hypothesis testing, levels of significance, student's t- test, Chi-square test (goodness of fit), ANOVA

References

1. Widmaier, E. P., Raff, H. & Strang, K. T. (2014). *Vander's Human Physiology-The mechanism of Body function*. 13th Ed. McGraw-Hill Higher Education.
2. Hall, J. E. (2010). *Guyton and Hall Textbook of Medical Physiology*. 12th Ed. Saunders.
3. Barrett, K. E., Barman, S. M., Boitano, S. & Brooks, H. (2012). *Ganong's Review of Medical Physiology*. 24th Ed. McGraw-Hill Medical.

4. Sembulingam, K. & Sembulingam, P. (2012). *Essentials of Medical Physiology*. JP Medical Ltd.
5. Rohatgi, V. K. & Saleh, A. K. Md. E. (2011). *An Introduction to Probability & Statistics*. John Wiley & Sons.
6. Casella, G. & Berger, R. L. (2002). *Statistical inference*. Duxbury Press.
7. Stanfield, C. L. (2010). *Principles of Human Physiology*. 4th Ed. Benjamin Cummings.
8. Fox, S. I. (2010). *Human Physiology*. 12th Ed. McGraw-Hill.
9. Silverthorn, D. U. (2012). *Human Physiology: An Integrated Approach*. Pearson.
10. Taiz, L. & Zeiger, E. (2010). *Plant Physiology*. 5th Ed. Sinauer Associates, Inc.
11. Stewart, P. & Globig, S. (2011). *Plant Physiology (Research Progress in Botany)*. Apple Academic Press.
12. Hopkins, W. G. & Höner, N. P. A. (2009). *Introduction to Plant Physiology*. 4th Ed. John Wiley & Sons.
13. Triola, M. M. & Triola, M. F. (2005). *Biostatistics for the Biological & Health Sciences*. Pearson.
14. Rosner, B. (2010). *Fundamentals of Biostatistics*. 7th Ed. Cengage Learning.

BMBC104: CELL BIOLOGY AND GENETICS

Total Hours: 54 **Credit: 3**

Objectives:

- To learn the detailed structures of eukaryotic and prokaryotic cells and methods used to examine them. Acquiring knowledge on cell-cell interactions, Cell cycle cell division and apoptosis.
- To understand a basic and comprehensive knowledge of eukaryotic and prokaryotic cells. A detail description of composition, structure and function of organelles and cell organelles and other cellular components.
- To learn human genetics and how to solve genetics problems that involve monohybrid and dihybrid crosses.

Outcome:

- Students will test and deepen their mastery of genetics by applying this knowledge in a variety of problem solving situations.
- Students will learn the structure and function of cells and biological membranes, signal transduction pathways, cell cycle and cell division, the flow of genetic information and the regulation of gene expression.

Module 1: Cell (8 hrs)

Cell wall, cell membrane - fluid mosaic model, unit membrane concept, chemical composition. Mitochondria**,** endoplasmic reticulum, golgi complex, peroxisomes, glyoxysomes, lysosome, plastids, chloroplast, ribosome, nucleus and nucleolus, centrosomes, vacuoles, cytoskeleton and cell motility. Microtubules, microfilaments and intermediate filaments.

Module 2: Specialized form of membranes, transport mechanisms and ion channels (6 hrs)

Specialized forms of membranes: brush border; flagella, red cell membranes, microsomal membrane functions. Membrane fluidity, asymmetry, lipid raft, functions of membrane proteins and lipids. Endocytosis and exocytosis; regulation of transport: porins facilitated diffusion, porter molecules; facilitated transport: symport, antiport, uniport, anion porter, glucose porter; active transport: proton pumps; Na^+ K^+ pumps, Ca^{2+} pumps; ionic channels: general characteristics and types of ionic channels - voltage, gated and ligand gated channels.

Module 3: Cell Cycle (12 hrs)

Cell cycle - different stages, variations, checkpoints, G1/S, G2/M, M, DNA damage check

points, regulations of cell cycle, maturation Promoting factor, cell cyclins, ubiquitin, ubiquitination, anaphase promoting complex, inhibitors of CdK, growth factors and D Cyclins, Rb protein, P53 and E2F transcription factors.

Module 4: Cancer, Aging, Cell Death (14 hrs)

Cancer- causes: carcinogenisis - physical, chemical and biological agents; properties of cancerous cells; stages in cancer development - initiation and progression, metastasis, tumour viruses, oncogenes, functions of oncogene products. Oncogene and signal transduction, oncogene and G proteins, oncogene and cell survival. Tumor suppressor gene: p^{53}, Rb functions of tumour suppressor gene products. Cancer Pathways: MAPK, ERK, PI3K/AKT, TP53 network, NF*K*B Pathways; signaling by TGF β factor. Diagnosis, prevention and treatment of cancer. Receptor Serine/ Threonine Kinases; other protein kinases; phosphoprotein phosphatases.

Aging: process of aging, theories of aging, Arking's contribution Oxidative stress, Telomere problem. DNA repair defects.

Cell Death: Necrosis and apoptosis, Differences between necrosis and apoptosis, stages in apoptosis, extrinsic and intrinsic pathway.

Module 5: Genetics (14 hrs)

Mendelian principles. Gene interactions - allelic and non allelic, complementation tests. Genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, Gene mapping methods: Linkage maps, tetrad analysis. Extra chromosomal inheritance: Inheritance of mitochondrial and chloroplast genes, maternal inheritance. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping. Mutation: types, causes and detection, mutant types - lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Structural and numerical alterations of chromosomes: deletion, duplication, inversion, translocation, ploidy and their genetic implications. Recombination: Homologous and non-homologous recombination, site-specific recombination.

Human Genetics and Population genetics

Population Genetics - type of gene variations, Measuring genetic variations, Hardy Weinberg principle and its deviations. Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

References

1. Snustad, D. P., Simmons, M. J. & Jenkins, J. B. (2008). *Principles of Genetics*. 5^{th}

Edn. John Wiley and Sons Inc.

2. Weaver, R. F. (2011). *Molecular Biology*. 5th Edition. McGraw-Hill Higher Education.
3. Smith, C. A. & Wood, E. J. (1996). *Cell Biology*. 2nd Edition. Garland Science.
4. Karp, G. (2013). *Cell and Molecular Biology: Concepts and Experiments*. 7th Ed. John Wiley & Sons Inc.
5. Cooper, G. M. & Hausman, R. E. (2013). *The Cell: A Molecular Approach*. 6th Ed. Sinauer Associates, Inc.
6. Becker, W. M., Kleinsmith, L. J., Hardin, J. & Bertoni, G. P. (2008). *World of the Cell*. 7th Ed. Benjamin Cummings.
7. Hardin, J., Bertoni, G. P. & Kleinsmith, L. J. (2011). *Becker's World of the Cell*. 8th Ed. Benjamin Cummings.
8. Griffiths, A. J. F., Wessler, S. R., Doebley, J. & Carroll, S. B. (2010). Introduction to Genetic Analysis. 10th Edition. W. H. Freeman.
9. Gardner, A. G., Simmons, M. J. & (2006). Principles of Genetics. 8th Ed. John Wiley and Sons.
10. Smith, C. & Wood, Ed. (1996). *Cell Biology*. 2ndEd. Chapman & Hall, London.
11. Cell Biology, Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Scott, M. P., Bretscher, A., Ploegh, H. & Matsudaira, P. (2007). *Molecular Cell Biology*. 6th Ed.W. H. Freeman.
12. Pollard, T. D., Earnshaw, W. C. & Lippincott-Schwartz, J. (2007). *Cell Biology*. 2nd Ed. Saunders.

PRACTICAL

BMBC1P01: LABORATORY COURSE - I

Total Hours: 180 **Credit: 4**

BIOCHEMISTRY

1. Preparation of solutions:
   - Percentage solutions
   - Molar solutions
   - Normal solutions
   - Dilution of Stock solutions
2. Preparation of buffers using the Henderson Hasselbach equation
3. Spectrophotometric experiments:
   - Verification of Beer Lambert's law
   - Determination of Concentration of molecules from Molar Extinction Coefficient values
4. Chromatographic techniques
   - Separation of amino acids by Paper chromatography (Descending or Ascending)
   - Separation of Plant pigments by Thin Layer Chromatography
5. Extraction of Polysaccharides (Starch, Glycogen), Proteins from appropriate source:
   - Quantification of isolated polysaccharide (Anthrone method), protein (Lowry's method) and lipids
6. Estimations,
   - Quantitative estimation of reducing sugars by Dinitrosalicylic acid method
   - Quantitative estimation of Methionine by Nitroprusside method
   - Estimation of Cholesterol by Zak's method
7. Qualitative analysis of Carbohydrate mixtures (a combination of polysaccharide, disaccharide and monosaccharide) following systematic scheme for analysis. (Starch, dextrin, glucose, fructose, maltose, lactose)

PHYSIOLOGY

1. Determination of haemoglobin concentration.
2. Determination of haematocrit.
3. Enumeration of blood cells
   a) Erythrocytes by haemocytometry
   b) Total leukocyte by haemocytometry

4. Preparation of Blood smears for differential count and cell morphology.
5. Determination of Erythrocyte Sedimentation Rate

CELL BIOLOGY AND GENETICS

1. Study of various stages of mitosis using cytological preparations of onion root tip.
2. Solving genetic problems related to monohybrid, dihybrid ratio and interaction of genes

References

1. Sawhney, S. K. & Singh, R. (2011). *Introductory Practical Biochemistry*. Narosa Publishing House, New Delhi.
2. Thimmaiah, S. K. (2004). *Standard Methods of Biochemical Analysis*. Kalyani Publishers, Ludhiana.
3. Oser, B. L. (2006). *Hawk's Physiological Chemistry*. 14th Edition. McGraw Hill Publishing Company New York.
4. Rao, B. S. & Deshpande, V. (2005). *Experimental Biochemistry: A Student Companion*. K International Pvt. Ltd, New Delhi.
5. Gupta R.C. & Bhargava, S. (2010). *Practical Biochemistry*. 4th Edition. CBS Publishers and Distributors, New Delhi.
6. Varley, H. (1954). *Practical Clinical Chemistry*. Interscience Publishers, Inc., New York.
7. Mukherjee, K. L. & Ghosh, S. (2010). *Medical Laboratory Technology – Procedure Manual for Routine Diagnostic Tests*. Volume 1. 2nd Edition. Tata McGraw-Hill Education, New Delhi.

Model Question Papers

Reg.No……

Name……..

MSc DEGREE EXAMINATION

First semester

MSc BIOCHEMISTRY

BMBC101- BIOCHEMISTRY

Time: 3 Hours **Maximum Mark:75**

PART A

(Short answer questions-2 marks each)

Answer any **TEN** of the following

1. Give the biological importance of glycoproteins?
2. Write down the structures of histones and its function?
3. What are antioxidants and proxidants?
4. What are buffers?
5. Write a note on the structure of ATP synthetase?
6. Describe the structure and functions of gangliosides?
7. List out the classification of carbohydrates based on their number of carbon atoms and functional groups?
8. What is sickle cell anemia?
9. Write a note on t RNA with structure?
10. How are lipids act as surfactants?
11. Write a note on exopolysaccharides from bacterial system?
12. Give the role membrane protein in transport system?
13. Write a note on B DNA?
14. Describe the structure and functions of sulphatides. (10X2=20 marks)

PART B

(Short essay type- 5 marks each)

Answer any **FIVE** of the following

15. Give the structure and importance of glycerophospholipids?
16. Write a note on bicarbonate buffer system?
17. Briefly explain bacterial cell wall polysaccharides
18. What do you understand about Ramachandran plot? Explain it?

19. Write a short note on the classification of amino acids?

20. Elaborate the functions of different types of ribose nucleic acid?

21. Describe the structure and functions of Thromboxanes?

22. Write a short note on Haemoglobin structure? (5x5=25marks)

PART C

(Long essay type-15 marks each)

Answer any **TWO** of the following

23. Describe secondary, tertiary and quaternary structure of proteins?

24. What are biological antioxidants? Explain it?

25. Write down the classification of lipids?

26. How are oligosaccharides purified and characterized from cell membrane?

(2x15=30marks)

Reg.No……

Name……..

M.Sc DEGREE EXAMINATION

First semester

MSc MICROBIOLOGY

BMBC102- GENERAL MICROBIOLOGY

Time: 3 Hours **Maximum Mark: 75**

PART A

(Short answer questions-2 marks each)

Answer any **TEN** of the following

1. Write a note on growth factors?
2. Outline the different modular organization of plasmids?
3. Define chemotaxis and describe tumble and run?
4. Distinguish between continuous and synchronous cultures?
5. Outline the process of lyophilization
6. Describe the difference between prokaryotic and eukaryotic genome?
7. What is quorum sensing? Describe how it occurs, and briefly discuss its importance in microorganisms?
8. Write a short note on IS elements?
9. Write a note on virioids and prions?
10. Brief note on binary fission?
11. What are inclusion bodies?
12. Note on fungal reproduction?
13. Briefly explain the general properties and structure of viruses?
14. Write a note on acidophiles and alkalophiles

(2X10=20 marks)

Part-B

(Short essay type-5 marks each)

Answer any **FIVE** of the following

15. Write a brief account on ABC transporters?
16. Explain the regulation of replication in plasmids?
17. How do ionizing radiations, ultraviolet radiations and visible light harm microorganisms? How do microorganisms protect themselves against damage from U V and visible light?
18. Describe the technique used for the detection and isolation of mutants?

19. Briefly explain on low temperature preservation methods
20. Describe the contributions of Robert Koch, Joseph lister and Winogradsky in the field of microbiology?
21. Write a short note on Mu-virus?
22. In what ways the G+C content data is taxonomically valuable? Give an account on the G+C content determination? (5 x 5=25 marks)

Part-C

(Long essay type-15 marks each)

Answer any **Two** of the following

23. Elucidate the morphology and life cycle of bacteriophage?
24. Explain Flagellar Structure with a detailed account on microbial locomotion?
25. Explain the mechanism of drug resistance in Bacteria
26. Write an essay on gene transfer mechanisms in prokaryotes?

(15x 2=30 Marks)

Reg.No……

Name……..

M. Sc. DEGREE EXAMINATION

First Semester

M.Sc. BIOCHEMISTRY

BMBC103 – PHYSIOLOGY AND BIOSTATISTICS

Time: 3 Hours **Maximum Mark: 75**

PART A

(Short answer questions-2 marks each)

Answer any **TEN** of the following

1. Comment on blood proteins.
2. Describe salivary glands.
3. Comment on PCA.
4. Distinguish between fast oxidative–glycolytic fibers and fast glycolytic fibers.
5. Describe electrical synapses.
6. Define stroke volume and explain the factors that regulate it.
7. Define standard deviation.
8. Comment on photoreceptors.
9. What is meant by seed viability?
10. Enlist the biochemical changes during ripening.
11. Explain synaptic plasticity.
12. Summarize the major features of different types of muscular tissue.
13. Differentiate between inspiratory capacity and vital capacity.
14. Comment on oligodendrocytes.

(10 x 2 = 20 marks)

PART B

(Short essay type - 5 marks each)

Answer any **FIVE** of the following

15. Comment on the mechanism and regulation of respiration.
16. Explain the role of rennin - angiotensin and ADH.
17. Describe the mechanism that contributes to hemostasis.
18. Elaborate the composition and functions of lymph.
19. Describe the three phases of digestion.
20. Give a detailed account on Phyto hormones.

21. Add notes on neurodegenerative disorders.
22. Explain measures of central tendency.

(5 x 5 = 25 marks)

PART C

(Long essay type - 15 marks each)

Answer any **TWO** of the following

23. Write an essay on the chemistry, synthesis, storage, release, receptors and functions of neurotransmitters.
24. Write an essay on urine formation process. Write down the composition of urine.
25. Explain the mechanism of respiration. Explain diffusion and transport of O_2 and CO_2 through blood and lungs.
26. Write an essay on the physiological function and biological action of various plant hormones.

(2 x 15 = 30 marks)

Reg. No……

Name……..

MSc DEGREE EXAMINATION

First semester

MSc BIOCHEMISTRY

BMBC104 - CELL BIOLOGY AND GENETICS

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

PART A

(Short answer questions-2 marks each)

Answer any **TEN** of the following

1. Write a note on mitochondrial damage?
2. Explain Homeotic genes and its combinatorial expression?
3. Write a brief note on interphase in cell cycle?
4. What are functions of Golgi complex?
5. Mention about MPF?
6. What is Tumor suppressor gene?
7. Explain properties of cancer cells?
8. Write briefly on cell cycle control points?
9. Explain the role of CED3, CED4 and CED9 in apoptosis?
10. Comment on karyotype?
11. Briefly explain Allelic interactions?
12. What do you mean by linkage? Explain the various types?
13. Comment on heritability?
14. Comment on crossing over.

(10×2=20 Marks)

PART B

(Short essay type- 5 marks each)

Answer any **FIVE** of the following

15. Describe the structure and functions of Ribosome?
16. Explain the molecular organization of cell membrane using fluid- mosaic model?
17. Give an account on ionic channels?
18. Discuss theories of ageing?
19. Write an account on cell death?
20. Give an account of extra chromosomal inheritance?

21. Write a note on cytoskeleton?

22. Comment on Pedigree analysis?

(5×5=25 Marks)

PART C

(Long essay type-15 marks each)

Answer any **TWO** of the following

23. Write notes on the following:

    a) NFκB –pathways c) Diagnosis, prevention & treatment of cancer

    b) MAP Kinase pathway

24. Give an account of

    a) Hardy- Weinberg genetic equilibrium

    b) Receptor mediated endocytosis.

25. Write an essay on the types, causes and detection of mutation?

26. Write an essay on programmed cell death.

(2×15=30 Marks)

SEMESTER II

BMBC205: MOLECULAR BIOLOGYAND GENETIC ENGINEERING

Total Hours: 72 **Credit: 4**

Objectives:

- To introduce students to the basic concepts and techniques used in molecular biology.
- Understand different steps in the central dogma of molecular biology, enzymes involved in synthesis of DNA, RNA and protein.
- Application of R-DNA technology and use of Restriction enzymes in construction of various vectors and libraries such as c-DNA & Genomic libraries.

Outcome:

This gives an in depth knowledge of biological processes through the investigation of the underlying molecular mechanisms.

- Gain knowledge about Recombinant DNA technology by studying about various Vectors and Restriction Enzymes involved.

Module 1: Replication (10 hrs)

DNA Replication - Identification of genetic material (Griffith, Avery and Hershey and Chase experiments). DNA replication - Meselson- Stahl experiment, the geometry of DNA replication, Molecular mechanisms of DNA Replication - bidirectional, rolling circle and theta mode replication. Replication of eukaryotic chromosomes. Differences in prokaryotic and eukaryotic replication. D-loop, methylation of DNA and DNA repair mechanisms. Repetitive DNA sequences - terminal, tandem (satellite DNA, minisatellite & microsatellite).

Module 2: Transcription (16 hrs)

Transcription**:** Prokaryotic transcription –Molecular mechanism. Eukaryotic transcription- Mechanism in detail, inhibitors of transcription.

Post transcriptional modifications**:** Splicing – RNA Splicing, self-splicing RNAs – Group I,II, III and IV introns. Capping, polyadenylation, mRNA processing events, monocistronic and polycistronic m-RNA, eukaryotic and bacterial RNaseP, RNAse III, RNAseII. tRNA processing**:** *Trans*-Splicing; RNA editing; post-transcriptional control of gene expression: mRNA stability, RNA interference, mRNA degradation, Alternate splicing.

Module 3: Translation (16 hrs)

Translation: Structure of RNAs in prokaryotes and eukaryotes. t- RNA: Structure, modified

bases in t-RNA, amino acyl t-RNA synthetase. r- RNA: Ribosomal structural components, comparison of eukaryotic and prokaryotic ribosomes. Genetic Code, Wobble hypothesis. Translation in prokaryotes and eukaryotes-molecular mechanism. Inhibitors and Modifiers of protein synthesis, Co-translational/ post-translational modifications, Protein trafficking, Anchor sequences, Protein splicing –inteins, exteins. Regulation of gene function: Positive and negative regulation, inducible and repressible system exemplified with the help of lactose operon, Tryptophan operon, attenuation control, control in arabinose operon. Regulation of gene expression in eukaryotes.

Module 4: Genetic Engineering (22 hrs)

Tools and techniques for Genetic Engineering, Isolation of DNA and RNA from different sources, enzymes used in genetic engineering with special reference to restriction enzymes, ligases and other DNA modifying enzymes. Modification of restriction fragments, vaccinia topoisomerases, homopolymer tailing, adaptors and linkers. Vectors – properties of vectors, eg. Plasmid- pSC101, pBR322, pUC their development, features and selection procedures; Bacteriophages -λ and M13,BAC,Cosmids,Phagemids- pEMBL, pBluescript, pGEM3Z, pSP64.Shuttle vectors- YAC. Tiplasmids, Expression vectors. Construction of genomic libraries and cDNA libraries, procedures for recombinant selection and library screening. Chemical synthesis of DNA, DNA sequencing- Sanger's dideoxy sequencing, Maxim and Gilbert's method. Hybridization techniques, Autoradiography. PCR - Steps, types and applications, RFLP, RAPD, AFLP, Foot and Finger printing.

Module 5: Transgenic Technology (8 hrs)

Applications of transgenic technology in plant and animals, methods and applications. Gene therapy. Biopharming. DNA chips and microarray, genetic markers.

References

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. & Walter, P. *Molecular Biology of the Cell*. 6th Edition. Garland Science, Taylor & Francis Group.
2. Allison, L. A. (2012). *Fundamental Molecular Biology*. 2nd Edition. Wiley
3. Ausbel, F. M. and Brent, R. (1994). *Current protocols in Molecular biology*. John Wiley & Sons Inc, NY
4. Brown, T. A. (2010). *Gene Cloning and DNA Analysis: An Introduction*. 6th Ed. John Wiley & Sons.
5. Clark, D. P. & Pazdernik, N. J. (2013). *Molecular Biology - Understanding the Genetic Revolution*. Academic Cell, Elsevier.
6. Cox, M. M., Doudna, J. A. & O'Donnell, M. (2012). *Molecular Biology: principles &*

practice. W. H. Freeman and Company, New York, NY.

7. Craig, N. L., Cohen-Fix, O., Green, R., Greider, C. W., Storz, G. & Wolberger, C. (2010). *Molecular Biology - Principles of Genome Function*. Oxford University Press.
8. Glick, B. R., Pasternak, J. J. & Patten, C. L. (2009). *Molecular Biotechnology - Principles and Applications of recombinant DNA*. 4th Ed. ASM Press Publications.
9. Karp, G. (2013). *Cell & Molecular Biology – Concepts & Experiments*. 7th Edition. Wiley.
10. Lewin, B. (2008). *Genes IX*. Jones and Bartelett Publishers Inc.
11. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. & Scott, M. P. (2012). *Molecular Cell Biology*.5th Edition. W. H. Freeman.

BMBC206: IMMUNOLOGY

Total Hours: 72 **Credit: 4**

Objectives:

- In this course, the students will be introduced to the basic concepts of immunology as it relates to human and animal health.
- The course is designed for students with no prior knowledge of immunology and students are encouraged to understand the fundamentals of immunology.

Outcome

- Demonstrate and understanding of key concepts in immunology along with overall organization of the immune system.
- Appreciate the significance of maintaining a state of immune tolerance sufficient to prevent the emergence of autoimmunity.
- To understand about Tumor Immunology and help the students to understand its immune prophylaxis and immune therapy.
- To make them understand the salient features of antigen antibody reaction & its uses in diagnostics and various other studies.
- Learn about immunization and their preparation and its importance

Module 1: Introduction to immune system (6 hrs)

Infection, Immunity, Innate and Adaptive Immunity, Mechanisms of innate immunity, Inflammation, phagocytosis-mechanism, Opsonisation, Receptors of Innate Immune system, Pattern recognition receptors and Pathogen Associated Molecular Pattern, Scavenger receptors and the Toll-like receptors. Organs and cells with immune functions. Lymphocytes and lymphocyte maturation.

Module 2: Antigen, Antibody and its interaction (18 hrs)

Antigens, Epitopes and Paratopes, Antigenicity and Immunogenicity, Adjuvants, Hapten, Super antigens, Immunoglobulin – structure, classes and functions, Fc receptors, Isotype, Allotype, Idiotype. Monoclonal antibodies – production and applications, Antibody engineering. Genetic basis of antibody diversity, Organization and Expression of Immunoglobulin Genes, Mechanism of variable gene rearrangement, Recombination Signal Sequences, V(D)J and VJ rearrangements, P-addition, N-addition, somatic hypermutation and affinity maturation, Class- switching, Synthesis of immunoglobulins, Antigen-antibody reactions, Affinity, Avidity and Cross reactivity, Agglutination and Precipitation Reactions, Passive agglutination, Agglutination Inhibition reaction, Complement fixation,

Radioimmuno assay, Immunoflourescence, ELISA- various types, Western blotting, Flow cytometry etc.

Module 3: T cells (18 hrs)

T -cell receptor, T-cell accessory membrane molecules and TCR-CD3 complex, Co-stimulatory signal, Clonal anergy, Signalling pathways by activation of TCR, ITAM, T-cell maturation, activation and differentiation, Cell mediated Immune response, B cell - generation, activation, differentiation, B – cell receptor B-cell co receptor complex, Humoral Immune response- Antibody formation, Primary and secondary immune response, Clonal selection theory. Cytokines, MHC, HLA typing, MHC-restriction, Antigen processing and presentation, Complement system and Complement activation pathways, regulation of complement activation, Biological effects of complements.

Module 4: Transplantation immunology, Tumor immunology and Immunohematology (16 hrs)

Immunology of organ and tissue transplantation, Graft and types, Allograft reaction and GVH reaction, Histocompatability testing, Immunosuppression, Factors influencing allograft survival, Immunology of malignancy - Tumor antigens, TATA, TSTA, Immune response in malignancy, Tumor Evasion of the Immune System, Immunotherapy of cancer, LAK cells, TILs, Immunohematology - ABO and Rh blood group system, Immunology of blood transfusion, Hemolytic disease of new born.

Module 5: Autoimmunity, Immunodeficiency and Immunoprophylaxis (14 hrs)

Immunological Tolerance, Autoimmunity, Classification of Autoimmune diseases, Mechanisms of autoimmunity. Hypersensitivity, types of hypersensitivity reactions and their features, Immunodeficiency diseases, primary immunodeficiency and secondary immunodeficiency disease, Immunoprophylaxis, Vaccines – types of vaccines, Routine immunization schedules, DNA vaccine and recent trends in vaccine development.

References

1. Ananthanarayan, R. and Panicker, C. K. J. (2008). *Textbook of Microbiology*. Orient Longman Private Ltd.
2. Ananthanarayan, R. and Panicker, C. K. J. (2009). *Ananthanarayan and Paniker's Textbook of Microbiology*. Orient Longman Limited Universities Press (India) Pvt. Ltd.
3. Coleman, R. M. (1992). *Fundamentals of Immunology*. McGraw-Hill Higher Education.

4. Wise, D. J. and Carter, G. R. (2004). *Immunology - A Comprehensive Review.* Iowa State University Press, Blackwell Science Co.
5. Schlegel, H. G. *General Microbiology*. 7th Edition. Cambridge University Press, New York, USA.
6. Hapel, H., Harney, M., Misbah, S., and Snowden, N. (2006). *Essentials of Clinical Immunology* 5th Edition. Blackwell Publishing Company.
7. Heritage, J., Evaus, E. G. V. and Killungten, R. A. (2007). *Introductory Microbiology*. Cambridge University Press.
8. Delves, P. J., Martin, S. J., Burton, D. R. and Roitt, I. M. (2002). *Roitt's Essential Immunology*. 12th Edition. Wiley-Blackwell, John Wiley and Sons Ltd., Publication.
9. Park, K. (2002). *Parks Text Book of Preventive and Social Medicine*. 17th Edition. Jabalpur: M/S Banarsidas Bhanot.
10. Kindt, T. J. Goldsby, R. A.and Osborne, B. A. (2007). *Kuby Immunology*. 6th Edition. W. H. Freeman and Co, New York
11. Frank, S. A. (2002). Immunology and Evolution of Infectious Disease**.** Princeton University Press.
12. Sharma, K. (2009). *Manual of Microbiology: Tools and Techniques*. 2nd Edition. Ane Book's Pvt. Ltd., New Delhi.

BMBC207: BIOPHYSICS, BIOINSTRUMENTATION AND BIOINFORMATICS

Total Hours: 72 **Credit: 4**

Objectives:

- To provide students with a foundation in the basic concepts of Biophysics, bioinstrumentation and bioinformatics.
- The basic objective is to give students an introduction to the basic practical techniques of bioinformatics.

Outcome:

- Biophysics makes use of physical concepts and techniques to address problems in biology
- Capable to choose and apply suitable separation techniques to identify different biomolecules.
- Emphasis will be given to the application of bioinformatics and biological databases to problem solving in real research problems.

Module 1: Energetics and DNA Protein Interaction (14 hrs)

Laws of thermodynamics, the concept of enthalpy, entropy and free energy, thermodynamic equilibrium, redox potential, high energy molecules, examples of redox potential in biological system. Membrane systems involved in energy transduction - Mitochondria, chloroplast.

DNA-Protein interaction: Lambda repressor and cro binding to DNA. Interactions of transcription factors - HLH, bHLH, Leucine Zipper, Cys-His, Zinc fingers. RNA - protein interactions, DNA-drug Interaction.

Module 2: Microscopy (10hrs)

Microscopy: Light, phase contrast, SEM, TEM, polarization, confocal and interference microscopy, fluorescence microscopy. Introduction to Atomic force microscopy. Principle, methods and applications of polarimetry, cytometry, flow cytometry.

Module 3: Spectroscopy and Isotope techniques (18 hrs)

Spectroscopy: Principle, Instrumentation, and Applications of UV-Visible spectroscopy, Infrared spectroscopy, Fluorescence spectra, NMR and ESR spectra, Raman spectroscopy. Isotope techniques: Ionising and non ionsing radiation, radiation units, dosimetry, applications of radioisotopes in blotting techniques.

Module 4: Electrophoresis and Chromatography (20 hrs)

Separation techniques: principle, instrumentation, methods and application - Paper chromatography, Thin layer chromatography, Gel filtration chromatography, Affinity chromatography, Ion-exchange chromatography and HPLC and HPTLC. Centrifugation - principle, methods and application; Ultra centrifugation. Principle and methods of Electrophoresis - Agarose Gel electrophoresis, polyacrylamide gel electrophoresis, SDS PAGE, capillary electrophoresis, isoelectric focusing and pulse field gel electrophoresis. Blotting techniques.

Module 5: Bioinformatics (10 hrs)

Bioinformatics: Introduction to bioinformatics, application of data mining in Bioinformatics, Biological databases and search tools, sequence databases, structural databases, derived and specialized databases. Three dimensional structure of proteins, prediction of structural classes, motifs, folds and domains, classification of three dimensional structures in Brookhaven protein data bank (HSSP, SCOP, FSSP, CATH); protein structure prediction, structural alignment methods, homology modelling, dynamical programming, Human brain project. Molecular simulation, rational drug design and docking, applications of bioinformatics.

References

1. Serdyuk, I. N., Zaccai, N. R. & Zaccai, J. (2007). *Methods in Molecular Biophysics – Structure, Dynamics & Function*. Cambridge University Press, New York.
2. Cantor, C. R. & Schimmel, P. R. (2008). *Biophysical Chemistry, The Behaviour of biological macromolecules*, Vol I,II, III. W H Freeman & Co 2.
3. Jackson, M. B. (2006). *Molecular and Cellular Biophysics*. 1st Edition. Cambridge University Press, New York.
4. Beard, D. A. & Hong, Q. (2008). *Chemical Biophysics – Quantitative Analysis of Cellular Systems*. Cambridge University Press, New York.
5. Brenden, C. & Tooze, J. (1999). *Introduction to Protein Structure*. 2nd Edition. Garland Science.
6. Narayanan, P. (2005). *Essentials of Biophysics*. New Age International.
7. Logan, S. R. (1998). *Physical Chemistry for Biomedical Sciences*. Taylor & Francis.
8. Bohr, H. G. (2009). *Handbook of Molecular Biophysics: Methods & Application*. Wiley- VCH Verlag GmbH & Co. (Weinheim, Germany).
9. Waigh, T. (2007). *Applied Biophysics - A Molecular Approach for Physical Scientist*.

John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England.

10. Schulz, G. E. & Schirmer, R. H. (1979). *Principle of Protein Structure*. Springer Verlag, Berlin, Heidelberg, New York.

BMBC208: METABOLISM AND BIOENERGETICS

Total Hours: 54 **Credit: 3**

Objectives:

- Understand the fundamental energetics of biochemical processes, chemical logic of metabolic pathways.
- Learn in detail about concepts to illustrate how enzymes and redox carriers and the oxidative phosphorylation machinery occur.
- Understanding the utilization of proton gradient to drive the formation of high energy bonds and high energy compounds.

Outcome:

- Knowledge in the digestion and absorption of carbohydrates, proteins and lipids and its metabolic pathways in human body.
- Knowledge in various diseases associated with the metabolism.
- Understand the function of specific anabolic and catabolic pathways and how these pathways are controlled and interrelated.

Module 1: Carbohydrate Metabolism (12 hrs)

Metabolism of Carbohydrates: Glycolysis and its regulation, fates of pyruvate-fermentation; Etner doudoroff pathway. Gluconeogenesis- reactions and regulation. Alternate pathways of carbohydrate metabolism: Pentose phosphate pathway, importance of the pathway and its regulation, glucuronic acid cycle. Metabolism of glycogen: glycogen breakdown and synthesis. Regulation of glycogen metabolism. Citric acid cycle- amphibolic nature of the cycle, anaplerotic reactions, regulation and energetics. Glyoxylate cycle. Peptidoglycan synthesis. Bacterial photosynthesis. Disorders of carbohydrate metabolism: glycohemoglobins, hypoglycemias, fructosamines, and ketone bodies. Glucose tolerance test. Glycogen storage diseases, galactosemia, fructosuria, pentosuria.

Module 2: Lipid Metabolism (12 hrs)

Lipid Metabolism: Fatty acid oxidation-α, β, ω oxidation. Catabolism of unsaturated fatty acids and odd-chain fatty acids, formation and utilization of ketone bodies. Fatty acid biosynthesis, desaturase and elongase- regulation. Synthesis and breakdown of traicylglycerols and its regulation. Phospholipids and glycolipid metabolism-glycerophospholipids, sphingolipids, sphingoglycolipids. Cholesterol metabolism: Cholesterol biosynthesis and regulation. Transport of cholesterol- LDLreceptor pathway. Cholesterol catabolism-Synthesis of bile acid. Lipoprotein metabolism-Chemical

composition, biological functions and metabolic fate of VLDL, LDL and HDL. Disorders of lipid metabolism- Hyperlipidemia, Hyper cholesterolemia; Metabolic acidosis, disorders of ketone body metabolism, sphingolipidosis; diseases associated with lipoprotein metabolism- atherosclerosis and coronary artery diseases; fatty liver, and lipotrophic factors. Tay Sach's disease, Niemann Picks disease, Gaucher's disease, inherited disorders of familial hyper and hypolipoproteinemias.

Module 3: Amino acid metabolism (12 hrs)

General reactions of amino acid metabolism- transamination, deamination and decarboxylation. Metabolism of individual amino acids. Urea cycle and its regulation. Fate of carbon skeleton: entry into glucogenic and ketogenic pathways. Disorders of amino acid metabolism: Phenylalanemia, homocystinuria, tyrosinemia, MSUD, phenylketonuria, alkaptonuria, albinism, amino acidurias and porphyrias.

Module 4: Nucleic Acid metabolism (9 hrs)

Metabolism of purine and pyrimidine nucleotides-biosynthesis (de novo and salvage pathways) and catabolism-inter conversion - uric acid formation, regulation. Disorders in purine/ pyrimidine metabolism: Lesch Nyhan syndrome, immunodeficiency diseases associated with defects in purine nucleotide metabolism, gout, oratic aciduria, xanthinuria.

Module 5: Mitochondrial Electron Transport Chain and Oxidative Phosphorylation (9 hrs)

Mitochondrial electron transport chain– organization and role in electron capture; oxidative phosphorylation; Structure and functional properties of cytochrome, Fe-S proteins and CoQ; F1F0 ATPase- structure and mechanism of action. Generation of the electrochemical proton gradient: chemiosmostic ATP synthesis. Inhibitors of respiratory chain and oxidative phosphorylation- uncouplers, ionophores. Regulation of oxidative phosphorylation.

References

1. Lehninger, Principles of Biochemistry Fourth Edition by David L. Nelson Michael M. Cox Publisher: W.H. Freeman; Fourth Edition (April23,2004)ISBN-10:0716743396ISBN-13:978-0716743392
2. E.S. West, W.R Todd, H.S Mason and T.J van Bruggen, A Text Book of Biochemistry , Oxford and IBH Publishing Co., New Delhi,1974
3. Biochemistry (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley &Sons Inc ISBN:047119350XISBN-13: 9780471193500, 978-0471193500
4. Principles of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E

Vance Publisher: Mcgraw-hill Book Company-Koga ISBN: 0697142752 ISBN- 13: 97806971142757, 978-0697142757

5. Principles of Biochemistry, 4/e(2006) by Robert Horton H, Laurenence A Moran, Gray Scrimgeour K Publisher: Pearsarson ISBN:0131977369, ISBN-13:9780131977365, 978-0131977365
6. Biochemistry 6thEdition (2007) by Jeremy M. berg John L.tymoczko Lubert Stryer Publisher: B.I publications Pvt. Ltd ISBN:071676766X ISBN-13:9780716767664, 978-716767664
7. Biochemistry (2008) by Rastogi Publisher: Mcgraw Hill ISBN: 0070527954 ISBN-13: 9780070527959, 978-0070527959

PRACTICAL

BMBC2P02: LABORATORY COURSE - II

Total Hours: 180 **Credit: 4**

Microbiology and Immunology

General rules in microbiology laboratory

Culture media and its preparation

1. Microscopic examination of bacteria in living conditions
2. Testing of motility
3. Staining procedures-Gram's, Volutin, Spore, Capsule, Negative, Acid Fast, Fungalstaining etc.
4. Cultivation of bacteria, fungi
5. Sterilization methods
6. Study of cultural characteristics and biochemical reaction of bacteria
7. Testing of disinfectants
8. Bacterial growth curve
9. Antibiotic sensitivity tests- disc diffusion, MIC
10. Raising of immune sera
11. Serological tests for the diagnosis of microbial infections
12. Agglutination and precipitation tests
13. Immunodiffusion in gel
14. ELISA

Molecular Biology and Genetic Engineering

1. PAGE- Protein separation
2. DNA and RNA isolation from different sources
3. Agarose gel electrophoresis of nucleic acids
4. Estimation of DNA and RNA
5. Online sequence analysis, BLAST
6. Phylogenetic analysis

References

1. Cheesbrough, M. (2006). *District Laboratory Practice in Tropical Countries.* Vol.

2. 2nd Ed. Cambridge University Press.

2. Collee, J. G. & Mackie, T. J. (1996). *Mackie and McCartney Practical Medical Microbiology*. 14th Ed. Churchill Livingstone, Edinburgh.
3. Sonnenwirth, A. C. & Jarrett, L. (1980) *Gradwohl's Clinical Laboratory Methods and*
4. *Diagnosis*. 8th Ed.Mosby, St Louis, Mo.; London.
5. Dubey, R. C. & Maheshwari, D. K. (2002). *Practical Microbiology*. S. Chand & Company Limited.
6. Aneja, K. R. (2003). *Experiments in Microbiology, Plant Pathology and Biotechnology*. 4th Edition. New Age International.
7. Sambrook, J. & Russell, D. W. (2001). *Molecular Cloning: A Laboratory Manual*, 3rd Edition. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
8. Sambrook, J., Fritsch, E. F. & Maniatis, T. (1989). *Molecular Cloning: A Laboratory Manual*. Volume 3. 2nd Edition. Cold Spring Harbor, NewYork: Cold Spring Harbor Laboratory Press.

Model Question Papers

Reg.No……

Name……..

MSc DEGREE EXAMINATION

Second Semester

MSc BIOCHEMISTRY

BMBC205-MOLECULAR BIOLOGYAND GENETIC ENGINEERING

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

PART A

(Short answer questions-2 marks each)

Answer any **TEN** of the following

1. What do you mean by RNA interference?
2. Comment on catabolite repression.
3. Comment on the properties of ribozymes.
4. Write a note on charon phages.
5. Add notes on inhibitors of transcription.
6. Write a brief account on runaway plasmid.
7. Comment on the classes of aminoacyl tRNA synthetases.
8. Write a note on Restriction enzymes**.**
9. What is Wobble hypothesis?
10. What do you mean by trans-splicing?
11. Distinguish between group 1 and Group 2 introns.
12. Give an account on the structure and different types of sigma factor in *E. coli*.
13. Comment on transcription promoter sites in prokaryotes.
14. Comment on PCR.

(10X2=20 Marks)

PART B

(Short essay type- 5 marks each)

Answer any **FIVE** of the following

15. Explain clamp loading complex.
16. Comment on post transcriptional modifications.
17. Explain *Ara* operon.
18. What is meant by Repetitive DNA sequence?

19. Comment on Spliceosome.

20. Diagram the four step transcription initiation process in *E. coli*

21. Briefly explain the DNA sequencing methods.

22. Add notes on BioPharming.

(5X5=25 Marks)

P ART C

(Long essay type-15 marks each)

Answer any **TWO** of the following

23. Explain the general features of DNA replication.

24. Compare and contrast the process of transcription in prokaryotes and eukaryotes.

25. Write an essay on protein targeting.

26. Write an essay on vectors used in gene cloning.

(15X2=30 Marks)

Reg.No……

Name……..

MSc DEGREE EXAMINATION

Second semester

MSc BIOCHEMISTRY

BMBC206-IMMUNOLOGY

Time: 3 Hours **Maximum Mark: 75**

PART A

(Short answer questions-2 marks each)

Answer any **TEN** of the following

1. Outline the immunological functions of bone marrow.
2. Discuss whether autoimmunity is driven by antigen.
3. Write down the properties of tumor antigens.
4. What are adjuvants? Give examples.
5. Describe SCID.
6. How do interferons render cells resistant to viruses?
7. What precautions should be taken to prevent hemolytic diseases in newborn?
8. Explain Rh incompatibility.
9. Why maternal milk is important for the immune protection of the baby
10. Summarize the biological functions of complement components.
11. All immunogens are antigens but not all antigens are immunogens. Justify.
12. Mention the role of T suppressor cells in cell mediated immunity.
13. What is inflammation and how does inflammation serve as a protective function.
14. What is precipitin reaction? Mention its application. (10X2=20 marks)

PART B

(Short essay type- **5** marks each)

Answer any **FIVE** of the following

15. Describe HLA antigens and ad note on their role in immunity.
16. Briefly describe the production of monoclonal antibodies
17. Give an account on the immune response occurring during transplantation.
18. Mention the role of scavenger receptors in pathogen recognition and innate immunity.
19. How is IgA secreted across mucosal surfaces?
20. Describe the characteristics and functions of macrophages
21. Compare and contrast the structure and functions of Class I and class II MHC molecules.

22. Briefly explain the alternative pathway of complement system

(5X5=25 Marks)

PART C

(Long essay type-**15** marks each)

Answer any **TWO** of the following

23. Explain the different classes of immunoglobulin's with the aid of neat labeled diagrams
24. Elaborate the mechanism of cell mediated immunity.
25. Classify immunity and describe innate immunity in detail.
26. Enumerate Hypersensitivity reactions and discuss in detail about Type IV Hyper sensitivity reaction

(2x15=30 Marks)

Reg.No……

Name……..

MSc DEGREE EXAMINATION

Second Semester

MSc BIOCHEMISTRY

BMBC207- BIOPHYSICS, BIOINSTRUMENTATION AND BIOINFORMATICS

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

PART A

(Short answer questions-2 marks each)

Answer any **TEN** of the following

1. What is Rf? How it is calculated?
2. State Bragg's law. How is it useful.
3. What is data mining?
4. Distinguish between ionizing and mutagenic radiation.
5. What is meant by constructive interference in X-ray crystallography?
6. Wht is a chromophore? What is the chromophore in a DNA?
7. Distinguish between opitical rotation and ORD.
8. What is the main application of flow cytometer?
9. What is entalphy?
10. Define DNA protein interaction.
11. What is HPTLC? Give 2 applications.
12. Define SEM.
13. Give an applications of polarimetery.
14. Write down the principle for chromatography?

(10X2=20 Marks)

PART B

(Short essay type- 5 marks each)

Answer any **FIVE** of the following

Explain spin-spin coupling in NMR.

15. Explain the principle and any one application of fluorescence.
16. Explain CATH and SCOP.
17. What is homology modeling? Explain.
18. How are proteins eluted from ion exchange columns.

19. Give the principle and application of affinity chromatography.
20. Give the principle of Isoelectric Focusing.
21. Give the principle of pulsed field gel electrophoresis. What is its application?

(5X5=25 Marks)

PART C

(Long essay type-15 marks each)

Answer any **TWO** of the following

22. Give an account of protein data bases.
23. Discuss the 3-D structure of an immunoglobulin molecule.
24. Give an account of DNA binding protein motifs.
25. Give the principle and application of SDS-PAGE. How are protein band on the gel stained?

(15X2=30 Marks)

Reg. No……

Name……..

M.Sc. DEGREE EXAMINATION

Second Semester

M.Sc. BIOCHEMISTRY

BMBC208-METABOLISM AND BIOENERGETICS

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

PART A

(Short answer questions-2 marks each) Answer any **TEN** of the following

1. What is chemiosmotic theory?
2. Draw the structure of cholesterol.
3. What is glucose tolerance test?
4. Name three prostaglandins.
5. Give a note on phenylketonuria.
6. Explain Lesch Nyhan syndrome.
7. What is an anaplerotic reaction?
8. Give function of glucagon.
9. What is decarboxylation?
10. Give Structure of ATPase.
11. What are biochemical basis of "Gouty Arthritis"?
12. What is Gout?
13. Define diabetes mellitus.
14. What is oxidative phosphorylation?

(10X2=20 Marks)

PART B

Short essay type- 5 marks each) Answer any **FIVE** of the following

15. Outline the reactions of Urea cycle?
16. Write the structure of cholesterol and outline the biochemical functions.
17. How are triacylglycerols degraded enzymatically?
18. Write a note on photophosphorylation.
19. Outline gluconeogenesis and its regulation.
20. Write a note on diseases associated with lipoprotein metabolism.
21. Explain de novo and salvage pathway of pyrimidine.

22. Briefly explain digestion and absorption of proteins.

(5X5=25 Marks)

PART C

(Long essay type-15 marks each) Answer any TWO of the following

23. Describe in detail β oxidation of fatty acids?
24. Discuss in detail the pentose phosphate pathway.
25. Describe the structure and function of insulin receptor and associated proteins in insulin signaling.
26. Explain briefly mitochondrial electron transport chain.

(15X2=30 Marks)

SEMESTER III

BMBC309: ENZYMOLOGY

Total Hours: 72 **Credit: 4**

Objectives:

- To provide a deeper insight into the fundamentals of enzyme structure and function and kinetics of soluble and immobilized enzymes.
- It deals with current applications and future potential of enzymes.

Outcome:

- The student will learn kinetics of enzyme catalyzed reactions and enzyme inhibitory and regulatory process.
- The student will get exposure of wide applications of enzymes and their future potential.

Module 1: Introduction to Enzymes (18 hrs)

Introduction to enzymes: Role of enzyme as a catalyst of biochemical reaction. Energy of activation and its significance. Transition state theory, rate enhancement through transition state stabilization and chemical mechanisms for transition state stabilization; Enzyme Commission system of classification and nomenclature of enzymes (Class and subclass with one example). Holoenzyme, apoenzyme, and prosthetic group; Coenzymes and their functions- NAD, NADP+, FAD, FMN, lipoic acid, TPP, pyridoxal phosphate, biotin and cyanocobalamin. Ribozymes, Abzymes. Concept of ES complex binding sites and active site. Mechanism of enzyme action – acid-base catalysis and covalent catalysis, Mechanism of action of serine proteases and carboxypeptidase A. Enzyme specificity and types.

Measurement and expression of enzyme activity, units of enzyme activity, Definition of IU, katal, enzyme turnover number and specific activity.

Module 2: Enzyme Kinetics (18 hrs)

Enzyme kinetics: order of reaction, study of the factors affecting the velocity of enzyme catalyzed reaction-enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators (explanation with graphical representation). Derivation of Michaelis Menten equation; Km and Vmax values and their significance, Lineweaver-Burk plot and its physiological significance, Eadie - Hofstee plot. Bi- substrate reactions: classification with examples of each class, derivation of rate equation for bi

substrate reaction, mechanism of bi substrate reactions - random, ordered and ping pong mechanisms.

Module 3: Enzyme Inhibition (10 hrs)

Enzyme inhibition –reversible (competitive, non-competitive, uncompetitive), partial, mixed, irreversible, allosteric and feedback inhibition with examples. Suicide inhibitor. Reversible- competitive, non-competitive and uncompetitive inhibitions (with kinetics). Dose- response curves of enzyme inhibition. Mutually exclusive binding of two inhibitors; Structure-activity relationships and inhibitor design; tight binding inhibitors with examples; time dependent inhibition with examples.

Module 4: Allosteric Enzymes, Multienzyme System and Isoenzymes (12 hrs)

Enzyme regulation - allosteric, non co-operative, co-operative and cumulative regulation of enzyme activity. Allosteric enzymes: concerted and sequential models for allosteric enzymes; significance of sigmoidal behaviour, allosteric regulation: example of aspartate transcarbamoylase. Covalently modulated enzymes-reversible and irreversible covalent modifications. Zymogen form of enzymes and zymogen activation. Multienzyme system – mechanism of action of pyruvate dehydrogenase and fatty acid synthase complexes and their role in regulation of metabolic pathways. Isoenzymes- lactate dehydrogenase and creatine phosphokinase.

Module 5: Industrial application of enzymes (14 hrs)

Enzyme assays, purification and characterization of enzymes. Applications of enzymes: Immobilization of enzymes, Industrial uses of enzymes: production of glucose from starch, cellulose and dextrans, use of lactase in diary industry, production of glucose fructose syrup from sucrose, use of proteases in food, leather and detergent industry. Diagnostic and therapeutic enzymes; Enzyme engineering.

References

1. Fundamentals of Enzymology: The cell and molecular Biology of Catalytic Proteins by Nicholas C. Price, Lewis Stevens, and Lewis stevens (2000) Publisher: Oxford University Press, USA ISBN: 019850229x ISBN-13: 9780198502296, 978-0198502296
2. 2.Enzyme Kinetics: A modern Approach Book: Enzyme Kinetics: A Modern Approach by Alejandro G. Marangoni (2003) Publisher: Wiley-interscience ISBN: 0471159859 ISBN_13:9780471159858, 978-0471159858
3. Enzyme Kinetics and Mechanisms by Taylor Publisher: Spring ISBN 8184890478

ISBN-13: 9788184890471, 978-8184890471

4. Enzyme Mechanism by P.K Sivaraj Kumar (2007) Publisher: RBSA Publishers ISBN: 8176114235 ISBN -13:9788176114233, 978-8176114233
5. Enzymes and Enzyme Technology by kumar (2009) Anshan Pub ISBN: 1905740875, ISBN-13:9781905740871, 978-1905740871
6. Enzymes in Industry: Production And Applications by Aehle W (2007) Publisher: John Wiley & Sons Inc ISBN: 3527316892 ISBN -13: 9783527316892, 9783527316892, 9783527316892 Enzymes: Biotechnology, Clinical Chemistry (second Edition) by Trevor Palmer, Philip Bonner (2007) Publisher: Horwood Publishing Limited ISBN: 1904275273 ISBN-13: 978-1904275275.

BMBC310: PLANT BIOCHEMISTRY

Total Hours: 72 **Credit: 4**

Objectives:

- It provides students with fundamental knowledge of biochemistry and specific knowledge of compounds and biochemical pathways that occur in plants.
- Understand about the rich diversity of secondary compounds and metabolism in plants and how such compounds contribute to human health

Outcome:

- Learn biochemical mechanisms underlying plant metabolism.
- Understand central metabolism, its plant-specific components, and their functional significance at multiple levels.

Module 1: Cell, Photosynthesis, Photorespiration (12 hrs.)

Plant cell: Structural organization of plant cell; Photosynthesis - Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways. Genes involved in photosynthesis. Photorespiration. Photosynthetic efficiency and plant productivity.

Module 2: Nitrogen Metabolism (12 hrs)

Nitrogen metabolism: Nitrogen cycle, Biochemistry of nitrogen fixation – nitrogenase complex – structure and functions, electron transport chain and mechanism of action of nitrogenase. Structure of 'NIF'genes and its regulation. Nitrate assimilation: Enzymes of nitrate metabolism, structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. Ammonium assimilation enzymes: glutamine synthetase, glutamate synthase and GDH.

Module 3: Secondary Metabolites (18 hrs)

Major chemical classes of secondary metabolites and their roles in plants. Secondary plant products– flavanoids, polyphenols, coumarins, terpenoids, phytosterols, quinines, cyanogenic glycosides, steroidal alkaloids, tannins, acetylenes, amines, non protein amino acids, gums, mucilages, resins etc. (Structures not necessary. Give examples of the compounds and the plants in which present and their importance). Essential oils: chemical composition and properties. Chemistry and functions of pectin, tannins, hemicelluloses and cellulose. Lignin-chemistry and functions; Chemistry of fibers. Lectins. Importance of secondary metabolites; Uses of secondary metabolites to man.

Module 4: Biosynthesis of secondary metabolites (18 hrs)

General biosynthetic pathways of the following classes of secondary metabolites (structures of intermediates not necessary): Terpenoids: Isoprene as Precursor, hemi, mono, sesqui, di, triterpenes and polyterpenes with examples and important members; their functions. Phenols: simple phenols, phenol carboxylic acids, phenylpropanes, flavan derivatives, and phenolic glycosides. Broad outline of their biosynthesis, functions in plants and uses. Alkaloids: definition of true and pseudo alkaloids, Phenyl ethylamines, pyrrolidone alkaloids, Piperidine alkaloids, Pyridine alkaloids ,tropane alkaloids, quinoline and isoquinoline alkaloids, Indole alkaloids, purine alkaloids, isoprenoidal alkaloids, steroidal alkaloids.

Module 5: Plant Toxins, Antioxidative Defence System, and Sensory Photobiology

(12 hrs)

Toxins of plant origin – mycotoxins, phytohemagglutinins, lathyrogens, nitriles, protease inhibitors, protein toxins. Antioxidative defence system in plants – reactive oxygen species and their generation, enzymic and non-enzymic components of antioxidative defence mechanism. Sensory photobiology - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; biological clocks.

References

1. Plant Metabolism by H.D Kumar and H.N Singh (1980) Publisher. Macmillan (Mar 1980) ISBN-10: 0333256387: ISBN-13:978-0333256381.
2. Biotechnology: Secondary Metabolites by K.G Ramawat, (2000) Publisher: Science Publishers, U.S. ISBN-10: 1578080576 ISBN-13: 978-1578080571
3. Plant Biochemistry by P.M Dey and J.B. Harborne (Editors) (1997) Publisher: Academic Press ISBN-10:0122146743, ISBN-13:978-0122146749
4. Plant Metabolism by Prof David T. Dennis, Prof David H. Turpin, Dr Daniel D. Lefebvre and Dr David B. Layzell (Editors) (1997) publisher: Longman; ISBN-10: 0582259061, ISBN-13:978-582259065
5. Plant Biochemistry by Hans-Walter Heldt Professor Em (3ed 2004)publisher: Academic ISBN-10: 0120883910 ISBN- 13: 978-0120883912
6. The Principals of Plant Biochemistry by Murield Wheldale Onslow (1931) Publisher: Cambridge University Press ASIN: BOO2BJMXIM
7. Buchnan B B and Gruissem W and Jones R L, Molecular biology of plants, Society of American Plant physiologists

8. Anderson J W and Boardall J, Molecular activities of plant cell
9. Bonner J and Varner J E, Plant Biochemistry, Acdemic Press, New York
10. Taiz L and Zeiger E, Plant Physiology, 2 nd Ed., Sinauer Associates, Inc Publishers, Massachussetts
11. Hopkins W G, Introduction to plant physiology, John Wiley & Sonsa, New York
12. Salisbury F B & Ross C W, Plant Physiology, 4 th Ed Wadsworth Publishing Company, California
13. Noggle G R and Fritz G J, Introductory Plant Physiology, Prantice Hall of India Pvt Ltd, N. Delhi

BMBC311: MOLECULAR ENDOCRINOLOGY

Total Hours: **72** **Credit: 4**

Objectives:

- To study of endocrinology at the cellular and molecular level as well as providing a firm basis for understanding normal hormonal control.
- Learn the underlying pathologies of important endocrine diseases.
- It will provide a basic understanding of the molecular mechanisms of hormone action and will include a description of the main hormone receptors and their signal transduction pathways.

Outcome:

- Students will be able to identify the organs involved in endocrine function, will know the major hormones that are produced by these organs and will know the physiological effect of these hormones.
- Students will be introduced to the molecular mechanisms of action of many of these mediators and will start to appreciate biochemical and signalling events at the cellular and whole animal level.

Module 1: Introduction to Endocrinology (12 hrs)

History of Endocrinology, classification of hormones, overview of circulation, modification and degradation. Target tissue, feedback control. Hormone receptors- class, general features, structure and regulation. Signal transduction and role of G proteins. Feedback regulation of hormone secretion. Mechanism of extracellular and intracellular hormone action.

Module 2: Hypothalamus and Pituitary Hormones (12 hrs)

Hypothalamus and Pituitary hormones (GH, TSH, ACTH, Prolactin, LH, FSH, ADH and Oxytocin) **-** Biochemistry and mechanism of action. Regulation of synthesis and secretion. Hypo and hyper activity of pituitary hormones-gigantism, dwarfism, acromegaly, diabetes insipidus, syndrome of inappropriate ADH secretion.

Module 3: Thyroid Hormones and Parathyroid Hormones (12 hrs)

Thyroid hormones- synthesis, secretion, transport and mechanism of action. Metabolic fate and biological actions. Antithyroid agents. Thyroid diseases: thyrotoxicosis, goiter, hypothyroidism, Graves' disease and Hashimoto's disease.

Parathyroid Hormone and Calcitonin- Biological actions, regulation of calcium and phosphorus metabolism, pathophysiology.

Module 4: Adrenal Hormones and Gonadal hormones (18 hrs)

Adrenal hormones: Adrenal cortex- glucocorticoids and mineralocorticoids-synthesis, secretion, transport and mechanism of action, metabolic fate and biological actions. Adrenal medulla- catecholamines- synthesis, secretion, transport and mechanism of action, metabolic fate and biological actions. Abnormal secretion of adrenal hormones- Addison's disease, Cushing's syndrome, Congenital adrenal hyperplasia and phaeochromocytoma.

Gonadal hormones- Androgens and estrogens-synthesis, secretion, transport and mechanism of action, metabolic fate and biological actions.

Module 5: Pancreatic Hormones and Gastrointestinal Hormones (18 hrs)

Pancreatic hormones- Islets of Langerhans- hormone secretion, biosynthesis mechanism of action (insulin and glucagon) and biological functions. Pancreatic polypeptide and insulin like growth factors. Delta cells and somatostatin.

Gastrointestinal hormones- cells, synthesis, structure, secretion and functions- GIP, VIP, gastrin, CCK and other peptides.

References

1. Barington (1979) Hormones and evolution Vol I&II Academic press, New York.
2. John F- Laycock and Peter H. Wise (1983), Essential of Endocrinology
3. Wiliaimas R.H. (1974). Textbook of Endocrinology V.Ed. Saunders Press, London.
4. Harvey Lodish (2016), Molecular Cell Biology, 8th Edition
5. Bolander .Jr F.F. (2004) Molecular Endocrinology Third Edition. Academic press. San Diego
6. Goodman. H.M (2003). Basic Medical Endocrinology. Third Edition. Academic press. San Diego.
7. Negi. C.S. (2009). Introduction to Endocrinology. PHI learning Pvt Ltd. New Delhi.
8. Mac Hadley, Jonathan Levine,(2007), Endocrinology, Pearson Publication.

BMBC312: RESEARCH METHODOLOGY

Total Hours: 54 **Credit: 3**

Objectives:

To assist you in your preparation for the master's comprehensive examination in the area of research methods**.**

Outcome:

- Demonstrate the ability to choose methods appropriate to research aims and objectives
- Understand the limitations of particular research methods
- Develop skills in qualitative and quantitative data analysis and presentation

Module 1: Research Methodology: An introduction (8 hrs)

Definition and meaning of research, Objectives of research, qualities of a good research and researcher. Types of research, significance of research. Research methodology –Scientific method.

Module 2: Research Process (12 hrs)

Research design- Meaning, features, guidelines, types, functions and significance.

Sampling design- Census and sampling survey, Characteristics of good sample design, Steps in sample design.

Sampling techniques, Measurement and scaling in research (brief mention). Sources of error in measurement.

Module 3: Data Collection and Report Writing (14 hrs)

Primary data, observation method, interview method, questionnaire, schedule method, secondary data (process of data and analysis)

Report writing- principles, steps in report writing, types of report, documentation (footnotes, tables, chart, graphs, bibliography, quotations, and appendices.

Module 4: IPR (10 hrs)

Introduction, patent, copyright, trademark, design, geographical indication, trade secrets. Biopiracy, Protection of plant varieties, farmer's right. Intellectual Property rights- problems related to trade of biological items.

Protection of Biotechnological Inventions- patenting of genes, DNA Sequences, Life forms

Module 5: Bioethics- Bioethical Issues (10 hrs)

Bio-safety Environmental Impacts, Ecological ethics, Rights of future generations- Issues of commercialization. Ethics in publication- plagiarism

References

1. Panneerselvam R (2004) *Research Methodology*, Prentice Hall of India, New Delhi.
2. Jerrord HZ (1999) *Biostatistical analysis*, Prentice Hall International, London
3. ImreLakatos (1970) *Falsification and the Methodology of Scientific Research Programme*. In ImreLakatos and Alan Musgrave (eds), Criticism and the Growth of Knowledge, Cambridge University Press.
4. C R Kothari (1985), Research Methodology, Methods and Techniques. 2nd Revised Edition,(2004)New Age International Publication.
5. Wayne C booth, Gregory G Colomb, and Joseph M Williams (1995). The Craft of Research, Chicago University of Chicago Press.
6. Dina A. Zinnes (1980) Three Puzzles in Search of a Researcher, International Studies Quarterly, vol. 24 (September), pp 315-342
7. Catherine Marshall and Gretchen B. Rossman (1989). Designing Qualitative Resaerch Newbury Park, London and New Delhi: Sage Publications
8. Montgomery, Douglas C. (2007), Design and Analysis of Experiments, Wiley India.
9. Carlos CM (2000). Intellectual Property Rights, the WTO and Developing countries; The TRIPS agreement and policy options, Zed Books, New York
10. Day RA (1992) How to write and publish a scientific paper, Cambridge University Press, London
11. Golafshani N (December 2003) Understanding realiability and validity in qualitative research. The Qualitative Report, 8(4) 597-607.
12. Leedy PD and Ormrod JE (2004)Practical Research: Planning and design, Prentice Hall India, New Delhi
13. Anthony M, Graziano AM and Raulin ML (2009) Research Methods: A process of Inquiry, Allyn and Bacon
14. Bordens K and Abbott B (2005) Research designs and methods: A process approaches (6thEd). Columbus, OH: McGraw-Hill Higher Education. ISBN: 978-0-0728-8764-8
15. Singh B. D. (2008), Biotechnology Exanding Horizons, Kalyani publishers.

PRACTICAL

BMBC3P03: LABORATORY COURSE - III

Total Hours: 180 **Credit: 4**

1. **Estimation of proteins from plant or animal sources.** Total protein by biuret method or Lowry method Albumin by Bradford method or BCG method
   Total liver protein by Lowry or Biuret method
2. **Estimation of carbohydrates from plant or animal sources**
   Glucose, glycogen by OT method, Folin-wu method, anthrone method, phenol sulphuric acid method.
3. **Estimation of lipids from plant or animal sources**.
   Cholesterol by Zak's method,
4. **Determination of enzymatic activity in biological tissues- serum, plasma, liver, plant extracts, etc**
   Alanine transaminase (GPT) Aspartate transaminase (GOT) Lactate dehydrogenase
   Amylase
   Urease
5. **Enzyme kinetics**
   Effect of substrate concentration on enzymatic activity Effect of pH on enzymatic activity
   Effect of enzyme concentration on enzymatic activity
6. **Extraction of enzymes and assay**
   1. Acid phosphatase from fresh potato (Solonum tuberosum)
   2. β amylase from sweet potato (Ipomoea batates)

References

1. Introductory practical Biochemistry SK Sawhnefy and Randhir Singh (eds) Narosa publishing House, New Delhi, ISBN 81-7319-302-9 P, 195-303
2. Standard Methods of Biochemical Analysis, S.K. Thimmaiah (ed), Kalayani Publishers, Ludhiana ISBN 81-7663-067-5, p 12-18.
3. Hawk's physiological Chemistry, Bernad L. Oscer (ed) TATA MC GRAW Hill publishing Company Ltd, New Delhi.
4. Experimental Biochemistry: A student Companion Beedu Sasidhar Rao & Vijay

Deshpande (ed), I.K International Pvt Ltd, New Delhi ISBN 81-88237- 41-8.

5. Practical Biochemistry, R.C Gupta and S. Bharghava (eds) BS Publishers and Distributors, New Delhi, ISBN/81-239-0124-0
6. Practical Clinical Chemistry, Harold Varley, CBS Publishers and Distributors, New Delhi.
7. Enzymes Assays, Jeans-Louis Reymond (ed) Wiley- Vch Publishers, Germany, ISBN-13; 978-3-527-31095-1ISBN-10: 978-3-527-31095-9
8. Practical Enzymology, H. Bisswanger (ed) ISBN: 3-527-30444-4
9. Medical Biochemistry- Principles and Experiments, John F Van Pilsum and Robert J Roon (eds) University of Minnesota press, Minneapolis ISBN O-8166-1344-3.
10. Biotechnology Procedures and Experiments handbook, S. Harisha (ed) Infini science Press LLC, New Delhi ISBN: 978-1-934015-11-7.

Model Question Papers

Reg.No……

Name ……..

MSc DEGREE EXAMINATION

Third semester

M Sc BIOCHEMISTRY

BMBC309- ENZYMOLOGY

Time: 3 Hours **Maximum Mark: 75**

PART A

(Short answer questions-2 marks each)

Answer any **TEN** of the following

1. What are allosteric enzymes? Give examples.
2. Define enzyme turn over number.
3. What is Zymogen form of enzymes.
4. What are non competitive inhibition?
5. How will you define Vmax? Write down its significance.
6. What are Dose Response curves?
7. Define Km value.
8. What are coenzymes? Give some examples
9. What are isoenzymes?
10. What is time dependent inhibitors?
11. Name two enzymes that contains the coenzymes copper.
12. Give an example of multienzyme system.
13. .Name two enzymes that contains the coenzymes copper?
14. What is irreversibe inhibition? Give example?

(2x 10=20)

PART B

(Short essay type- 5 marks each)

Answer any **FIVE** of the following

15. How will you determine Km Value? Write down its significance.
16. Write down the characterization of enzymes.
17. What are competitive inhibition?
18. Derive Michaelis- Menten Equation.
19. In brief explain the interaction between enzymes and substrates

20. Write short notes on Bi-substrate Reaction.

21. Write briefly about Tight-Dependent Inhibiton with examples.

22. Briefly account on Purification of enzymes. (5x5=25)

PART C

(Long essay type-15 marks each)

Answer any **TWO** of the following

23. Explain the Isolation and Purification of enzymes.

24. Explain multienzyme complexes and their role in regulation of metabolic pathways

25. Give in detail the enzyme Commission System of Classification and Nomenclature of enzymes.

26. Expain the industrial and medical application of enzymes

(2x15=30)

Reg.No……

Name……..

M Sc. DEGREE EXAMINATION

Third semester

M Sc BIOCHEMISTRY

BMBC310- PLANT BIOCHEMISTRY

Time: Three hours **Maximum: 75 marks**

Part A

Answer any ten questions. Each question carries 2 mark.

1. Give a note on lipid composition of chloroplast membrane?
2. What is compensation point?
3. Define true and pseudo alkaloids and pyrrolidine alkaloids?
4. Mention the role of secondary metabolites in pharmceutical industry?
5. Write about the monoterpens, sesquiterpenes and diterpenes?
6. List the few examples of synthetic growth hormones with structure?
7. Why photorespiration is a wasteful process in C4 plants?
8. Write a short note on metabolic functions of auxins?
9. Mention about structure of nitrogenous complex.
10. Mention the reaction involved in glutamate synthase and GDH.
11. Give the structure of ATP synthase.
12. What is chemiosmotic theory?
13. Define photosynthetic efficiency.
14. Write a short note on metabolic functions of ethylene. (10X2=20 marks)

Part B

Answer any five questions. Each question carries 5 marks.

15. Briefly describe biosynthesis of Absicic acid and its metabolic functions?
16. Explain about phenolic compounds?
17. Write a note on nitogen metabolism?
18. Briefly explain the role of glutamine synthase , glutamate synthase and GOH in ammonium assimilation?
19. Outline Hatch and Slack pathway?
20. Describe the photosynthetic efficiency and plant productivity?
21. Mention the structure of NIF genes to its regulation in nitrogen metabolism?
22. Discuss the comparison between C3 and C4 pathway in plants?

(5×5=25 marks)

Part C

Answer any two questions. Each question carries 15 marks

23. Write a note on plant growth regulators?
24. Outline the reactions of calvin cycle and its significance?
25. Describe the major chemical classes of secondary metabolites?
    a) Alkaloids
    b) Flavanoids
26. Write the pathway involved in the dark and fixation of CO_2 in Circculents and its significance?

(2x15=30 marks)

Reg.No……

Name……..

M Sc. DEGREE EXAMINATION

Third semester

M Sc BIOCHEMISTRY

BMBC311-Molecular Endocrinology

Time: Three hours **Maximum: 75marks**

Part A

Answer any ten questions.

Each question carries 2 marks.

1. Name the hormones that regulate calcium levels in humans.
2. Comment on hypothyroidism.
3. Why is pancreas considered as both an endocrine and exocrine gland?
4. Write down the structural features of pituitary gland.
5. What are the physiological role and the mode of action of Aldosterone?
6. Name the hormones that secreted from the gastro intestinal tract.
7. What are second messengers? Give two examples.
8. List the hormone that regulates blood pressure.
9. Mention the activity of pituitary hormones on the disease gigantism and dwarfism.
10. Give the biological action of calcitonin.
11. Action of glucocorticoids on carbohydrate metabolism.
12. Outline the biosynthesis of insulin from proinsulin.
13. General features of hormone receptors.
14. Mention on feedback control.

(10×2=20 Marks)

Part B

Answer any five questions. Each question carries 5 marks

15. Write down the biosynthesis of adrenal steroid hormones.
16. What are the physiological roles of glucagon?
17. Describe the mechanism of action of glucocorticoids.
18. Name the hormones secreted by the neurohypophysis and give their physiological actions.
19. Give an account of heterotrimeric G protein
20. Write a note on panhypopituitarism.
21. Give the pathway for the synthesis of testosterone starting from cholesterol.

22. How is diabetes mellitus different from diabetes insipidus? Explain.

(5×5=25 Marks)

Part C (Long essay type questions)

Answer any two questions. Each question carries 15 marks.

23. Give a general account of gastrointestinal hormones.
24. Explain in detail about the posterior pituitary gland and its relation to the hypothalamus.
25. What are catecholamines? How are they synthesized? Mention their action and diseases associated with them.
26. Describe the mechanism of insulin action.

(2×15=30 Marks)

Reg.No……

Name……..

M. Sc. DEGREE EXAMINATION

First semester

M. Sc. BIOCHEMISTRY

BMBC312 -RESEARCHMETHODOLOGY

Time: 3 Hours **Maximum Mark: 75**

PART A

(Short answer questions-2 marks each)

Answer any **TEN** of the following

1. Define research.
2. List out the objectives of research.
3. Mention the qualities of a good research and researcher.
4. Elaborate the significance of research.
5. Write a short note on research methodology.
6. Comment on the sources of error in measurement.
7. Describe measurement and scaling in research.
8. What is meant by plagiarism?
9. Comment on census method.
10. Write a note on sampling survey.
11. Distinguish between trade dress and trade secrets.
12. Write a note on copyright.
13. Comment on farmer's right.
14. Write a note on protection of plant varieties.

(10 x 2 = 20 marks)

PART B

(Short essay type- 5 marks each)

Answer any **FIVE** of the following

15. Mention the sampling techniques involved in research.
16. Write a note on the types of research.
17. Briefly explain protection of biotechnological inventions.
18. Comment on the rights of future generations.
19. Write a short note on sampling design.
20. Elaborate the environmental impacts.

21. Explain the concept '*Ecological ethics'*.

22. Write a short note on biosafety measures. (5 x 5 = 25 marks)

PART C

(Long essay type-15 marks each)

Answer any **TWO** of the following

23. Write an essay on types of data collection. Mention the merits and demerits of each category.

24. Explain Intellectual Property rights.

25. Write an essay on the steps involved in the preparation of research report.

26. Elucidate Biopiracy.

(2 x 15 = 30 marks)

SEMESTER IV

BMBC413: CLINICAL BIOCHEMISTRY

Total Hours: 90 **Credit: 4**

Objectives:

- To extend your theoretical and practical knowledge in the fields of Biochemistry.
- It will gain an immersive laboratory experience covering concepts of experimental design, sample preparation and learning about current, state-of-the-art analytical techniques and platforms, which are routinely used in clinical practice and research.

Outcome:

- Ability to develop and perform a range of diagnostic techniques relevant to the field of laboratory medicine.
- To use logical and systemic thinking and high level critical analysis skills to solve problems by utilizing diagnostic techniques and methodologies in the chosen areas of clinical laboratory specialization.

Module 1: Automation in the Clinical Biochemistry (18 hrs)

Automation in the clinical biochemistry - Instrumental concept, selection of instruments and various instruments used in modern clinical labs. Quality assurance, Quality control; Pre-analytical, analytical and post analytical variables in quality analysis, External and internal quality control measurements. Precision, reliability, reproducibility and other factors in quality control. Good clinical practices: basics and principles. Normal values in health and diseases, Radioisotopes in diagnosis. Specimen collection (blood, urine and feaces), processing, storage of specimens and its clinical significance.

Module 2: Hematological Parameters and Clinical Analysis of Urine (18 hrs)

Hematological parameters- abnormalities of blood formation, variation of plasma proteins, Disorders of erythrocyte metabolism: hemoglobinopathies, anemias, disturbances in blood clotting mechanisms: fibrinolysis and thrombosis; Lipid profile in health and disease; Clinical analysis of urine samples.

Module 3: Kidney, Liver Gastric and Thyroid Function Tests and Disorders (18 hrs)

Kidney, liver gastric and thyroid function tests-Renal function tests, free water clearances, acute and chronic renal failure. Liver function tests: clinical features and test based on excretory functions, metabolic capacity of liver, synthetic functions of liver, serum enzymes.

Gastric disorders: Disorders of gastric function, method of evaluation, pancreatic diseases, steatorrhoea, malabsorption syndrome test for their evaluation. Gastric function tests: collection of gastric contents, examination of gastric residium, FTM and stimulation tests. Thyroid function tests.

Module 4: Pregnancy and Prenatal Diagnosis of Inborn Errors of Metabolism (18 hrs)

Pregnancy test, prenatal diagnosis of inborn errors of metabolism- amniotic fluid and fetal blood examination, acetylcholinesterase and other tests on amniotic fluid, diagnosis of chromosomal abnormalities by cytogenetics and genetic counselling. Diagnosis of genetic diseases by molecular biology techniques (cystic fibrosis, hemachromatosis, thalassemias and sickle cell anemia). AIDS- clinical diagnosis.

Module 5: Diagnostic and Therapeutic enzymes, Detoxification Mechanism, Mechanism of Drug Action (18 hrs)

Biochemical diagnosis of disease by enzymatic evaluation- principles of clinical enzymology. Enzyme patterns in disease – Liver and muscle disease, myocardial infarction: serum enzymes and isoenzymes in health and disease –aspartate aminotransferase, alanine aminotransferase, acid and alkaline phosphatases, amylase, cholinesterase, CPK, aldolase and lactate dehydrogenase. Enzymes of pancreatic origin and biliary tract.

Detoxification mechanism of the body: phase I and phase II pathways of detoxification, enzymes of detoxification, polymorphism in drug metabolizing enzymes. Mechanism of drug action and channels of its excretion.

References

1. John K. Candlish (1992). Notes on *Clinical Biochemistry* : World Scientific Publishing Company ISBN: 9810210663 ISBN-13: 9789810210663, 978-9810210663
2. William J. Marshall, Stephan K. Bangert, Elizabeth S.M. Ed. S.M (ed) Marshall (2008). Clinical Biochemistry: Metabolic And Clinical Aspects : Elsevier Science Health Science Div ISBN: 0443101868 ISBN-13: 9780443101861, 978-0443101861
3. John K. Joseph (2006). Biochemistry : Campus Books International ISBN: 8180301109 ISBN -13: 9788180301100, 978-8180301100
4. B PH.D. Marks, Allam D. Marks colleen M. Smith (1996). Basic Medical Biochemistry: A Clinical Approach Dawn Publisher; Lippincott Williams & Wilkins; illustrated edition ISBN -10: 068305595X ISBN-13: 978-0683055955
5. William J Marshall, Stephen K Bangert (2008). Clinical Chemistry, Else ISBN: 0723434603, ISBN-13:978-0723434603

6. Carl A Burits, Edward R Ashwood (2008). Tictz fundamental of clinical Chemistry : Else ISBN: 8131213749, ISBN-13: 9788131213742,978-8131213742

ELECTIVE COURSES

BMBC4E01: NUTRITION IN HEALTH AND DISEASES

Total Hours: 90 **Credit: 4**

Objectives:

- To gain an understanding of the Fundamentals of Nutrition through an examination of the identity, acquisition, and utilization of the nutrients and the science of nutrition**.**
- To learn to critically evaluate nutrition information available from a variety of sources.

Outcome:

- Students will be able to interpret and apply nutrition concepts to evaluate and improve the nutritional health of communities.

Module 1: An Overview of Nutrition (18 hrs)

An overview of nutrition: food choices, the nutrients, Nutrition assessment, diet and health. Digestion and absorption of nutrients: Carbohydrates, Proteins, Lipids and other nutrients, Factors affecting digestion, Role of dietary fibers in nutrition. Proteins-energy malnutrition, Health effects of protein, Vegetarian diets.

Module 2: Energy Balance and Body Composition (18 hrs)

Energy balance and body composition: The Kcalories of foods provide, body weight, body composition and health, weight management, Causes of obesity, Treatments for obesity. An overview of vitamins and major minerals, trace minerals. Antioxidant nutrients and phytochemicals in disease prevention. Calcium-roles in the body, calcium deficiency, Osteoporosis. Iron deficiency, iron toxicity, zinc deficiency, zinc toxicity.

Module 3: Life Cycle Nutrition (18 hrs)

Life Cycle nutrition: Pregnancy and lactation: nutrition during pregnancy and lactation, maternal health, practices incompatible with pregnancy, fetal alcohol syndrome. Nutrition in infancy and childhood. Nutrition in adolescence. The early development of chronic diseases. Nutrition in adulthood and later years. Illness and nutrition status, nutrition medications and complementary therapies.

Module 4: Nutrition and Disorders (18 hrs)

Nutrition and disorders of the gastro intestinal tract, parenteral nutrition. Nutrition in Severe stress. Nutrition and diabetes mellitus: Complication of diabetes mellitus, Treatment of

diabetes, Medical Nutrition therapy for diabetes, Mastering diabetes control. Nutrition and disorders of the heart blood vessels and lungs: Atherosclerosis, hypertension, prevention and treatment of heart disease, Diet strategies, Drug therapy, Acute respiratory failure, metabolic syndrome.

Module 5: Nutrition in Renal disease, Liver Disease and Cancer (18 hrs)

Nutrition and Renal disease: kidney stones and treatment, the nephrotic syndrome, Renal failure, Dialysis and Nutrition, Nutrition and liver disorders, Fatty liver and hepatitis, Cirrhosis, Gall stones. Medical nutrition therapy for cancer. Medical nutrition therapy for HIV. Ethical issues in Nutrition care.

References

1. Whitney, Cataldo of holfes. *Understanding normal and Clinical nutrition*. Sixth edition.
2. Tom Brody. *Nutritional Biochemistry*.
3. M.N Chatterje and R. Shindea. *A text Book of Medical Biochemistry*. Jaypee Publications.
4. R.K Murray, D.K. Garnnes and V.V Rodwell, McGraw Hill. *Harpers Illustrated Biochemistry*.
5. A.C. Guyton and J.E Hall. *Medical Physiology*. Saunders pub.
6. C.C. Chatterjee. *Human Physiology*. Medical and Allied Agency
7. Swaminathan. *Nutritional Biochemistry*.
8. S.R Rolfes, LK De Bruyne and E.N Whitney. *Life span nutrition- Conception through life*.
9. CH Robinson and MR Lawler. *Normal and Therapeutic nutrition.*

BMBC4E02: ENVIRONMENTAL SCIENCES

Total Hours: 90 **Credits: 4**

Objectives:

- Acquire an awareness of the environment as a whole and its related problems.
- Acquire the skills for identifying and solving environmental problems.

Outcome:

- Students will apply knowledge of the sciences within an interdisciplinary context in solving environmental issues such as environmental health, food and agriculture, energy, waste and pollution, climate change, population, resource management, and loss of biodiversity.

Module 1: Basic Concepts of Ecology and Environment (20 hrs)

Components of Biosphere – atmosphere, hydrosphere & lithosphere; principles and concepts of ecosystem; structure of ecosystem – abiotic and biotic factors; cybernetics and homeostasis; energy transfer in an ecosystem - food chain, food web, ecological efficiencies, trophic structure and energy pyramids, productivity; principles pertaining to limiting factors; biogeochemical cycles; terrestrial and aquatic ecosystems; intra and inter specific interactions; biomes; types of forests of India.

Biodiversity: types of diversity - genetic diversity, species diversity and ecosystem diversity; α- diversity, β-diversity & γ-diversity; biodiversity and ecosystem services; functional properties of Biodiversity; drivers and dynamics of changes in biodiversity; threats to biodiversity loss; morphological and molecular characterization of biodiversity; molecular taxonomy; methods of biodiversity conservation - In-situ Conservation: Protected Areas: Introduction, Biosphere Reserves and National Parks, On-farm and Home Garden Conservation, Ex-situ Conservation: Germplasm Collections, Botanical Gardens, Seed Banks, Test-tube Gene Banks, Pollen Banks, Field Gene Banks, DNA Banks, In-vitro conservation methods.

Concept of Sustainable Development; Bioprospecting, Bio-piracy IPR's Cryopreservation - assessing, analyzing and documenting biodiversity; IUCN – Red data book.

Module 2: Chemistry of Environment (16 hrs)

a. **Air pollution** – air pollutants (types, sources of pollution and effects of pollutants), air quality standards, sampling and monitoring, prevention and control; acid rain, ozone depletion, greenhouse effect and global warming
b. **Water pollution** – water pollutants (types, sources of pollution and effects of

pollutants), water quality standards, sampling and monitoring, prevention and control

c. **Radioactive pollution –** radioactive pollutants (types, sources of pollution and effects of pollutants),
d. **Soil pollution –** causes, effects on human and ecosystem and clean up options
e. **Toxic heavy metals -** contamination sources, entry routes, detrimental effects and remediation
f. **Aliphatic/aromatic hydrocarbons –** hydrocarbon decay, environmental effects
g. **Soaps and surfactants –** cationic, anionic and nonionic detergents, modified detergents;
h. **Pesticide residue –** classification, degradation, analysis, pollution due to pesticides; phenols and petrochemicals; organo chlorine and organo phosphates

Module 3: Treatment Technologies for Polluted Environment (22 hrs)

Biosensors - types and applications in environmental pollution detection and monitoring, Traditional Biological treatment: stabilization pond, aerated lagoon, activated sludge process trickling filter anaerobic treatment; Solid and liquid waste treatment

Environment-friendly use of microbes (bacteria and fungi) in biodegradation and Biotransformation: Bioremediation In situ and Ex situ bioremediation; Constrains and priorities of bioremediation; Evaluating Bioremediation; Bioremediation of VOCs; Biodegradation - Factors affecting process of biodegradation; Methods in determining biodegradability. Microbial transformation; Accumulation and concentration of metals; Biosorption- Oil field microbiology; improved oil recovery; Biotechnology and oil spills - Use of plants in biodegradation and environment cleaning - phytoremediation.

Xenobiotics; Persistence and biomagnifications of Xenobiotic molecules; Microbial interactions with xenobiotics; Phase I and Phase II reactions; Cyt P450 mediated reactions - Teratogens and Carcinogens: Assessment of toxicity; Assessment of environmental risks.

Module 4: Technology for Sustainable Agriculture (18 hrs)

Biodegradation of agricultural chemicals; GM Crops and their impact on environment; Biological nitrogen fixation; Phosphate solubilization; Biofertilizers; Biological control of insect pests; Role of biopesticides/ insecticides; Biocontrol of plant pathogens; Integrated pest management-practical implementation, Vermicomposting

Module 5: Technology for Resource Management (14 hrs)

Role of biotechnology in management of resources - Reclamation of wasteland: Biomass production: Biogas and biofuel production; Development of environment-friendly processes

such as integrated waste management

References

1. Alexander, M. (1999). Biodegradation and Bioremediation. 2nd Edition. Academic Press.
2. Arms, K. (2003). Holt environmental Science. Holt Mc Dougal.
3. Begon, M., Townsend, C. R. & Harper, J. L. (2005). Ecology: From Individuals to Ecosystems. 4th Edition. Wiley-Blackwell.
4. Conklin, A. R. Jr. (2004). Field Sampling: Principles and Practices in Environmental Analysis. CRC Press.
5. Crueger, W. and Crueger, A. (1990). Biotechnology: Textbook of Industrial Microbiology. Sinauer Associates Inc.
6. Enger, E. D. & Smith, B. F. (2012). Environmental Science – A Study of Interrelationships. 13th Edition.
7. Fahey, T. J. and Knapp, A. K. (2007). Principles and Standards for Measuring Primary Production. Oxford University Press, UK
8. Grant, W. E. and Swannack, T. M. (2008). Ecological Modeling. Blackwell.
9. Mido, Y. & Satake, M. (1995). Chemicals in the Environment. Discovery Publishing House, New Delhi.
10. Odum, E. P. and Barrett, G. W. (2004). Fundamentals of Ecology. 5th Edition. Brooks/Cole.
11. Prasad, M. N. V. and Strzalka, K. (2010). Physiology and biochemistry of metal toxicity and tolerance in plants. Springer Dordrecht.
12. Rittman, B. E. and Mc Carty, P. L. (2000). Environmental, Biotechnology: Principals and Applications. 2nd Edition. McGraw-Hill.
13. Sharma, B. K. (2007). Environmental Chemistry. 11th Edition. Goel Publishing House, Meerut.
14. Tyagi O. D. and Mehra, M. (1990). Textbook of Environmental Chemistry. Anmol publications.
15. Wilkinson, D. M. (2007). Fundamental Processes in Ecology: An Earth system Approach. Oxford University Press, UK
16. Wainwright, M. (1999). An Introduction to Environmental Biotechnology. Kluwer Academic Publishers.

BMBC4E03: PLANT AND ANIMAL CELL CULTURE

Total Hours: 90 **Credit: 4**

Objectives:

- It introduces the student to the theory and practice of plant tissue culture and their role from modifying plants in plant biotechnology to the propagation of endangered plants and from modifying cell lines in biotechnology to the propagation of all lines for use in medical, microbiological and biochemical research.

Outcome:

- Students will able to introduce the various components of plant tissue culture media, e.g. minerals, growth factors, hormones, and what governs the choice of components.
- Students will able to explain some of the more advanced techniques, e.g. embryo rescue, and protoplasting.

Module 1

Animal Cell Culture: Historical Background, Importance and progress in Animal Cell Culture Technology, Biology of Animal Cell; Cellular interactions, Laboratory setup and equipments, aseptic technique, different cell culture media and supplements, Importance of Serum and Serum Free Media, preparation and sterilization of cell culture media and supplements

Conventional plant breeding, tissue culture as a technique to produce novel plants and hybrids, tissue culture media (composition and preparation), Sterilization and agents of sterilization, initiation and maintenance of callus and suspension cultures, single cell clones . Organogenesis, somatic embryogenesis. Transfer and establishment of whole plants in soil. Shoot tip culture, rapid clonal propagation and production of virus free plants, embryo culture and embryo rescue.

Module 2

Different tissue culture techniques; Disaggregation of tissue and primary culture; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation ; Continuous cell lines; Passaging number; Anchorage and Anchorage independent cells and cultures; Suspension culture; Organ culture and Histotypic cultures: tissue specific stem cells; embryonic hematopoietic and neural stem cells, classification and sources.

Protoplast isolation, culture and fusion; Selection of hybrid cells and regeneration of hybrid plants; Symmetric and asymmetric hybrids, cybrids, anther, pollen and ovary culture for production of haploid plants and homozygouslines. Somaclonal variation. In vitro mutation-

sexual incompatibility and male sterility; Cryopreservation; Slow growth cultures and DNA banking for germplasm conservation.

Module 3

Division, growth forms, measurement of viability and cytotoxicity; characterization of cultured cell; cell cloning and selection; Cell synchronization; Transfection and transformation of cell; Maintenance of cell lines; cryopreservation and germplasm storage; Common cell culture contaminants. Plant transformation technology- Basis of tumor formation; Hairy root; Features of Ti and Ri plasmids; Mechanism of DNA transfer; Role of virulence genes; Use of Ti and Ri as Vectors; Binary vectors; use of scaffold attachment regions; Methods of nuclear transformation; viral vectors and their applications; multiple gene transfer; vector less or direct DNA transfer Particle bombardment, eletroporation, micro injection; Transformation of monocots; Transgene stability and gene silencing.

Module 4

Commercial scale production of animal cells, stem cells and their application; Over view of embryonic and adult stem cells for therapy; Neuro degenerative disease; Parkinsons, Alzheimer, Spinal cord injuries and other brain syndromes; Tissue system failures; Diabetes; Cardiomyopathy; Kideney failure; Liver failure, Cancer, Hemophilia, Application of animal cell culture for in vitro testing of drugs and testing of toxicity of environmental pollutants; 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.

Module 5

Cell culture reactors; Scale up in suspension; Mixing and aeration; Roating chambers; perfused suspension cultures; Fluidized bed reactors for suspension culture; scale up in monolayers; Multi surface propagators; Multiarray disks, spirals and tubes; Roller culture; Micro carries; Perfuse monolayer cultures; Membrane perfusion; Hollow fiber perfusion; Matrix perfusion; Immobilized cell culture.

References

1. Freshney, culture of Animal cell, 5th edition
2. Ed. John R.W Masters Animal cell culture-Practical approach 3rd edition, Oxford university press-2000
3. In vitro cultivation of Animal cells. Elsevier India PVT LTD-17-A/1 Main Ring Road, New Delhi-110024

4. R. Sasidhara, Animal Biotechnology MJP publishers-Chennai.
5. Plant biotechnology-J Hammond, et.al; Springer Verlag.
6. Biotechnology in crop improvement –H S chawla.
7. Practical application of plant molecular biology-R J Henry, Chapman & Hall.
8. Elements of biotechnology; P K Gupta
9. An introduction to plant tissue culture-M K Razdam.
10. Cell culture and somatic cell genetics of plants (Vols.1to3)-A K Vasil, A, Press.
11. Principles of plant biotechnology: An introduction to genetic engineering in plants SH Mantell, et al
12. Advances in biochemical engineering/ Biotechnology-Anderson, et.al.
13. Plant cell and tissue culture-S Narayanswamy, Tata Mc

BMBC4E04: BIOCHEMICAL TOXICOLOGY

Total Hours: 90 **Credit: 4**

Objectives:

- Introduces you to the principles of toxicology, with particular emphasis on the principles governing toxic responses to chemical exposures, including the disposition of toxicants, and the nature and effect of toxicity.

Outcome:

- Developed a broad and coherent body of knowledge in toxicology to support a basic understanding of the principles governing toxic responses to chemical exposures.

Module 1

Fundamentals of Toxicology and dose-Response Relationships: Introduction Biomarkers Criteria of Toxicity New Technologies Evaluation of Toxicity Interactions; Dose Response; Measurement of Dose-Response; Relationships Linear Dose Response Hormesis; Hazard and Risk Assessment Duration and Frequency of Exposure and Effect

Module 2

Factors Affecting Toxic Responses: Disposition: Absorption, Sites of absorption, distribution, Excretion; Metabolism: types of Metabolic change phase I reactions; Phase 2 reactions; control of Metabolism, Toxication vs. Detoxication

Module 3

Toxicity testing; Test protocol, Genetic toxicity testing & Mutagenesis assay: *In vitro* test systems: bacterial mutation tests-Reversion test, Ames test, Fluctuation test, and Eukaryotic mutation test. *In vivo* test system Mammalian mutation test-Host mediated assay and Dominant Lethal test. Biochemical basis of toxicity: Mechanism of toxicity: Disturbance of excitable membrane function, Altered Calcium homeostasis, Covalent binding to cellular macromolecules and genotoxicity, Tissue specific toxicity

Module 4

Toxic Responses to Foreign Compounds: Direct Toxic Action: Tissue Lesions; Mechanism and response in cellular toxicity, pharmacological, physiological and Biochemical effects; Developmental Toxicology-Teratogenesis; Immunotoxicity Genetic Toxicity; Chemical Carcinogenesis

Module 5

Biochemical Mechanisms of Toxicity: Tissue Lesions: Liver Necrosis; kidney Damage; Lung Damage, Liver damage, Cardiac damage; Neurotoxicity; Exaggerated and Unwanted

pharmacological effects; Physiological effects; Biochemical Effects: Lethal Synthesis and Incorporation, Interaction with specific Protein Receptors; Teratogenesis; Immunotoxicity; multi-Organ Toxicity

References

1. Principles of Toxicology by: Karen E Stine, Thomas M Brown 2006 Publisher. Crc Press ISBN: 084932856X ISBN: -13: 9780849328565,978-0849328565
2. Principles of Biochemical Toxicology by John A. Timbrell Publisher: Informa Healthcare ISBN: 0849373026 ISBN-13: 9780849373022, 978-0849373022
3. Environmental Toxicology by Sigmund F. Zakrzewski, (2002) Publisher: Oxford University Press, USA ISBN: 0195148118 ISBN-13: 9780195148114, 9780195148114

PRACTICAL

BMBC4P04: LABORATORY COURSE - IV

Total Hours: 180 **Credit: 4**

Clinical Biochemistry Experiments

1. Liver function tests
   - Estimation of total proteins in serum
   - Estimation of serum albumin by BCG method
   - Estimation of albumin – globulin ratio in Serum
   - Estimation of Serum bilirubin
   - Assay of SGOT& SGPT-DNPH method
   - Assay of alkaline phosphatase-King &Armstrong method
2. Renal Function tests
   - Estimation of blood urea by Diacetyl monoxime method
   - Estimation of creatinine by Jaff's method
   - Estimation of uric acid-caraway method
3. Glucose tolerance test
4. Analysis of abnormal urine.

References

1. Introductory Practical biochemistry, S.K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 195-303.
2. Standard Methods of Biochemical Analysis, S.K. Thimmaiah (ed), Kalayani Publishers, Ludhiana ISBN 81-7663-067-5, p12-18.
3. Experimental Biochemistry: A Student companion, Beedu Sasidhar Rao & Vijay Deshpande (ed), I.K International Pvt. LTD, New Delhi ISBN 81- 88237-41-8, p 13-17, p 49-72.
4. Practical Biochemistry, R.C Gupta & Bhargava (eds) CBS Publishers and distributors, New Delhi, ISBN 81-239-0124-0, p 9-27.
5. Practical Clinical Chemistry, Harold Varley, CBS Publishers and distributors, New Delhi.
6. Gradwhol's Clinical Laboratory Techniques. Stanley & Raphael. W.E. Company, London, UK.

Model Question Papers

Reg.No……

Name……..

M Sc. DEGREE EXAMINATION

Fourth semester

M Sc BIOCHEMISTRY

BMBC413- CLINICAL BIOCHEMISTRY

Time:3 Hrs. **Maximum marks: 75**

PART- A

(Answer any **TEN** questions. Each question carries **2 marks**)

1. What is meant by heamoglobin A_{1c} ?
2. Define FTM?
3. Describe about free water clearances
4. Distinguish between precision and accuracy
5. Define α-thalassemias?
6. Mention about anemias.
7. How we collect gastric contents in gastric function tests?
8. What is gout?
9. Mention about any one of the stimulations test
10. Define quality assurance.
11. Write two examples of disorders of trace elements
12. How is the detoxification done by the liver?
13. Factors involved in blood clotting .
14. Add a note on flocculation tests. (10x2=20marks)

PART- B

(Answer any **FIVE** questions. Each question carries **5** marks)

15. Write a note on disorders of erythrocyte metabolism.
16. Explain about cystic fibrosis?
17. Briefly explain about Acetyl Choline esterase and other tests on amniotic fluid?
18. Give an account on AIDS and its clinical diagnosis.
19. Mention about specimen collection and processing.
20. Give an account on Diabetic mellitus.

21. Write a note on serum enzymes?

22. Explain about Glycogen storage diseases?

(5x5=25 marks)

PART – C

(Answer any **Two** question. Each question carries **15 marks**)

23. Write an essay on Liver Function tests?

24. Give an detailed account on Quality control

25. Explain about Gastric Function tests?

26. Write an essay on chromosomal abnormalities by cytogenetics?

(2x15=30 marks)

Reg. No……

Name……

M.Sc. DEGREE EXAMINATION

Second Semester

M.Sc. BIOCHEMISTRY

BMBC4E01- NUTRITION IN HEALTH AND DISEASES

Time: 3 Hrs. **Marks:75**

PART- A

(Answer any **10** questions.

Each question carries **2 marks**)

1. What is Nutrition Assessment?
2. Write a note on Energy value of foods?
3. What are functional foods? Give examples.
4. Distinguish between Gall stones and kidney stones.
5. What are the consequents of HIV infection?
6. Mention about vegetarian diet.
7. What is the relationship between Diet and Health?
8. Distinguish between Hepatitis and Cirrhosis.
9. What is the difference between diet and health.
10. What is stress?
11. Weight management.
12. Mention factors affecting digestion
13. Comment on iron deficiency.
14. What is BMR?

(10x2=20)

PART- B

(Answer any **FIVE** questions.

Each question carries **5 marks**)

15. Give an account of the role of water in nutrition and metabolism.
16. Compare the nutrition requirements in infancy and in old age.
17. Define BMR. Write down the factors affecting BMR.
18. Give an idea about proteins in the body.
19. What is meant by Metabolic Syndrome? Explain the causes and management.
20. What are the complications of diabetes mellitus?

21. Explain the mechanism of atherosclerosis.

22. What are antioxidants? How do they prevent diseases?

(5x5=25marks)

PART – C

(Answer any **Two** question.

Each question carries **15 marks**)

23. Explain in details on nutrition during pregnancy and lactation.

24. Explain digestion, absorption and transport of carbohydrates?

25. Explain in detail the nutritional aspects of Cardiovascular diseases.

26. Explain the nutritional importance of various Vitamins and related disorders.

Reg.No……

Name……..

M. Sc. DEGREE EXAMINATION

First Semester

M.Sc. BIOCHEMISTRY

BMBC4E02 – ENVIRONMENTAL SCIENCES

Time: 3 Hours **Maximum Mark: 75**

PART A

(Short answer questions-2 marks each)

Answer any **TEN** of the following

1. Explain biological nitrogen fixation.
2. Differentiate between teratogens and carcinogens.
3. Mention the factors affecting process of biodegradation.
4. Write notes on organophosphates.
5. Comment on green house gases.
6. List out the sources of radioactive pollution.
7. Explain soil profile.
8. List the methods in determining biodegradability.
9. What is bioprospecting?
10. Comment on stabilization pond.
11. Give a brief account on water quality standards.
12. Comment on Red data book.
13. Explain modified detergents.
14. Mention the effects of acid rain. (10 x 2 = 20 marks)

PART B

(Short essay type - 5 marks each)

Answer any **FIVE** of the following

15. Comment on cryopreservation.
16. Explain the techniques involved in molecular taxonomy.
17. Write a short note on ozone depletion.
18. Mention the environmental effects of heavy metal toxicity.
19. Comment on the biological control of insect pests.
20. Give a detailed description on the forests types of India.
21. Describe the persistence and biomagnifications of Xenobiotics.

22. Comment on reclamation of wasteland. (5 x 5 = 25 marks)

PART C

(Long essay type - 15 marks each)

Answer any **TWO** of the following

23. Write an essay on biogeochemical cycles.

24. Compare the types, sources and effects of air and water pollutants.

25. Write an essay on GM Crops and their impact on environment.

26. Critically evaluate the concept of sustainable development and the current trends.

(2 x 15 = 30 marks)

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