DEPARTMENT OF
MICROBIOLOGY

Curriculum and Syllabus for Postgraduate Programme in Microbiology
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

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S. B College Changanassery

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Changanassery

13. **Mrs.Anju Susan Joy**

Assistant Professor

Department of Microbiology & Biochemistry

S.B College, Changanassery

MISSION

Provide quality education and impart futuristic scientific skills

VISION

- Our vision is to produce highly qualified and competent students in all the selected area of Microbiology
- Cooperation with other scientific departments and faculties for establishing interdisciplinary specialization such as biophysics, bioinformatics, medical microbiology, etc.
- Continuous strengthening of the scientific and cultural relationships with the scientific organizations
- Preparation of graduates who can fulfill the needs of the scientific research laboratories, and the national projects
- Provision of an educational system that faculties preparation for young and brilliant scientists who contribute in the development of the society.
- Focusing on the studies and researches in both academic and applied fields that aim at development and community services.

OBJECTIVES OF THE PROGRAMME:

On completion of the course candidates shall have achieved the following objectives:

- A detailed knowledge of structure, function and application of microorganisms.
- Skills in handling microorganisms in the laboratory.
- An understanding of applications of microorganisms in the industry, health-care, environmental protection, food, agriculture and research.
- Understanding current trends in microbiology and critically appraising published work
- Demonstrating an ability to design, undertake and interpret a research project presented in the form of a dissertation

PROGRAMME OUTCOME:

Students will able to acquire retained and apply specialized knowledge relevant to microbiology. They acquire competency in laboratory safety and in routine microbiological laboratory skills through involvements in research and internship activities. Course includes 10hrs labs per week.

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 Industrial training

Student should undergo an Industrial Training for a minimum period of 50 hours at any reputed institution. The Industrial Training programme shall be carried out preferably during the summer vacation following the second semester. Students should submit a training completion cum attendance certificate and a report of the training programme. The credits of the industrial training programme shall be included in the third semester.

4.13 End-semester assessment

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

4.14 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.

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

4.16 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.

4.17 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**

4.18 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.

4.19 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.

4.20 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**

4.21 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).

4.22 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

4.23 **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

4.24 **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.

4.25 **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

4.26 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.

ercentage of Marks	**rade**	**Performance**	**rade Point**
95 and above	S	Outstanding	10
5 to below 95	A+	Excellent	9
5 to below 85	A	Very Good	8
5 to below 75	B+	Good	7
5 to below 65	B	Above Average	6
5 to below 55	C	Satisfactory	5
0 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	BMMB101	Biochemistry	4	72	4	25	75	100
	BMMB102	General Microbiology	4	72	4	25	75	100
	BMMB103	Physiology and Biostatistics	4	72	4	25	75	100
	BMMB104	Cell Biology and Genetics	3	54	3	25	75	100
	BMMB1P01	Laboratory Course – I (P)	10	180	4	25	75	100
		Total	**25**	**450**	**19**	**125**	**375**	**500**
Semester II	BMMB205	Molecular Biology and Genetic Engineering	4	72	4	25	75	100
	BMMB206	Immunology	4	72	4	25	75	100
	BMMB207	Biophysics, Bioinstrumentation and Bioinformatics	4	72	4	25	75	100
	BMMB208	Metabolism and Enzymology	3	54	3	25	75	100
	BMMB2P02	Laboratory Course - II (P)	10	180	4	25	75	100
		Total	**25**	**450**	**19**	**125**	**375**	**500**
Semester III	BMMB309	Food Microbiology and Quality Assurance	4	72	4	25	75	100
	BMMB310	Industrial Microbiology	3	54	3	25	75	100
	BMMB311	Environmental and Agricultural Microbiology	4	72	4	25	75	100
		Elective Course	4	72	4	25	75	100
	BMMB3P03	Laboratory Course - III (P)	10	180	4	25	75	100
	BMMB3IT	Industrial Training		50	1	100		100
		Total	**25**	**500**	**20**	**225**	**375**	**600**
Semester IV	BMMB412	Systemic Bacteriology	5	90	4	25	75	100
	BMMB413	Virology, Mycology and Protozoology	5	90	4	25	75	100
		Elective Course	5	90	4	25	75	100
	BMMB4P04	Laboratory Course - IV (P)	10	180	4	25	75	100
	BMMB4PJ	Project	-	-	4	25	75	100
	BMMB4VV	Viva-Voce	-	-	2	-	100	100
		Total	**25**	**450**	**22**	**125**	**475**	**600**
		Grand Total	**-**	**-**	**80**	**600**	**1600**	**2200**

ELECTIVE COURSES

Course Code	Course Title
BMMB3E01	Nano Biotechnology
BMMB3E02	Microbial Diversity and Extremophiles
BMMB3E03	Marine Microbiology
BMMB4E04	Clinical Microbiology
BMMB4E05	Molecular Microbiology
BMMB4E06	Environmental Science

SEMESTER I

BMMB101: 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: (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: (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: (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: (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: (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

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8. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. & Walter, P. (2008). *Molecular Biology of the Cell*. 5th Edition. Garland Science.
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BMMB102: 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.

Outcomes:

- 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 (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 (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 (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 (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 (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.
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11. Russell, A. D., Hugo, W. B., and Ayliffe, G. A. J. (1999). *Principles and practice of disinfection, preservation and sterilization*, 3rdEdition. Blackwell Science, Oxford.

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BMMB103: 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.

Outcomes:

- 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.

Human Physiology

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

Module 1: (18 hrs)

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 (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 (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 disorded, 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 (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 (10 hrs)

Biostatistics

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

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2. Hall, J. E. (2010). *Guyton and Hall Textbook of Medical Physiology*. 12th Ed. Saunders.

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14. Rosner, B. (2010). *Fundamentals of Biostatistics*. 7th Ed. Cengage Learning.

BMMB104: 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.

Outcomes:

- 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: (6 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: (6 hrs)

Specialized forms of membranes: brush border; flagella, red cell membranes, microsomal membrane functions. Membrane fluidity, asymmetry, lipid raft, functions of membrane proteins & 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: (7 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: (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, NFkB pathways; signalling by TGFβ 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: (21 hrs)

Genetics

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*. 5th Edn. John Wiley and Sons Inc.

2. Weaver, R. F. (2011). *Molecular Biology*. 5th Edition. McGraw-Hill Higher Education.
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12. Pollard, T. D., Earnshaw, W. C. & Lippincott-Schwartz, J. (2007). *Cell Biology*. 2nd Ed. Saunders.

PRACTICAL

BMMB1P01: 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, disaccharideand 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*. I. K International Pvt. Ltd, New Delhi.
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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 Paper

Reg.No……

Name……..

MSc DEGREE EXAMINATION,

First semester

MSc MICROBIOLOGY

BMMB101- 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?

Reg.No……

Name……..

M.Sc DEGREE EXAMINATION,

First semester

MSc MICROBIOLOGY

BMMB102- 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. MICROBIOLOGY

BMMB103 – 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……..

M.Sc DEGREE EXAMINATION, NOVEMBER 2019

First semester

M.Sc MICROBIOLOGY

BMMB104 - 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

BMMB205: MOLECULAR BIOLOGY AND 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.

Outcomes:

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: (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: (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: (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: (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. Ti-plasmids, Expression vectors. Construction of genomic libraries and cDNA libraries, procedures for recombinant selection and library screening. Chemical synthesis of DNA, DNA sequencing -plus and minus 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: (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.

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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.

BMMB206: 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.

Outcomes

- 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: (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: (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, Radio-

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

Module 3: (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 :(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 :(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

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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. Anes Book's Pvt. Ltd., New Delhi.

BMMB207: 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.

Outcomes:

- 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: (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.

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: (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: (18 hrs)

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

Module 4: (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: (10 hrs)

Bioinformatics: Introduction to bioinformatics, application of data mining in Bioinformatics, Biological databases and search tools, sequence databases, structural data bases, derived and specialized data bases. 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

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2. Cantor, C. R. & Schimmel, P. R. (2008). *Biophysical Chemistry, The Behaviour of biological macromolecules*, Vol I,II, III. W H Freeman & Co 2.
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10. Schulz, G. E. & Schirmer, R. H. (1979). *Principle of Protein Structure*. Springer Verlag, Berlin, Heidelberg, New York.

BMMB208: METABOLISM AND ENZYMOLOGY

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.

Outcomes:

- 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(12 hrs)

Metabolism of carbohydrates: Glycolysis and its regulation, Etner Dudoruff pathway, gluconeogenesis-reactions and regulation. Glycogenesis and glycogenolysis. Citric acid cycle- reactions, regulation and energetics. Glyoxylate cycle.Significance of mitochondrial respiratory chain and oxidative phosphorylation. Electron transport chain: structural components of the chain. Generation of the electrochemical proton gradient: chemiosmotic ATP synthesis. Structural and functional properties of ATP synthase. Inhibitor agents and decoupling agents of the respiratory chain and ATP synthesis; synthesis of bacterial peptidoglycan .Bacterial photosynthesis and accessory pigments.

Module 2 (11 hrs)

Metabolism of proteins, lipids and nucleic acids: general reactions of amino acid metabolism- transamination, deamination, decarboxylation and urea cycle. Metabolism of individual amino acids-valine, leucine, isoleucine, tyrosine, tryptophan, phenyl alanine and methionine.β oxidation and biosynthesis of fatty acids. Cholesterol-synthesis and degradation Synthesis of purines and pyrimidines-salvage pathway, degradation and regulation of pathway.

Module 3 (12 hrs)

Enzymes and Enzyme kinetics: Holoenzyme, apoenzyme, and prosthetic group,

mechanism of enzyme action, transition state stabilization, enzyme specificity and types, Enzyme Commission system of classification and nomenclature of enzymes, ribozymes and abzymes**.** Coenzymes and their functions - NAD, $NADP^{+,}$ FAD, FMN, lipoic acid, TPP, pyridoxal phosphate, biotin and cyanocobalamin. Measurement and expression of enzyme activity, enzyme assays. Definition of IU, katals, enzyme turnover number and specific activity.

Order of the reaction, factors affecting the velocity of enzyme catalyzed reaction, derivation of Michaelis -Menten equation, Km value and Vmax value and their significance, Lineweaver- Burk plot and its physiological significance; Bi-substrate reactions: classification with examples of each class, reaction mechanisms-random, ordered and ping pong.

Module 4 (12 hrs)

Enzyme inhibition and regulation: Reversible and irreversible - examples. Reversible-competitive, noncompetitive and uncompetitive inhibition, feed back inhibition (with kinetics); Dose response curves of enzyme inhibition; mutually exclusive binding of two inhibitors.

Allosteric enzymes: concerted and sequential models for allosteric enzymes; significance of sigmoidal behaviour, allosteric regulation: example of aspartate transcarbamoylase. Zymogen form of enzymes and zymogen activation; Isoenzymes-lactate dehydrogenase and creatine phosphokinase.

Module 5 (7 hrs)

Application of enzymes: immobilisation 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.

References

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PRACTICAL

BMMB2P02: LABORATORY COURSE - II

Total Hours: 180 **Credit: 4**

MICROBIOLOGY AND IMMUNOLOGY

1. General rules in microbiology laboratory
2. Culture media and it's preparation
3. Microscopic examination of bacteria in living conditions
   -Wet mount preparation
   -Hanging drop method
4. Staining procedures- Gram's, Volutin, Spore, Capsule, Negative, Acid Fast, Fungal staining etc.
5. Cultivation of bacteria, fungi
6. Sterilization methods
7. Study of cultural characteristics and biochemical reaction of bacteria
8. Testing of disinfectants
9. Bacterial growth curve
10. Antibiotic sensitivity tests- disc diffusion, MIC
11. Serological tests for the diagnosis of microbial infections-VDRL, WIDAL, RPR, CRP ,ASO
12. Immunodiffusion in gel
13. ELISA

MOLECULAR BIOLOGY AND GENETIC ENGINEERING

1. PAGE- Protein separation
2. Isolation of DNA from different sources- plants and microorganisms.
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.

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4. Dubey, R. C. & Maheshwari, D. K. (2002).*Practical Microbiology.* S. Chand & Company Limited.
5. Aneja, K. R. (2003).*Experiments in Microbiology, Plant Pathology and Biotechnology*.4th Edition. New Age International.
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7. Sambrook, J., Fritsch, E. F. & Maniatis, T. (1989). *Molecular Cloning: A Laboratory Manual*. Volume 3.2nd Edition. Cold Spring Harbor, New York: Cold Spring Harbor Laboratory Press.

Model Question Papers

Reg.No……

Name……..

MSc DEGREE EXAMINATION

Second Semester

M.Sc MICROBIOLOGY

BMMB205-MOLECULAR BIOLOGY& 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 MICROBIOLOGY

BMMB206-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 (CSS PG) EXAMINATION, Second Semester

M.Sc. MICROBIOLOGY

BMMB208-METABOLISM AND ENZYMOLOGY

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. What are allosteric enzymes? Give examples
3. Give Structure of ATPase
4. What is Zymogen form of enzymes.
5. What are non competitive inhibition?
6. How will you define Vmax? Write down its significance.
7. What are Dose Response curves?
8. Define Km value.
9. What are coenzymes? Give some examples
10. What are isoenzymes?
11. What is time dependent inhibitors?
12. Draw the structure of cholesterol
13. Give an eg of multienzyme system.
14. What is the application of enzymes in leather industry?

(10X2=20 Marks)

PART B

(Short essay type- 5 marks each)

Answer any **FIVE** of the following

14.Outline the reactions of Urea cycle?

15.Write the structure of cholesterol and outline the biochemical functions.

16. Derive Michaelis- Menten Equation

17. Write a note on photophosphorylation.

18.Outline gluconeogenesis and its regulation.

19. Write down the characterization of enzymes.

20 . Explain de novo and salvage pathway of pyrimidine.

21. Write briefly about Tight-Dependent Inhibiton with examples

(5X5=25 Marks)

PART C

(Long essay type-15 marks each)

Answer any **TWO** of the following

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

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

24. Expain the industrial and medical application of enzymes

25. Explain briefly mitochondrial electron transport chain.

(15X 2=30 Marks)

SEMESTER III

BMMB309: FOOD MICROBIOLOGY AND QUALITY ASSURANCE

Total Hours: 72 **Credit: 4**

Objectives:

- This course also deals with microbiological analysis of food to determine the safety and quality of food

Outcomes:

- Understand the beneficial role of microorganisms in food processing and the microbiology of different types of fermented foods
- Study the different types of microorganisms in milk and their activities.
- Understand the significance and activities of microorganisms in various food and role of intrinsic and extrinsic factors on microbial growth in foods leading to spoilage,
- and understand the principles underlying the preservation methods
- Recognize and describe the characteristics of important food borne pathogens
- Understand of the basis of food safety regulations and discuss the rationale for the use of standard methods and procedures for the microbiological analysis of food.

Module 1: (8 hrs)

Food and microorganisms- historical developments, microorganisms important in food: molds - general characters, classification and identification, molds of industrial importance. Yeasts and yeast-like fungi - general characters and classification, yeasts of industrial importance. Bacteria: Morphological, cultural and physiological characters important in food bacteriology, genera of bacteria important in food bacteriology. Factors affecting growth of microorganisms.

Module 2: (20 hrs)

Microbial Food Spoilage and Food Preservation: Contamination of food from natural sources. Pre-harvest and post-harvest contamination of vegetables and fruits. Contamination during processing and transport. Spoilage of perishable foods (vegetables and fruits, meat and meat products, milk and milk products, fish and other sea foods, egg and poultry products).Canning procedures and processes, spoilage of canned foods. Microbiological examination of milk and milk products. Applications of microbial enzymes in dairy industry [Protease, Lipases]. Preservation methods: physical and

chemical methods, natural organic molecules (nisin) and enzymes. Biosensors in food industry.

Module 3: (18 hrs)

Microbiology of food items: Fermented food-milk and milk products, bread, vinegar, wine, beer, fermented vegetables, Indian fermented foods, oriental foods, fermented meats and fish. Microorganisms as food-production of edible mushrooms, SCP. Probiotics and prebiotics. Genetically engineered microorganisms in the Food Industry.

Module 4: (8 hrs)

Food borne diseases- intoxication and food poisoning, *Staphylococcus, Clostridium, Escherichia coli and Salmonella* infections and Mycotoxins. Emerging foodborne diseases.

Module 5: (18 hrs)

Importance and functions of quality control, methods for quality assessment, sterilization control and sterility testing. Sampling and specification of raw materials and finished products. A comparison of quality control and quality assurance. Use of microbiological methods in Quality-Control system and Quality- Assurance system.

Food laws and regulations- National food legislation/authorities and their role, product certifications (ISI mark of BIS). International organization and agreements-FAO,WHO, concept of codex alimentarius, codex India, world international organization for standardization(ISO).Food safety: General principles, issues and factors affecting food safety, risk management, Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP),Hazard Analysis Critical Control Point System(HACCP),Hurdle effect, quality management system. Shelf life of food products- factors affecting shelf life and methods to check the shelf life. Food Packaging and labelling.

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12. Waites, M. J. (2001). *Industrial Microbiology*. Blackwell Science, Oxford.
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BMMB310: INDUSTRIAL MICROBIOLOGY

Total Hours: 54 **Credit: 3**

Objectives:

- Appreciate how microbiology is applied in manufacture of industrial products, learn methods in discovery of new useful microorganisms and acquire knowledge of the design of Fermentors and process controls.

Outcomes:

- Develop an understanding of fermentation & inoculum media, their formulation and principles & techniques of sterilization.
- Appreciate the different types of fermentation processes & understand the biochemistry of various fermentations and product recovery methods.
- Get acquainted with techniques applicable for Improvement of microorganisms based on known biochemical pathways and regulatory mechanisms and learn the methods of immobilization of enzymes and cells.
- Identify techniques applicable for Improvement of microorganisms based on known biochemical pathways and regulatory mechanisms
- Comprehend the techniques and the underlying principles in downstream processing.

Module 1: (8 hrs)

Pasteur and Fermentation; Scope of industrial microbiology. Isolation and screening of industrially useful microorganisms, Primary and secondary screening, Strain improvement in industrial microbiology; improvement of characters other than product yield. Storage of cultures for repeated fermentations

Module 2: (10 hrs)

Design of a fermentor, instrumentation and process control; Types of fermenters. Importance of media in fermentation, media formulation and modification. Industrial sterilization, Inoculum development- scaling up of process form shake flask to industrial fermentation

Module 3: (12 hrs)

Fermentation process: Types of fermentations: aerobic and anaerobic; surface, submerged and continuous fermentations. Downstream processing. Detection and assay of fermentation products. Computer control of fermentation process.

Module 4: (16 hrs)

Microbial production of Industrial solvents (Ethyl alcohol, Glycerol and acetone butanol);

organic acids (Citric acid, Lactic acid, Acetic acid and Itaconic acid) amino acids(Glutamic acid and Lysine), Ergot alkaloids, Vitamins(Vitamin B_{12}, Vitamin B_2 and Vitamin C)antibiotics(Penicillin, Steptomycin, Tetracyclin, Griseofulvin), Microbial transformations of steroids.

Module 5: (8 hrs)

Modern trends in microbial production of bioplastics (PHB, PHA), biopolymers (dextran, alginate, xanthan, pullulan), Recombinant DNA products: insulin, somatostatin, interferon. Immobilization of microbial cells. Bio warfare, Biosensors.

References

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BMMB311: ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

Total Hours: 72 **Credit: 4**

Objectives:

To understand various aspects of environmental microbiology and microbial ecology and to become familiar with current research in environmental microbiology.

Outcomes:

- Learn the occurrence, abundance and distribution of microorganism in the environment and their role in the environment
- Understand various plant microbes interactions especially rhizosphere, phyllosphere and mycorrhizae and their applications especially the biofertilizers and their production techniques
- Understand the basic principles of environment microbiology and be able to apply these principles to understanding and solving environmental problems – waste water treatment and bioremediation.

Module 1: (8 hrs)

Aerobiology -Microbial contamination of air - Sources of contamination, microbial indicators of air pollution. Enumeration of bacteria in air, air sampling devices. Air sanitation. Effect of air pollution on plants and human.

Module 2: (18 hrs)

Aquatic microbiology: Microbiology of water- water pollution and water borne pathogens. Microbial indicators of water pollution. Bacteriological examination of water. Purification and disinfection of water.

Microbiology of sewage-sewage characteristics – wastewater treatment –primary, secondary and tertiary treatment, anaerobic sludge digestion. BOD and COD.

Module 3: (16 hrs)

Microbial flora of soil and factors affecting them, Bio geochemical cycling – Nitrogen, Carbon, Phosphorus, Sulphur cycles and its importance. Microbial interaction – plant-microbe, microbe-microbe interactions.

Biological nitrogen fixation-symbiotic and free living nitrogen fixation, physiology and genetics of nitrogen fixation. Phosphate solubilization. Phytopathology – Bacterial, fungal and viral diseases of plants and their control measures.

Module 4: (12 hrs)

Microbial products and plant health- PGPR (plant growth promoting rhizobacteria); Siderophore production. Significance of mycorrhizae, microbial herbicides. Microbial control of pests-bacterial, viral and fungal agents. Biological control agents in plant diseases, integrated pest management. Biofertilizers, GM crops and its importance.

Module 5: (18hrs)

Recycling of solid wastes – Composting, Biogas. Biodegradation- Parameters influencing Biodegradation. Types of biodegradation reactions- aerobic and anaerobic. Biodegradation of Lignin, cellulose, dyes, herbicides and pesticides. biodegradation of petroleum products. biomagnification. Bioremediation and micro remediation, role of genetically engineered microorganisms in bioremediation. Bioleaching of metals, microbial methylation. Microbial corrosion- Biofilms, Microbial enhanced oil recovery (MEOR)

References

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PRACTICAL

BMMB3P03: LABORATORY COURSE - III

Total Hours: 180 **Credit: 4**

AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY

1. Isolation and Study of common soil bacteria, fungi and actinomycetes
2. Enumeration of soil microbes by plate culture methods
3. Study of antagonistic activities among soil microbes
4. Estimation of rhizosphere microbial population and calculation of R:S ratio
5. Isolation of non-symbiotic nitrogen fixing bacteria
6. Isolation of *Rhizobium* from nodules of leguminous plants
7. Study of common plant pathogens
8. Isolation of phosphate solubilizing microorganisms
9. Isolation of mycorrhizal spores and its identification
10. Bacteriological examination of air
11. Bacteriological examination of water- SPC, MPN Presumptive, Confirmed and Complete test etc.
12. Winogradsky column
13. Determination of BOD, DO & COD

FOOD AND INDUSTRIAL MICROBIOLOGY

1. Bacteriological examination of food- vegetables, meat products, traditional foods etc
2. Bacteriological analysis of milk, standard plate count, presumptive test for coliforms, methylene blue reduction test and phosphatase test.
3. Cultivation of edible mushrooms.
4. Immobilization technique
5. Crowded plate technique for screening of industrially important microorganisms- microbes producing enzymes, antibiotics etc.
6. Production of wine
7. Production of citric acid
8. Solid state and submerged fermentation

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2. Aneja, K. R. (2003). *Experiments in Microbiology, Plant Pathology and Biotechnology*.4th Edition. New Age International.
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Model Question Papers

Reg. No……

Name……..

M.Sc. DEGREE EXAMINATION

Third Semester

M.Sc. MICROBIOLOGY

BMMB309 - FOOD MICROBIOLOGY AND QUALITY ASSURANCE

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

PART A

(Short answer questions-2 marks each)

Answer any **TEN** of the following

1. Outline the importance of biosensors in food industry?
2. Discuss genetically engineered microorganisms in the Food Industry?
3. Give an account on microbiological examination of milk?
4. What are the difference between Probiotics and prebiotics?
5. Describe production of SCP?
6. How the spoilage of vegetables and fruits occurs?
7. What precautions should be taken to ensure quality assurance?
8. Explain the production of beer?
9. What is aflatoxin?
10. Summarize the production of fermented vegetables?
11. Explain Morphological, cultural and physiological characters important in food bacteriology?
12. Mention the role of good Manufacturing Practices?
13. Discuss the applications of microbial enzymes in dairy industry?
14. Comment on GMP and GLP

(10X2=20 Marks)

PART B

(Short essay type- 5 marks each)

Answer any **FIVE** of the following

Describe spoilage of milk and milk products?

15. Briefly describe the production of vinegar?
16. Give an account on different Preservation methods?
17. Mention the role of Hurdle effect?

18. Explain food laws and its regulation?

19. Describe the factors affecting growth of microorganisms in food?

20. Explain HACCP in detail?

21. Briefly explain the production of mushroom?

(5X5=25 Marks)

PART C

(Long essay type-15 marks each)

Answer any **TWO** of the following

22. Explain the Canning procedures, processes and spoilage of canned foods?

23. Write an essay on food borne infections and intoxication?

24. Elaborate the use of microbiological methods in Quality control?

(15X2=30 Marks)

Reg. No……

Name……..

M.Sc. DEGREE EXAMINATION

Third Semester

M.Sc. MICROBIOLOGY

BMMB310 INDUSTRIAL MICROBIOLOGY

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

PART A

(Short answer questions-2 marks each)

Answer any **TEN** of the following

1. What are antifoams? Give examples.
2. Comment on biopolymers.
3. Explain the contributions of Louis Pasteur in Industrial microbiology
4. Briefly explain the immobilization of microbial cells
5. Give an account on culture collection centers
6. What is primary screening? Explain
7. Differentiate between surface and submerged fermentation process.
8. Why *Aspergillus niger* is preferred for citric acid production
9. Briefly explain the fermentative production of Vitamin B12
10. Write down the production of vinegar
11. What is meant by scaling up process
12. Comment on recombinant DNA products
13. Mention the steps involved in the recovery of lactic acid.
14. Briefly explain air lift fermentor.

(10X2=20 Marks)

PART B

(Short essay type- 5 marks each)

Answer any **FIVE** of the following

15. Briefly explain the strain improvement in industrial microbiology.
16. Elaborate the fermentative production of Ethyl alcohol in detail.
17. Comment on the microbial transformation of steroids
18. Write a note on inoculum preparation in fermentation
19. Explain computer control of fermentation process.

20. What are biosensors? Explain
21. Give an account on secondary screening methods.
22. Comment on industrial sterilization process.

(5X5=25 Marks)

PART C

(Long essay type-15 marks each)

Answer any **TWO** of the following

23. Write in detail about the isolation and preservation of industrially important microorganisms?
24. Explain the basic design of a fermentor. What are the different types of fermentors used?
25. Elaborate the downstream processing in industrial microbiology
26. Give a detailed account on the microbial production of antibiotics.

(2X15=30 Marks)

Reg.No……

Name……..

M.Sc. DEGREE EXAMINATION, OCTOBER 2019

Third Semester

M.Sc. MICROBIOLOGY

BMMB311- ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

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

PART A

(Short answer questions-2 marks each)

Answer any **TEN** of the following

1. Differentiate between protocooperation and mutualism
2. Define bioleaching.
3. Mention the significance of carbon cycle in the environment.
4. Give an account on biological oxygen demand.
5. Discuss the effects of air pollution on plants and animals.
6. Comment on the microbial flora of soil and factors affecting them.
7. What are GM crops?
8. Comment on CRYEMA test
9. Differentiate BOD and COD
10. Mention the significance of carriers in biofertilizers.
11. Role of microbes in biofilm formation
12. Give an account on microbial indicators of air pollution
13. Discuss the role of methanogens in biogas production
14. Write an account on neutralism

(10 x 2=20 Marks)

PART B

(Short essay type- 5 marks each)

Answer any **FIVE** of the following

15. Discuss the role of microbes in marine fouling.
16. Write down the etiology, symptomology and of any two bacterial diseases of plants
17. Discuss the enumeration of bacteria from air.
18. Explain non symbiotic nitrogen fixation with appropriate examples.
19. Briefly explain the various steps involved in composting
20. Describe the infection process of vesicular arbuscular mycorhizae.

21. Explain microbial enhanced oil recovery
22. .Illustrate the major steps in sulphur cycle.

(5x 5=25 Marks)

PART C

(Long essay type-15 marks each)

Answer any **TWO** of the following

23. Give a detailed account on bioremediation processes.
24. Elaborate the various microbial interactions with suitable examples.
25. Explain the production of nitrogen bio fertilizers with special emphasis on Rhizobium species.
26. Write an essay on microbial contamination of air and give an account on indicators of air pollution.

(15x2=30 Marks)

SEMESTER IV

BMMB412: SYSTEMIC BACTERIOLOGY

Total Hours: 90 **Credit: 4**

Objectives:

- To impart knowledge of the basic principles of bacteriology and **to** teach laboratory skills in the disciplines.

Outcomes:

- Know the morphological, biochemical, cultural properties of bacteria.
- Get complete information on pathogenesis of bacterial diseases
- Comprehend the diagnosis of bacterial infections and prevention methods

Module 1: (6 hrs)

Normal bacterial flora of human body; General attributes and virulence factors of bacteria causing infections, Host Parasite relationships.

Module 2: (16 hrs)

Study of morphology, cultural characteristics, pathogenesis, diagnostic lab tests and prevention of the following bacterial pathogens. Aerobic Cocci- *Staphylococci, Streptococci* and *Neisseriae*. Anaerobic cocci-*Peptostreptococcus, Peptococcus* and *Veillonella*.

Module 3: (16 hrs)

Gram positive bacilli- *Corynebacterium* and *Bacillus*. Anaerobic rods- *Clostridia, Propionibacterium, Bifidobacterium, Bacterioides, Fusobacterium* and *Leptotrichia*.

Module 4: (30 hrs)

Gram negative bacilli- Enterobacteriaceae- *E.coli, Proteus, Klebsiella, Shigella, Salmonella, Vibrio, Pseudomonas, Haemophilus, Yersinia, Bordetella* and *Brucella*.

Miscellaneous Bacteria-*Listeria, Campylobacter, Helicobacter.*

Module 5: (22 hrs)

Spirochetes- Treponema and Borelia. Acid fast bacilli-*M.tuberculosis* and *M.leprae*, Non tuberculous mycobacteria, Actinomycetes and Nocardia, Mycoplasma, Rickettsiae and Chlamydiae.

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BMMB413: VIROLOGY, MYCOLOGY AND PROTOZOOLOGY

Total Hours: 90 **Credit: 4**

Objectives:

- Students will gain knowledge about the various viral, fungal and protozoan infections and their control and prevention.

Outcomes:

- Learners will be able to gain information properties of viruses, virions and prions
- Assimilate knowledge on epidemiology, diagnosis and treatment of various viral disease.
- Use an understanding of medical mycology and parasitology to make appropriate and effective on-the-job professional decisions.
- Adapt parasitology and mycology laboratory techniques.

Module 1: (26 hrs)

Virus infections: Pathophysiology and epidemiology for the diseases caused by Pox virus, Herpes virus, Adeno virus, Entero virus, Myxo virus, Arbo virus, Rhabdo virus, Hepatitis virus and HIV.

Module 2: (14 hrs)

Viruses and cancer - Viruses implicated in the cancers of humans. Slow virus infection, Prion diseases. Antiviral agents. Mechanisms of action of Interferons.

Module 3: (16 hrs)

Fungal infections in man. Superficial mycoses (Pityriasis Versicolor; Tinea Nigra; Piedra). Cutaneous mycoses (Various forms of Tinea, *Microsporum* spp., *Trichophyton* spp., and *Epidermophytonfloccosum).* Subcutaneous mycoses (Mycotic mycetoma, Chromoblastomycosis; Sporotrichosis; Rhinosporidiosis) Systemic Mycoses (Blastomycosis;Paracoccidioidomycosis; Histoplasmosis; Coccidioidomycosis).Opportunistic fungal Infections.

Module 4: (16 hrs)

Laboratory diagnosis of fungal diseases. Impact of exposure on human health to fungal toxins. Mushroom poisoning, Antimycotic agents and treatment options.

Module 5: (18 hrs)

Protozoa- Medically important protozoans. *Entamoeba histolytica*, *Giardia lamblia*, Trypanosomes, *Leishmania*, *Plasmodium* and *Toxoplasma.* Laboratory diagnosis and control of medically important protozons.

References

1. Cann, A. J. (2005). *Principles of Molecular Virology*. 4th Edition. Elsevier Academic Press.
2. Pichare, A. P. & Nagoba, B. S.(2013).*Medical Microbiology: Prep Manual for Undergraduates*. Elsevier India Pvt. Ltd.
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16. Richardson, M. D. & Warnock, D.W. (2004). *Fungal Infection: Diagnosis and Management*. Wiley.
17. Ash and Orihel (1997). *Human Parasitology*. 4th Edition. ASCP Press, 18.Peters and Gilles (1995). *Tropical Medicine and Parasitology*. Mosby-Wolfe

PRACTICAL

BMMB4P04: LABORATORY COURSE - IV

Total Hours: 180 **Credit: 4**

1. Study of the morphology, staining characters, cultural characters and identification of medically important bacteria *Staphylococci, Streptococci, E.coli, Klebsiella, Salmonella, Proteus, Pseudomonas, Vibrio, Bacillus.*
2. Isolation and identification of bacteria from mixed culture.
3. Study of common laboratory contaminants.
4. Culture methods for isolation and identification of fungi- KOH mount preparation,
5. Lactophenol cotton blue staining, Slide culture technique etc.
6. Gram staining and Germ tube test of *Candida albicans*
7. Cultivation of viruses in embryonated eggs different routes – harvesting
8. Examination of peripheral blood for malarial parasites
9. Techniques for collection of clinical specimens for microbiological analysis-
10. Macroscopic,microscopic examination of clinical samples.

References

1. Cheesbrough, M. (2006).*District Laboratory Practice in Tropical Countries.* Vol.2. 2nd Ed. Cambridge University Press.
2. Sonnenwirth, A. C. & Jarrett, L. (1980). *Gradwohl's Clinical Laboratory Methods and Diagnosis*.8th Ed. Mosby, St Louis, Mo.; London.
3. Cappuccino, J. G. & Sherman, N. (2008). Microbiology: A Laboratory Manual. 9th Ed. Pearson/Benjamin Cummings.
4. Mackie, T.J., McCartney, J.E. & Collee, J.G. (1989).*Mackie & McCartney Practical Medical Microbiology*.13th Ed Churchill Livingstone.
5. Rowland, S. S., Walsh, S. R., Teel, L. D. & Carnahan, A. M. (1994).*Pathogenic and Clinical Microbiology: A Laboratory Manual*. Lippincott Williams and Wilkins.
6. Prince, C. P. (2009).*Practical Manual of Medical Microbiology*. Jaypee Brothers Medical Publishers (p) Ltd., New Delhi.
7. Collee, J. G., Mackie, T. J. & McCartney, J. E. (1996).*Mackie and McCartney Practical Medical Microbiology*. Churchill Livingstone, New York.

Model Question Papers

Reg.No……

Name……..

M.Sc. DEGREE EXAMINATION

Fourth semester

M.Sc. MICROBIOLOGY

BMMB412-SYSTEMIC BACTERIOLOGY

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

PART A

(Short answer questions-**2 marks** each)

Answer any **TEN** of the following

1. Define bile solubility test?
2. Mention LT toxin?
3. What is ETEC?
4. Differentiate Streptococcus pneumonia from Streptococcus pyogenes?
5. Mention the selective media & its composition for Gonococci?
6. Comment on Nagler's reaction
7. Give an account on Peptostreptococci
8. Define epidemic with example?
9. Comment on Satellitism
10. What is Q fever
11. Write a note on Lepromin test
12. Give an account on Petrussis toxin
13. Define Listeriosis
14. What is coagulase test? (10 X 2= 20 Marks)

PART B

(Short essay **5 marks** each)

Answer any **FIVE** of the following

Write a note on Mantoux test?

15. Briefly describe Actinomycosis?
16. Mention the antigenic structure of Salmonella?
17. Write down the morphology, cultural characteristics and pathogenesis of Mycoplasma.
18. Describe briefly on Anthrax?

19. Give an account on etiology & pathogenesis of veneral disease of Gonorrhea?
20. Describe briefly about the normal flora of human body
21. Mention the special media used in the cultivation of cholera vibrios?

(5 X 5=25 Marks)

PART C

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

Answer any **TWO** of the following

22. Explain the etiology, pathogenesis,epidemiology, lab diagnosis,treatment of bacillary dysentery?
23. Give an account in detail the etiology, pathogenesis, lab diagnosis,treatment of tuberculosis?
24. Explain urinary tract infection in detail?
25. Describe briefly the cultural characteristics,virulence factors,toxins,pathogenesis,lab diagnosis of staphylococcus aureus?

(15 X 2= 30 Marks)

Reg. No……

Name……..

M.Sc. DEGREE EXAMINATION

Fourth Semester

M.Sc. MICROBIOLOGY

BMMB413- Virology Mycology and Protozoology

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

PART A

(Short answer questions-**2** marks each)

Answer any **TEN** of the following

1. Describe the structure of influenza virus?
2. Comment on antigenic drift and antigenic shift.
3. Write a note on polio vaccines
4. Comment on paramyxovirus
5. Write a note on prions
6. Comment on Pityriasis versicolor
7. What are Dermatophytes?
8. Describe the host range of polio viruses?
9. Describe the importance of arboviruses?
10. Brief account on Giardia lambia
11. Comment on oncogenic viruses
12. Describe the prophylaxis and treatment of varicella?
13. Brief account on Epstein- barr virus.
14. Morphology of Adenovirus. (10X2=20marks)

PART B

(Short essay type- 5 marks each)

Answer any FIVE of the following

15. Explain the clinical features and Lab diagnosis of Herpes Simplex?
16. Give a detailed account on cytomegaloviruses?
17. Describe about the antigens in influenza virus?
18. Give a detailed account on Mumps virus?
19. Explain the, properties and complications of Arbo viruses?
20. Write a short essay on Slow virus infections?

21. Describe the Laboratory diagnosis of fungal diseases?

22. Laboratory diagnosis of HIV. (5X5=25marks)

Part-C

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

Answer any **TWO** of the following

23. Write the structure of Rhabdo virus, Adeno virus and HIV virus? Comment on the disease caused by these viruses?

24. Write an essay on Superficial Mycosis and Deep Mycosis?

25. Explain in detail about Giardia lamblia, Trichomonas, Trypanosomes?

26. Explain in detail type B Hepatitis (2X15=30marks)

ELECTIVE COURSES

BMMB3E01: NANO BIOTECHNOLOGY

Total Hours: 72 **Credit: 4**

Objective:

- This course brings a fundamental understanding of the integrated multidisciplinary nature of Nanotechnology and it's applications in biological science.

Outcome:

- To make them understand the basic science behind the properties of materials at the nanometer scale, and the principles behind advanced experimental techniques for studying nanomaterials.
- Get acquainted with the applications of Nano science in various industries.

Module 1: (12 hrs)

Basic concepts, Fundamentals and future prospects of Nanotechnology – Historical and Modern Aspects of Nanotechnology. Nanomaterials - Types, properties and technological advantages of various Nanostructures - Quantum dot, Quantum wire, Quantum well, Dendrimers, Nano-robots, Nanofluidics, Carbon Nanotubes, Graphene, and nanocomposites. Nanobiotechnology – concept and trends.

Module 2: (18 hrs)

Synthesis of nanoparticles –Top- down and Bottom-Up approaches. Physical, Chemical and Biological fabrication of nanoparticles. Use of biological sources (microorganisms, plants, proteins) in biosynthesis of nanoparticles - Extracellular and intracellular synthesis, Interaction of nanoparticles with biomolecules. Mechanisms involved in microbial synthesis, Advantages of biosynthesis – biocompatibility. Metal and polymer nanoparticles.

Module 3: (12 hrs)

Characterization of nanoparticles – Spectroscopy (UV-Visible and Raman Spectroscopy) Microscopy (TEM, SEM, AFM and STM), Quantitative analysis (EDS, X-Ray Photoelectron Spectroscopy) XRD, FTIR, NMR, TGA and DLS.

Module 4: (18 hrs)

Applications – Nanoparticular carrier system, Nanofabrication, nanosensors, Nano-imaging, Gene therapy, Cancer diagnosis and therapy, targeted drug delivery- peptide mediated and nanoparticle mediated, controlled drug release, tissue engineering, Nanoparticles as

Antimicrobial agent, Nanolithography, DNA and Protein Microarrays, prosthetic and medical implants, Nanotechnology in Agriculture/Food/water purification, Nanotechnology in Electronics, Nanotechnology in Textile, Nanotechnology in Energy.

Module 5: (12 hrs)

Nanotoxicology - Toxicity of nanoparticles - Interactions of nanoparticles with cells and their cellular toxicology. Specific physicochemical properties linked to Nano toxicity. Mechanisms of NP-induced toxicity and other bio-effects. Proper NP characterization and assessment of NPs in the biological milieu. Safety issues of metal-based nanoparticles. Potential health and environmental effects of nanoparticles.

References

1. Parthasarathy, B.K. (2007). *Introduction to Nanotechnology*, Isha Books.
2. Papazoglou E. & Parthasarathy, A. (2007). *Bionanotechnology* of *Synthesis Lectures on Biomedical Engineering.* Volume 7. Morgan& Claypool Publishers.
3. Rehm, B. (2006). *Microbial Bionanotechnology: Biological Self-assembly Systems and Biopolymer-based Nanostructures.* Horizon Bioscience.
4. Reisner, D. E. & Bronzino J. D. (2009). *Bionanotechnology: Global prospects.* CRC Press.
5. Nalwa H.S. (2005). *Handbook of Nanostructured biomaterials and their applications in Nanobiotechnology*. American Scientific publications.
6. Wilson, M., Kannangara, K., Simmons M. & Raguse, B. (2005). *Nano Technology – Basic Science and Emerging Technologies*. 1st Edition. Overseas Press, New Delhi.

BMMB3E02: MICROBIAL DIVERSITY AND EXTREMOPHILES

Total Hours: 72 **Credit: 4**

Objective:

- Describe the diverse group of microbes and their adaptations in extreme environments

Outcome:

- Understand the microbial classification schemes used for taxonomy and identification of microorganisms.
- Understand conventional and molecular methods used for studying microbial diversity.
- Acquire knowledge of biochemistry and physiology of extremophiles for their application potentials in Biotechnology

Module 1: (18 hrs)

Biodiversity: Introduction to Microbial biodiversity – distribution, abundance, ecological niche. Types- Bacterial, Archael and Eucaryal. Molecular techniques for studying microbial biodiversity- use of DNA probes, markers, Expressed sequence tagging (EST), Denatured Gradient Gel electrophoresis, RFLP, RAPD, MALDI-TOFF, Fluorescent in situ hybridization (FISH) Conservation of marine Bio resources, Metagenomics etc.

Module 2: (18 hrs)

Characteristics and classification of Archaebacteria: Psychrophiles; Thermophiles: Classification, habitats and ecological aspects. Extremely Thermophilic Archaebacteria, Applications of thermozymes and psychrophilic archaeal extremozymes; Methanogens: Classification, Habitats and applications.

Module 3: (12 hrs)

Alkalophiles and Acidophiles: Classification, alkaline environment, soda lakes and deserts, calcium alkalophily Applications. Acidophiles: Classification, life at low pH, acidotolerence, applications.

Module 4: (12 hrs)

Halophiles and Barophiles: Classification, Dead Sea, discovery basin, cell walls and membranes – Purple membrane, compatible solutes. Osmoadaptation / halotolerence.

Applications of halophiles and their extremozymes. Barophiles: Classification, high-pressure habitats, life under pressure, barophily, death under pressure.

Module 5: (12 hrs)

Space Microbiology: Aims and objectives of Space research. Life detection methods

a] Evidence of metabolism (Gulliver) b] Evidence of photosynthesis (autotrophic and heterotrophic) c] ATP production d] Phosphate uptake e] Sulphur uptake. Monitoring of astronauts microbial flora:

Reference

1. *Extremophiles* by Johri B.N. 2000. Springer Verlag, New York
2. *Microbial Diversity* by Colwd, D. 1999, Academic Press.
3. *Microbial Life in Extreme Environments*. Edited by D. J. Kushner. Academic Press.
4. *Microbiology of Extreme Environments.* Edited by Clive Edward. Open University Press. Milton Keynes.
5. *Microbiology of Extreme Environments and its potential for Biotechnology*. Edited by M.S. Da Costa, J.C. Duarate, R. A. D. Williams. Elsevier Applied Science, London.
6. *Extreme Environment. Mechanism of Microbial Adaptation*. Edited by Milton R. Heinrich. Academic Press.
7. *Thermophiles. General, Molecular and Applied Microbiology*. Edited by Thomas D. Brock. Wiley Interscience Publication.
8. *Microbial Ecology*. *Fundamentals and Applications* by. Ronald M. Atlas and RichardBartha.2ndand 4thEdition.The Benjamin Cummins Publication Co. Inc.

BMMB3E03: MARINE MICROBIOLOGY

Total Hours: 72 **Credit: 4**

Objective:

- This course is aimed to understand microbiology of marine environment with special emphasis on microbiological ecology, adaptability, marine pollution and marine microbial biotechnology

Outcome:

- Acquire basic understanding of marine microorganisms and their applications in various fields

Module 1: (16 hrs)

Marine Microbial flora: Marine environment – sea-benthic & littoral zone, salt pan, mangroves and estuarine microbes, microbial loop – marine microbial community – planktons, bacteria, fungi, protozoa, marine invertebrate associated microorganisms Methods of collection and estimation of marine microbes. Influence of physical, chemical and biological factors on marine microbes.

Module 2: (12 hrs)

Marine Adaptability: Survival at extreme environments – starvation – adaptive mechanisms in thermophilic, alkalophilic, osmophilic and barophilic, psychrophilic microorganisms – hyperthermophiles and halophiles

Module 3: (12 hrs)

Marine Microbial Disease: Marine food borne pathogens & Water borne pathogens – A*eromonas, Vibrio, Salmonella*, *Pseudomonas,*etc.

Module 4: (14 hrs)

Marine Pollution: Microbial indicators of marine pollution and control, invertebrate associated microorganisms.- biofouling, biocorrosion, biofilms and bioremediation

Module 5: (18 hrs)

Marine Microbial Biotechnology: Marine natural products, valuable chemicals, bioactive compounds from marine microorganisms, marine bio-sensor. Biosurfactants, biopolymers and novel enzymes from marine organisms.

References

1. Prescott, L. M., Harley, J. P. & Klein, D. A. (2005).*Microbiology*.6th Ed. McGraw-Hill, Boston, London.

2. Maier, R. M., Pepper, I. L. & Gerba, C. P. (2009) *Environmental Microbiology.* Elsevier Academic Press.
3. Nybakken, J. W. & Bertness, M. D. (2005).*Marine biology: an ecological approach.* Pearson/Benjamin Cummings.
4. Belkin, S. & Colwell, R. R. (2006).*Oceans and Health: Pathogens in the Marine Environment.* Springer Science + Business Media.
5. Gal, Y. L., Ulber, R. & Antranikian, G. (2005).*Advances in Biochemical Engineering/Biotechnology Advances in Biochemical Engineering / Biotechnology Series Vol 96. Marine Biotechnology Vol 1* Series Editor: Scheper.
6. Bhakuni, D. S. & Rawat, D. S. (2005).*Bioactive Marine Natural Products.* Springer.

BMMB4E04: CLINICAL MICROBIOLOGY

Total Hours: 90 **Credit: 4**

Objective:

- Describe microbiological laboratory safety, various microbial infections their diagnostic procedures

Outcome:

- Provides opportunities to develop diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.

Module 1: (18 hrs)

Microbiology laboratory safety - Biological Safety Cabinets; Biocontainment, Biosafety Levels; Biosafety guidelines- biosafety concerns at the level of individuals, institutions; Laboratory and associated infections. Good microbiological practices. Classification of biological agents based on hazards. Transportation of biohazardous materials & precautions

Module 2: (18 hrs)

Diagnostic cycle; General concepts for specimen collection, transport and processing. Infection control, Emerging infections, Accreditation of laboratories

Module 3: (22 hrs)

Etiology, pathogenesis and laboratory diagnosis of- Blood Stream infections, Respiratory Tract infections, Central Nervous System infections, Gastrointestinal Tract infections, Urinary Tract infections, Genital Tract infections. Sexually transmitted diseases and nosocomial infections.

Module 4: (18 hrs)

Skin, soft tissue and wound infections. Burn infections, Infections of sinuses, Infections of eye and ear. Pyogenic infections. Infections in immune compromised and immune deficient patients. Infections in foetus and neonates.

Module 5: (14 hrs)

Serodiagnosis of infectious diseases; Routine diagnostic procedures, Molecular techniques in diagnostic microbiology. Laboratory control of antimicrobial therapy.

References

1. Black, J. G. (2014). *Microbiology: Principles and Explorations*. 9th Ed. Wiley.
2. Sood, R. (2003). *Medical Laboratory Technology: Methods and Interpretations*.

Jaypee Brothers Medical Publishers.

3. Kindt, T. J., Goldsby, R. A. &Osborne, B. A. (2006). *Kuby Immunology*. 6th Ed. W. H. Freeman & Company.
4. Forbes, B. A., Sahm, D. F. & Weissfeld, A. S. (2007). *Bailey & Scott's Diagnostic Microbiology*. 12th Ed. Mosby-Year Book, London.
5. Mukherjee, K. L. & Ghosh, S. (2010). *Medical Laboratory Technology*. 2nd Ed. Tata McGraw-Hill Education.
6. Sonnenwirth, A.C., and Jarett, L. (1980). *Gradwohl's Clinical Laboratory Methods and Diagnosis*. 8th Ed. Mosby-Year Book, London.
7. Cheesbrough, M. (2006). *District Laboratory Practice in Tropical Countries*. Vol.2. 2nd Ed. Cambridge University Press.
8. Mackie, T. J., McCartney, J. E. and Collee, J. G. (1989). *Mackie & Mccartney Practical Medical Microbiology*. 13th Ed Churchill Livingstone.
9. Topley, W. W. C., Wilson, G. S., Parker, T. and Collier, L. H. (1990). *Topley and Wilson's Principles of Bacteriology, Virology and Immunology*. Hodder Arnold.
10. Blair, J. E., Lennette, E. H. & Truant, J. P. (1970). Manual of Clinical Microbiology. American Society for Microbiology

BMMB4E05: MOLECULAR MICROBIOLOGY

Total Hours: 90 **Credit: 4**

Objective:

- Application oriented field which mainly deals with the study of molecular mechanisms, exploitation of microorganisms and rDNA technology.

Outcome:

- Elucidate the molecular techniques involved in gene manipulation and rDNA technology; explain the significance of gene transfer methods for the production of transgenics.

Module 1: (18 hrs)

Phylogenetic overview of bacteria and archaea, Molecular biology of microbial evolution, rRNA sequence and cellular evolution, Signature sequences and phylogenetic probe. Identification and characterization of microorganisms. Molecular typing methods: Bacterial strain typing, Pulsed Field Gel Electrophoresis, PCR-based microbial typing, Genotyping by Variable Number Tandem Repeats, Multilocus Sequence Typing, Automated Ribotyping, G+C percentage , DNA-DNA hybridization Molecular subtyping for epidemiology.

Module 2: (18 hrs)

Genome wide approach to study prokaryotic biology, Microbial genome – comparison of genome size, Insight from genome of *E.coli*, *Streptomyces coelicolor* and *Neurospora crassa*. Unculturable bacteria and Metagenomics. Bacterial differentiation and molecular basis of endospore formation, Microbial stress response, Microbes in special habitat: Bacterial biofilm, molecular basis of biofilm development, biofilm dispersal strategies, biofilm in infection, quorum sensing. Extremophiles, molecular adaptation to extreme environment. Endophytes – metabolite diversity.

Module 3: (18 hrs)

Molecular basis of microbial virulence. Bacterial adherence: basic principles, effects of adhesion on bacteria and host cells. Bacterial invasion of host cells; mechanism. Bacterial toxins: classification based on molecular features, Identification of novel toxins by genome mining, Application of bacterial toxin in cell biology and pharmacology.

Module 4: (18 hrs)

Microbial induction of apoptosis. Molecular and visual clinical diagnosis methods. Molecular detection and characterization of bacterial pathogens, detection of bioterrorism. Laboratory controls and standards in molecular diagnostics.

Module 5: (18 hrs)

Microbial production of recombinant proteins : expression, purification and applications, Microbes in plant transformation, *Agrobacterium tumefaciens* T-DNA transfer process, Manipulation of *Agrobacterium* for genetic engineering, vectors for *Agrobacterium* mediated transformation,

Microbial production of plant metabolites; engineering *E.coli* for the production of curcumin. Combinatorial and engineered biosynthesis, Microbial polyketides and their applications.

References

1. Persing, D. H. (2011).*Molecular microbiology: diagnostic principles and practice.* 2nd Ed ASM Press, Washington, DC.
2. Madigan, M. T., Martinko, J. M. (2006).*Brock biology of microorganisms.*11th Ed. Pearson Prentice Hall, Upper Saddle River, NJ; London.
3. Moat A. G., Foster J. W. & Spector M. P. (2002).*Microbial physiology.* 4th Ed. Wiley-Liss, New York.
4. Prescott L. M., Harley J. P., & Klein D. A. (2005) *Microbiology.*6th Ed. McGraw-Hill, Boston; London.

BMMB4E06: ENVIRONMENTAL SCIENCE

Total Hours: 90 **Credit: 4**

Objectives:

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

Outcomes:

- 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: (18 hrs)

Definition, principles and scope of environmental science. Earth, Man and environment, ecosystem, pathways in ecosystem. Physico-Chemical and Biological factors in the environment. Geographical classification and Zones. Structure and functions of ecosystem-Abiotic and biotic components, Energy flows, Food chains, Food web, Ecological pyramids: types and diversity. Terrestrial (Forest, grass land) and Aquatic (Fresh water, marine, eustarine) ecosystems. Mineral cycling. Habitat and niche. Major terrestrial biomes. Impact of microorganisms on global ecology, Microorganisms in extreme environment.

Module 2: (18 hrs)

Definition, Principles and scope of ecology. Human ecology and Human settlement. Evolution, origin of life and speciation. Population ecology: characteristics and regulation. Community ecology: structure and attributes. Levels of species diversity and its management, Edges and Ecotones. Ecological succession. Common flora and fauna in India. Endangered and Threatened Species.

Module 3: (18 hrs)

Biodiversity status: monitoring and documentation. Biodiversity management approaches. Conservation of biological diversity, methods and strategies for conservation. Natural resources, conservation and sustainable development. Hotspots of biodiversity, National parks and Sanctuaries.

Module 4: (18 hrs)

Environmental pollution- Air: Natural and anthropogenic source of pollution, Primary and Secondary pollutants, Methods of monitoring and control of air pollution, Effects of pollutants on human beings, plants, animals, material and on climate, Acid rain, Air Quality

standards. Water: Types, Sources and consequences of water pollution, Physio-chemical and Bacteriological sampling and analysis of water quality, Soil: Physio-chemical and Bacteriological sampling as analysis of soil quality, Soil pollution- Control, Industrial waste effluents, and heavy metals. Their interaction with soil components, Noise: Sources of noise pollution, Noise control and battement measures. Impact of noise on human health. Radioactive and thermal Pollution. Bioremediation- Strategies for bioremediation, |biosensors, biological indicators of pollution and monitoring, Detoxification of hazardous chemicals, mycotoxins. Biological weapons.

Module 5: (18 hrs)

Introduction to environmental impact analysis, Impact Assessment Methodologies, Generalized approach to impact analysis, Guidelines for Environmental Audit, Introduction to environmental Planning, Environmental priorities in India and Sustainable development, Environment protection- issues and problems, International and national efforts for environment protection. Global environmental problems- Ozone depletion, global warming, climatic change, desertification, green movement, ecofeminism. Current environmental issues in India

References

1. Chapman, J. L. & Reiss, M. J. (1999). *Ecology: principles and applications.*2nd Ed. Cambridge University Press, Cambridge.
2. Jones, A. (1997).*Environmental biology.* Routledge, London
3. Odum, E. P. & Barrett, G. W. (2005).*Fundamentals of ecology.*. 5th Ed. Thomson Brooks/Cole, Belmont, CA.
4. Odum, E. P. (1983).*Basic ecology.* Saunders College, Philadelphia, London
5. Kumar, A. (2004).*A Textbook of Environmental Science.* APH Publishing Corporation
6. Allaby, M. (2000).*Basics of Environmental Science.* Routledge.
7. Cunningham, W. P., Cunningham, M. A. & Saigo, B. W. (2003).*Environmental science: a global concern.* 7th Ed. McGraw-Hill, Boston, London.
8. Pickering, K. T. & Owen, L. A. (1997) *An introduction to global environmental issues.* 2nd Ed. Routledge, London

Model Question Papers

Reg. No……

Name……..

M.Sc. DEGREE EXAMINATION

Third Semester

M.Sc. MICROBIOLOGY

BMMB3E03- Marine Microbiology

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

PART A

(Short answer questions-**2** marks each)

Answer any **TEN** of the following

1. What is Biofouling?
2. Note on Salt pan?
3. Write down the role of phytoplanktons in marine environment?
4. List out the commonly occurring bacterial genera in marine water?
5. Describe about osmophilic and barophilic microorganisms?
6. Explain the symptoms of *Comblyobacter jejuni* gastro enteritis?
7. Write a short note on Bio-corrosion?
8. What is Bio-sensor?
9. Differentiate benthic and littoral zone
10. Name any 2 enzymes from marine organisms. Mention their use
11. What is carbonate equilibrium system in sea water
12. Define algal bloom
13. Name any two natural product obtained from marine environment
14. Comment on microbial loop? (10 X 2 = 20marks)

PART B

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

Answer any **FIVE** of the following

15. Briefly explain microbial indicators of marine pollution and their control?
16. Write a detailed account on Biofilm formation?
17. Write about the adaptive mechanisms in thermophilic and barophilic condition?
18. Define the influence of biological factors on marine microbes
19. Write a note on enzymes from marine organisms?

20. Mention the importance of microbial biosensors in marine environment

21. List out the applications of transgenic marine organisms?

22. *E.coli*– An indicator of marine pollution. Explain? (5X5=25 Marks)

PART C

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

Answer any **TWO** of the following

23. Write an essay on marine food borne pathogens?

24. What is bioremediation? Write a detailed account on Bioremediation in marine environment?

25. Explain in detail the survival at extreme environments?

26. Write an account on valuable chemicals obtained from marine microorganisms .mention their Uses? (2 X 15 = 30marks)

Reg. No……

Name……..

M.Sc DEGREE EXAMINATIONS , MARCH 2019

Fourth Semester

M.Sc. MICROBIOLOGY

BMMB4E04 -Clinical Microbiology

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

PART A

(Short answer questions-2 marks each)

Answer any **TEN** of the following

1. Write down the etiology and symptomology of blepharatis and conjunctivitis
2. Comment on peritonsilar abscesses
3. Keratitis is considered as a situation of emergency.Why?
4. Distinguish between transient and continuous bacteraemia
5. Give an account on joint infections
6. Describe TORCH complex
7. Explain various biosaftey levels
8. Give an account on joint infections.
9. Define acute upper respiratory tract infections.
10. Give an account on blood stream infections
11. Comment on emerging infections.
12. Briefly explain the laboratory control of antimicrobial therapy
13. What is lumbar puncture?
14. Comment on Griess nitrate test

(10X2=20 Marks)

PART B

(Short essay type- 5 marks each)

Answer any **FIVE** of the following

15. Briefly explain the laboratory control of antimicrobial therapy
16. Comment on pyogenic infections
17. Write down the classification of biological agents based on hazards
18. Explain the clinical features of skin infections.
19. Discuss the various laboratory associated infections.
20. Briefly explain the infections in immunocompromised patients.

21. Give an account on sexually transmitted diseases.
22. Explain nosocomial infections

(5X5=25 Marks)

PART C

(Long essay type-15 marks each)

Answer any **TWO** of the following

23. Give a detailed account on the etiology, symptomology, and pathogenesis and lab diagnosis of urinary tract infections.
24. Elaborate the various molecular techniques used in diagnostic microbiology.
25. Elaborate the general concepts of specimen collection transport and processing in clinical microbiology.
26. Write an essay on central nervous system infections

(15X2=30 Marks)

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