DEPARTMENT OF
MICROBIOLOGY

Curriculum and Syllabus for
Model III BSc Zoology and Industrial Microbiology
(Double Core) Programme
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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PROGRAMME OBJECTIVES

The programme is designed to help the students to:

1. Impart basic knowledge in Microbiology, Zoology and related subjects meant both for a graduate terminal course and for higher studies
2. Acquire basic knowledge and skills for employment in the field of Microbiology especially Industrial Microbiology.
3. Inculcate interest in and love of nature with its myriad living creatures.
4. Understand the unity of life with the rich diversity of microorganisms and their ecological significance.
5. Acquire basic skills for the utilization of microbes for human welfare.
6. Acquire basic skills in the observation and study of nature, biological techniques, experimental skills and scientific investigation.
7. Acquire basic knowledge and skills in applied branches to enable them for self-employment.
8. Impart awareness about the conservation of the biosphere.

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. To gain hands-on experience related to field of microbiology.

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 faculty's 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.

MEMBERS OF BOARD OF STUDIES

1. Dr. Joe Prasad Mathew (Chairman)

Associate Professor

Department of Zoology

S. B College Changanassery

2. Dr. Vijayan K T V

Assistant Professor

Department of Microbiology

Government College for Women

Vazhuthacaud,

Thiruvananthapuram.

3. **Dr. Radhakrishnan E. K.**

Assistant Professor School of Biosciences

M.G University Kottayam

4. **Dr. Sajeevan T P**

Assistant Professor

National Center for Aquatic Animal health

Fine Arts Avenue

CUSAT, Cochin

5. **Suresh Kumar (**Industry Nominee of Board of Studies)

Director

Bio Merieux

6. **Sneha P Joseph (**Alumni representative)

Microbiologist

Believers church Medical College

Thiruvalla

7**. Jeena M John**

Assistant Professor

Department of Microbiology & Biochemistry

S.B College

Changanassery

8. **Sweety K Ennacheril**

Assistant Professor

Department of Microbiology & Biochemistry

S.B College

Changanassery

9**. Jiji Jacob**

Assistant Professor

Department of Microbiology & Biochemistry

S.B College

Changanassery

10. **Julie Nadayil**

Assistant Professor

Department of Microbiology & Biochemistry

S.B College

Changanassery

11. **AksharaRetheeshBabu**

Assistant Professor

Department of Microbiology & Biochemistry

S.B College

Changanassery

12. **Dr. Vincy Mary Varghese**

Assistant Professor

Department of Microbiology & Biochemistry

S.B College

Changanassery

13. **Anju Susan Joy**

Assistant Professor

Department of Microbiology & Biochemistry

S.B College

Changanassery

REGULATIONS FOR UNDERGRADUATE (UG) PROGRAMMES UNDER CREDIT SEMESTER SYSTEM (SB-CSS-UG) 2019

1. SHORT TITLE

1.1 These Regulations shall be called St. Berchmans College (Autonomous) Regulations (2019) governing undergraduate programmes under Credit Semester System.

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 undergraduate programmes, BA/BSc/BCom/BCA, 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-UG 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 undergraduate 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 undergraduate programme undertaken in the Department.

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

3.9 'Duration of Programme' means the period of time required for the conduct of the programme. The duration of an undergraduate programme shall be six (6) 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 portion of a subject to be taught and evaluated in a semester.

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

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

3.14 'Complementary Course' means a course, which would enrich the study of core courses.

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

3.16 'Common Course II' means additional language, which can be opted by a student, from among the languages offered by the College.

3.17 The Common Course I and II is compulsory for all students undergoing undergraduate programmes.

3.18 'Open Course' means a course offered by the departments other than the parent department outside the field specialization of the student, which can be opted by a student.

3.19 'Elective Course' means a course, which can be substituted, by equivalent course from the same subject.

3.20 'Vocational Course' means a course that enables the students to enhance their practical skills and ability to pursue a vocation in their subject of specialization.

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

3.22 '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.

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

3.24 There will be two categories of extra credit courses, mandatory and optional. If a candidate fails to complete the mandatory course, he/she shall complete the same within the tenure of the programme.

The details of the extra credit and audit courses are given below:

Semester	Course	Type
I	Course on Basic Life Support System and Disaster Management	Compulsory, audit course, Grades shall be given
I to VI	Value Education	Compulsory, extra credit
	Virtual Lab experiments/MOOC	Optional, extra credit
II & III	Add on Course	Compulsory, extra credit, Grades shall be given
Summer vacation following semester II	50 hours (10 days) Social Awareness Programme	Compulsory, extra credit, Grades shall be given
IV	Internship/Skill Training	Compulsory, audit course, Grades shall be given
V	Finishing School	Compulsory, audit course

3.25 'On the Job Training' means a job training course given to the students to acquaint them with various industrial skills.

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

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

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

3.29 '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.

3.30 'Improvement Examination' is an examination conducted to improve the performance of a student in the courses of a particular semester as per the exam manual.

3.31 'Supplementary Examination' is an examination conducted for students who fail in the courses of a particular semester as per the exam manual.

3.32 The minimum credits, required for completing an undergraduate programme is one hundred and twenty (120).

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

3.34 '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.

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

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

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

3.38 '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.

3.39 '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.

3.40 '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 the respective course.

3.41 '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.

3.42 'Grace Marks' means marks awarded to course/courses as per the choice of the student, in recognition of meritorious achievements of a student in NCC/NSS/sports/arts and cultural activities.

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

4. PROGRAMME STRUCTURE

4.1. The programme shall include core courses, vocational courses, complementary courses, common courses, open course and elective courses. There shall be a project/dissertation to be undertaken by all students. The programme will also include assignments, seminars, practical, viva-voce, OJT, field visit, industry visit etc., if they are specified in the curriculum.

4.2. Total credits for a programme is one hundred and twenty (120). The credit distribution for various UG programmes is shown below.

Model III BSc/BCA

i.	Programme duration	6 Semesters
ii.	Total credits required for successful completion of the programme	120
iii.	Minimum credits required from Core + Elective + Project + Complementary courses	109
iv.	Minimum credits required from Common course I	8
v.	Minimum credits required from Open course	3
vi.	Minimum attendance required	75%

4.3. **Project/Dissertation**

All students shall do a project/research work in the area of core course in the sixth semester. The project/ research work shall be done individually or as a group of maximum five (5) students. The projects/research work shall be identified during the fourth semester of the programme with the help of the supervising teacher. The report of the project/research work shall be submitted to the department during sixth semester and shall be produced before the

examiners appointed by the College. The project report/dissertation shall be subject to internal and external evaluation followed by a viva-voce/defence.

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 shall be 1:4, for courses with or without practical. There shall be a maximum of eighty (80) marks for external evaluation and twenty (20) marks for internal evaluation.

4.5. **In-semester assessment**

The components of the internal or in-semester assessment and their marks are as below.

Common Courses

There are four components for ISA, which include attendance, assignment/seminar and in-semester examinations. All the components of the internal assessment are mandatory.

Component	Marks
Attendance	2
Assignment/Seminar	5
Class test	5
Model examination	8
Total	**20**

Marks for attendance

% of Attendance	Marks
Above 90	2
75 – 90	1

(Decimals shall be rounded off to the next higher whole number)

Courses other than common courses without practical

Component	Marks
Attendance	2
Viva	4
Assignment/Seminar	4
Class test	4
Model examination	6
Total	**20**

Marks for attendance

% of Attendance	Marks
Above 90	2
75 – 90	1

(Decimals shall be rounded off to the next higher whole number)

Courses other than common courses with practical

Component	Marks
Attendance	2
Viva	3
Assignment/Seminar	2
Class test	3
Model examination	5
Total	**15**

Marks for attendance

% of Attendance	Marks
Above 90	2
75 – 90	1

(Decimals shall be rounded off to the next higher whole number)

Internal assessment of practical courses

The internal assessment of practical courses shall be conducted either annually or in each semester. The components for internal assessment are given below.

Internal assessment of practical courses evaluated in each semester

Component	Marks
Attendance	1
Lab Test	2
Record*	2
Total	**5**

*Marks awarded for Record shall be related to number of experiments/practicals recorded.

Marks for attendance

% of Attendance	Marks
Above 75	1

(Decimals shall be rounded off to the next higher whole number)

Internal assessment of practical courses evaluated annually

Component	Marks
Attendance	2
Lab Test	4
Record*	4
Total	**10**

*Marks awarded for Record shall be related to number of experiments/practicals recorded.

Marks for attendance

% of Attendance	Marks
Above 90	2
75 – 90	1

(Decimals shall be rounded off to the next higher whole number)

4.6. **Assignments**

Assignments shall be submitted for every course in the first four semesters. At least one assignment for each course shall be submitted in each semester.

4.7. **Seminar**

A student shall present a seminar in the fifth and sixth semesters.

4.8. **In-semester examination**

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

4.9. 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 of 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.

4.10. A student who has not secured minimum marks in internal examinations can redo the same before the end semester examination of the semester concerned.

4.11. **End-semester assessment**

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

4.12. The end-semester examinations 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.

4.13. The question paper shall be strictly on the basis of model question paper set by Board of Studies.

4.14. 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.

4.15. End-semester Examination question pattern shall be as given below.

Courses without practical

Section	Total No. of Questions	Questions to be Answered	Marks	Total Marks for the Section
A	12	10	2	20
B	9	6	5	30
C	4	2	15	30
			Maximum	**80**

Courses with practical

Section	Total No. of Questions	Questions to be Answered	Marks	Total Marks for the Section
A	12	10	2	20
B	9	6	4	24
C	4	2	8	16
			Maximum	**60**

4.16. 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.

4.17. Practical examination shall be conducted annually or in each semester. The duration and frequency of practical examination shall be decided by the respective Board of Studies.

4.18. Practical examination shall be conducted by one external examiner and one internal examiner.

4.19. The marks for end-semester theory and practical examinations are given below

Course	Marks
Courses without practical	80
Course with practical	60
Practical (assessment in each semester)	20
Practical (odd and even semester combined)	40

4.20. The project report/dissertation shall be subject to internal and external evaluation followed by a viva-voce at the end of the programme. Internal Evaluation is to be done by the supervising

teacher and external evaluation by an external evaluation board consisting of an examiner appointed by the Controller of Examinations and the Head of the Department or his nominee. A viva-voce/defence related to the project work shall be conducted by the external evaluation board and students have to attend the viva-voce/defence individually.

Components of Project Evaluation	**Marks**
Internal Evaluation	20
Dissertation (External)	50
Viva-Voce (External)	30
Total	**100**

4.21. If the student fails in project evaluation, he or she shall submit the project report/dissertation after modifying it on the basis of the recommendations of the examiners.

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
35 to below 45	D	Pass	4
Below 35	F	Failure	0

5. CREDIT POINT AND GRADE POINT AVERAGE

5.1. **Credit Point**

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

$$\mathbf{CP = C \times GP}$$

where C is the credit and GP is the grade point

5.2. **Semester Grade Point Average**

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

$$\mathbf{SGPA = TCP/TCS}$$

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.

5.3. **Cumulative Grade Point Average**

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

$$\mathbf{CGPA = TCP/TC}$$

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.

5.4. **Grade Point Average (GPA)** of different category of courses viz. Common Course I, Common Course II, Complementary Course I, Complementary Course II, Vocational Course, Core Course etc. are calculated using the formula

GPA = TCP/TC

where TCP is the Total Credit Point of a category of course and TC is the total credit of that category of course

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
3.5 to below 4.5	D	Pass
Below 3.5	F	Failure

5.5. A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass in a course.

5.6. For a pass in a programme, a separate minimum of grade 'D' is required for all the individual courses.

5.7. If a candidate secures F Grade for any one of the courses offered in a semester/programme, only F grade will be awarded for that semester/programme until the student improves this to D grade or above within the permitted period.

5.8. Candidate who secures D grade and above will be eligible for higher studies.

6. SUPPLEMENTARY/IMPROVEMENT EXAMINATION

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

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

7. ATTENDANCE

7.1. 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 undergraduate programme may be granted by the College. This condonation shall not be counted for internal assessment.

7.2. 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.

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

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

8. BOARD OF STUDIES AND COURSES

8.1. The Board of Studies concerned shall design all the courses offered in the UG 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.

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

8.3. The syllabus of a course shall contain the title of the course, course objectives, course outcome, contact hours, the number of credits, reference materials and model questions.

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

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

9. REGISTRATION

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

9.2. 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.

9.3. A student may be permitted to complete the programme, on valid reasons, within a period of twelve (12) continuous semesters from the date of commencement of the first semester of the programme.

9.4. The minimum strength of students for open courses is 15 and the maximum is 75 per batch.

9.5. Each student shall register for the open courses in the prescribed registration form in consultation with the faculty mentor during fourth semester. Faculty mentor shall permit registration on the basis of the preferences of the student and availability of seats.

10. ADMISSION

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

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

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

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

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. Stream
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 courses other than extra credit and audit 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 shall keep all the records of the continuous evaluation, for at least a period of two years, for verification.

14. GRIEVANCE REDRESS MECHANISM

14.1. In order to address the grievance of students regarding 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 ADD ON COURSES FOR UNDERGRADUATE PROGRAMMES

1. DEFINITIONS

1.1 'Add On Course General Coordinator' is a senior teacher nominated by the Principal to coordinate and monitor the Add On courses conducted by various departments.

1.2 'Add On Course Coordinator' is a teacher nominated by a Department Council to coordinate the evaluation and other academic activities of the Add On Course undertaken in the Department.

2. COURSE STRUCTURE

2.1 Add On Course shall be completed outside the regular teaching hours of the undergraduate programmes and shall be completed within the first four semesters of the programme.

2.2 The credit will be awarded only if the student get D grade (35% marks) and above.

2.3 A student can earn any number of extra credits according to his/her choice.

2.4 The minimum credits for an Add On Course shall be two (2).

3. EVALUATIONS

The evaluation of each course shall be done internally and contain two parts.

i. Continuous evaluation
ii. Final evaluation

Both continuous evaluation and final evaluation shall be carried out using indirect grading. The marks for continuous evaluation is twenty (20) and that of final evaluation is eighty (80).

Continuous evaluation

The components of the continuous evaluation and their marks are as below.

For all courses without practical

There are two components for continuous evaluation, which include attendance and assignment. All the components of the continuous evaluation are mandatory.

Components	Marks
Attendance	10
Assignment	10
Total	**20**

Marks for attendance

% of Attendance	Marks
90 and above	10
85 - 89	8
80 – 84	6
76 – 79	4
75	2

(Decimals shall be rounded mathematically to the nearest whole number)

For all courses with practical

The components for continuous evaluation of courses with practical are given below.

Components	Marks
Attendance	10
Lab involvement	10
Total	**20**

Marks for attendance

% of Attendance	Marks
90 and above	10
85 - 89	8
80 – 84	6
76 – 79	4
75	2

(Decimals shall be rounded mathematically to the nearest whole number)

Assignments

At least one assignment shall be submitted for each course.

4. **FINAL EVALUATION**

The final evaluation of theory and practical courses shall be conducted by the College/Department. It can be eighty marks written examination or eighty marks project/practical examination or eighty marks written and project/practical examination combined, as decided by the Board of Studies.

4.1 The question paper shall be strictly on the basis of model question paper set by Board of Studies.

4.2 A question paper may contain objective type, short answer type/annotation, short essay type questions/problems and long essay type questions.

4.3 The duration of written examination shall be decided by the respective Board of Studies and the duration of the practical examination shall be decided by the concerned course coordinator.

4.4 Practical examination shall be conducted by one internal examiner.

4.5 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
95 and above	S	Outstanding
85 to below 95	A+	Excellent
75 to below 85	A	Very Good
65 to below 75	B+	Good
55 to below 65	B	Above Average
45 to below 55	C	Satisfactory
35 to below 45	D	Pass
Below 35	F	Failure

4.6 A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass in a course.

5. **ATTENDANCE**

The minimum requirement of aggregate attendance for appearing the final evaluation shall be 75%.

6. **BOARD OF STUDIES AND COURSES**

6.1 The Board of Studies concerned shall design the Add On Course offered by the department. The Board shall design and introduce new Add On Course, modify or redesign existing Add On

Course and replace any existing Add On course with new/modified Add On course to facilitate better exposure and training for the students.

6.2 The syllabus of an Add On course shall also include the title of the course, contact hours, the number of credits, reference materials and question paper pattern.

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

6.4 The Add On courses conducted under Credit Semester System shall be monitored by the Academic Council.

6.5 For redressing the complaints in connection with the conduct of Add On course, students shall approach the Grievance Redress Committee functioning in the college.

REGULATIONS FOR CERTIFICATE COURSE IN VALUE EDUCATION FOR UNDERGRADUATE PROGRAMMES

Value Education is a compulsory extra credit course for all the students admitted to the undergraduate programmes.

i. **Duration**

The duration of the course shall be three academic years (six semesters) spanning 60 hrs. There shall be minimum 20 hours in an academic year.

ii. **Evaluation**

The evaluation of each course shall contain two parts.

i. Continuous evaluation
ii. Final evaluation

There shall be a maximum of forty (40) marks for external assessment and ten (10) marks for internal assessment.

Continuous Evaluation

Assignment

The students are supposed to submit at least one assignment in every year and five (5) marks will be given for a submitted assignment

Attendance

The minimum requirement of aggregate attendance during a semester for appearing the end final examination shall be 75%.

Marks for attendance

Maximum of five (5) marks will be given for attendance as follows.

% of Attendance	Marks
90 and above	5
85-89	4
80-84	3
76-79	2
75	1

(Decimals shall be rounded off to the next higher whole number)

Final evaluation

The final examination shall be conducted by the course coordinator. The final assessment examination shall be conducted at the end of every year. There shall be an annual written examination of one and a half hours (1½) duration. The question paper shall be strictly on the basis of model question paper set by Expert Committee. A question paper consists of short answer type, short essay type and long essay type questions.

A separate minimum of 30% marks each for internal and external assessment (continuous and final evaluation) and aggregate minimum of 35% are required for a pass in a course.

iii. **Grading**

The total marks of the course shall be one hundred and fifty (150). The grading of the course is as follows:

Percentage of Marks	Grade	Performance
95 and above	S	Outstanding
85 to below 95	A+	Excellent
75 to below 85	A	Very Good
65 to below 75	B+	Good
55 to below 65	B	Above Average
45 to below 55	C	Satisfactory
35 to below 45	D	Pass
Below 35	F	Failure

iv. **Award of certificate**

The course is envisaged with three levels in three academic years. There shall be examination in every year. If a student does not acquire minimum marks he/she can continue with further levels. But he/ she shall be eligible to get certificate only after completing all the levels successfully. The certificate will be issued after completing all the levels with minimum grade D for the pass. On successful completion of the course, grade card shall be issued to the students indicating the grade. The college issues the certificate on value education to all the undergraduate students who successfully complete the course. The course shall be completed during the tenure of the programme.

REGULATIONS FOR 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. The grading of the course is as follows:

Percentage of Marks	Grade	Performance
95 and above	S	Outstanding
85 to below 95	A+	Excellent
75 to below 85	A	Very Good
65 to below 75	B+	Good
55 to below 65	B	Above Average
45 to below 55	C	Satisfactory
35 to below 45	D	Pass
Below 35	F	Failure

x. 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.
xi. For redressing the complaints in connection with the conduct of BLS & DM students shall approach the Grievance Redress Committee functioning in the college.

REGULATIONS FOR SOCIAL AWARENESS PROGRAMME (SAP)

i. Social Awareness Programme 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 the SAP.

iii. The centre shall identify the areas where the students can serve the society through the SAP.

iv. During the first semester itself, the centre for SAP shall organise programmes to sensitize the students about the significance and relevance of SAP and publish a list of different areas where they can work as volunteers. Students shall register their preferences (three) with the centre for SAP. The centre shall allot students to various areas based on their preference. For the preparation of the allotment list, the marks obtained in the higher secondary examination shall also be used as a criterion. Centre for SAP shall take the help of the Head of the concerned department and the mentor(s) of the concerned batch at the time of finalization of the allotment list.

v. Students shall carry out the voluntary work allotted to them after the regular class hours/weekends/holidays falling in the second semester or the summer vacation following the second semester.

vi. Evaluation of the SAP activity shall be based on the hours of work put in by a student. A minimum of 50 hours of social work (corresponding to 50 marks) is required for the successful completion of SAP. Every additional work beyond the minimum 50 hours shall fetch five (5) marks per hour. Maximum marks shall be 100. Students who donate blood during the second semester shall be given 10 marks upon the production of the certificate from the medical officer. However, Marks earned through blood donation shall not be counted for a pass in the programme. Mark for blood donation shall be awarded only once during the SAP.

vii. Upon completion of SAP, the marks earned and the grades awarded shall be published by the Director of SAP. The grading is as follows:

Percentage of Marks	Grade	Performance
95 and above	S	Outstanding
85 to below 95	A+	Excellent
75 to below 85	A	Very Good
65 to below 75	B+	Good
55 to below 65	B	Above Average
45 to below 55	C	Satisfactory
35 to below 45	D	Pass
Below 35	F	Failure

viii. Two credits shall be awarded to students who complete the requirements of SAP.

ix. Students who could not complete the requirements of the SAP shall appear for the same with the next batch. There shall be two redo opportunity.

x. For redressing the complaints regarding allotment, harassment at the place of work, and the marks and grades awarded students shall approach the Grievance Redress Committee functioning in the college.

xi. Director of SAP has the right to exclude students who are physically handicapped from SAP.

REGULATIONS FOR INTERNSHIP/SKILL TRAINING PROGRAMME

i. Every UG student shall 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 (eg. 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 fourth semester or during the Christmas vacation falling in the fourth 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.
viii. Students who could not complete the requirements of the internship/skill training programme shall appear for the same with the next batch. There shall be only one redo opportunity.

REGULATIONS FOR FINISHING SCHOOL

i. The training to help students develop their soft skills and interview skills, 'The Finishing School', shall be coordinated by a nodal centre.

ii. The nodal centre shall include at least one teacher from each department. A teacher shall be nominated as the Director of the nodal centre.

iii. The training shall impart soft skills comprising of language skills, personal presentation and grooming, resume preparation, group discussion techniques, and interview skills among the undergraduate students.

iv. This course shall be conducted during the fifth semester for all the undergraduate students.

v. There will be a total of 20 contact hours which shall be handled by a team of professional members/faculty. In addition, a one-day outbound training session by a team of professional trainers that touches on the aspects of creativity, problem solving and team building shall also be organized.

vi. The students shall be assessed and grades shall be awarded based on the components as shown below.

Component	Marks
Attendance	5
Class Test	10
Assignments	10
Group discussion	10
Interview	15
Total	**50**

vii. The grading of the course is as follows:

Percentage of Marks	Grade	Performance
95 and above	S	Outstanding
85 to below 95	A+	Excellent
75 to below 85	A	Very Good
65 to below 75	B+	Good
55 to below 65	B	Above Average
45 to below 55	C	Satisfactory
35 to below 45	D	Pass
Below 35	F	Failure

viii. For redressing the complaints in connection with the conduct of finishing school students shall approach the Grievance Redress Committee.

VIRTUAL LAB EXPERIMENTS/MOOC

i. 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.

ii. 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.

iii. 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.

iv. College shall arrange infrastructure for taking up Virtual Lab experiments and/or MOOC courses.

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 :

Stream :

Name of Examination :

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					
	Common Course I												
	Core Course												
	Core Course												
	Complementary Course												
	Complementary Course												
	Total												
	Weighted Average Score												
	Semester Result												
	SGPA												
	End of Statement												

Entered by:

Verified by:

Controller of Examinations **Principal**

St Berchmans College
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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

Photo

Name of the Candidate :

Permanent Register Number (PRN) :

Degree :

Programme :

Stream :

Date :

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													
	Common Course I **Core Course** **Core Course** **Complementary Course** **Complementary Course**												

SEMESTER II													
	Common Course I **Core Course** **Core Course** **Complementary Course**												
SEMESTER III Complementary Course													
	Core Course **Core Course** **Complementary Course** **Complementary Course**												
SEMESTER IV													
	Core Course **Core Course** **Complementary Course** **Complementary Course**												
SEMESTER V													
	Core Course **Core Course** **Open Course**												
SEMESTER VI													
	Core Course **Core Course** **Project**												

SEMESTER RESULTS

Semester	Marks Awarded	Maximum Marks	Credits	SGPA	Grade	Month & Year of Passing	Result
I II III IV V VI							

PROGRAMME PART RESULTS

Programme Part	Marks Awarded	Maximum Marks	Credits	CGPA	Grade
Common Course I: Core Course: Complementary Course: Complementary Course: Open Course:					
Total					

FINAL RESULT

CUMULATIVE GRADE POINT AVERAGE (CGPA) =

GRADE =

*** 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 1:4 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;

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

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
35 to below 45	D	Pass	4
Below 35	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
3.5 to below 4.5	D	Pass
Below 3.5	F	Failure

Table 2

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

Note: Course title followed by (P) stands for practical course. A separate minimum of 30% marks each for internal and external assessments (for both theory and practical) and an aggregate minimum of 35% 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

Semester I

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
2	Core Course: Industrial Microbiology	2	2	75
3	Core Course: Industrial Microbiology	2	2	75
4	Core Course: Zoology	2	2	75
5	Core Course Practical: Industrial Microbiology	2	Evaluation in Semester II	
6	Core Course Practical: Industrial Microbiology	2		
7	Core Course Practical: Zoology	2		
8	Complementary Course: Biochemistry	2	2	75
9	Complementary Course: Computer Science	2	2	75
10	Complementary Course Practical: Biochemistry	2	1	25
11	Complementary Course Practical: Computer Science	2	1	25
	Total	**25**	**16**	**575**

Semester II

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
2	Core Course: Industrial Microbiology	2	2	75
3	Core Course: Industrial Microbiology	2	2	75
4	Core Course: Zoology	2	2	75
5	Core Course Practical: Industrial Microbiology	2	2	50
6	Core Course Practical: Industrial Microbiology	2	2	50
7	Core Course Practical: Zoology	2	2	50
8	Complementary Course: Biochemistry	2	2	75
9	Complementary Course: Computer Science	2	2	75
10	Complementary Course Practical: Biochemistry	2	1	25
11	Complementary Course Practical: Computer Science	2	1	25
	Total	**25**	**22**	**675**

Semester III

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Core Course: Industrial Microbiology	3	3	75
2	Core Course: Industrial Microbiology	3	2	75
3	Core Course: Zoology	3	3	75
4	Core Course Practical: Industrial Microbiology	2	Evaluation in Semester IV	
5	Core Course Practical: Industrial Microbiology	2		
6	Core Course Practical: Zoology	2		
7	Complementary Course: Biochemistry	3	3	75
8	Complementary Course: Computer Science	3	3	75
9	Complementary Course Practical: Biochemistry	2	1	25
10	Complementary Course Practical: Computer Science	2	1	25
11	Industrial Visit	-	1	30
	Total	**25**	**17**	**455**

Semester IV

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Core Course: Industrial Microbiology	2	2	75
2	Core Course: Industrial Microbiology	2	2	75
3	Core Course: Zoology	3	3	75
4	Core Course: Zoology	2	2	100
5	Core Course Practical: Industrial Microbiology	2	2	50
6	Core Course Practical: Industrial Microbiology	2	2	50
7	Core Course Practical: Zoology	2	2	50
8	Complementary Course: Biochemistry	3	3	75
9	Complementary Course: Computer Science	3	3	75
10	Complementary Course Practical: Biochemistry	2	1	25
11	Complementary Course Practical: Computer Science	2	1	25
	Total	**25**	**23**	**675**

Semester V

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Core Course: Industrial Microbiology	3	3	75
2	Core Course: Zoology	3	3	75
3	Core Course: Zoology	4	3	75
4	Core Course: Zoology	3	3	75
5	Core Course Practical: Industrial Microbiology	3	Evaluation in Semester VI	
6	Core Course Practical: Zoology	2		
7	Core Course Practical: Zoology	2		
8	Core Course Practical: Zoology	2		
9	Open Course	3	3	100
10	OJT	-	1	40
11	Study Tour and Visit to Research Institutes	-	1	30
	Total	**25**	**17**	**470**

Semester VI

Sl. No.	Course Title	Hours/ Week	Credit	Marks
1	Core Course: Industrial Microbiology	3	3	75
2	Core Course: Industrial Microbiology	3	3	75
3	Core Course: Zoology	3	3	75
4	Core Course: Zoology	3	3	75
5	Core Course: Zoology	3	3	75
6	Core Course Practical: Industrial Microbiology	2	2	50
7	Core Course Practical: Industrial Microbiology	2	1	25
8	Core Course Practical: Zoology	2	2	50
9	Core Course Practical: Zoology	2	2	50
10	Core Course Practical: Zoology	2	2	50
11	Project (Either from Core I or Core II)	-	1	100
	Total	**25**	**25**	**700**
	Grand Total	**-**	**120**	**3500**

Zoology Core syllabus will be provided by Zoology Board of Studies
Elective courses will be opted from Zoology elective courses

OUTLINE OF MICROBIOLOGY CORE COURSES

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
Semester I							
BBMB101	Fundamentals of Microbiology	2	36	2	15	60	75
BBMB102	Microbial Diversity	2	36	2	15	60	75
	Fundamentals of Microbiology & Microbial Physiology (P)	2	36	Evaluation in Semester II			
	Microbial Diversity & Immunology (P)	2	36	Evaluation in Semester II			
Semester II							
BBMB203	Microbial Physiology	2	36	2	15	60	75
BBMB204	Immunology	2	36	2	15	60	75
BBMB2P01	Fundamentals of Microbiology & Microbial Physiology (P)	2	36	2	10	40	50
BBMB2P02	Microbial Diversity & Immunology (P)	2	36	2	10	40	50
Semester III							
BBMB305	Microbial Genetics and Recombinant DNA Technology	3	54	3	15	60	75
BBMB306	Medical Microbiology	3	54	2	15	60	75
	Microbial Genetics and Recombinant DNA technology & Industrial Microbiology(P)	2	36	valuation in semester IV			
	Medical Microbiology & Fermentation Technology (P)	2	36	Evaluation in semester IV			
BBMB3IT	Industrial Training			1	30	-	30
Semester IV							
BBMB407	Industrial Microbiology	2	36	2	15	60	75
BBMB408	Fermentation Technology	2	36	2	15	60	75
BBMB4P03	Microbial Genetics and Recombinant DNA Technology & Industrial Microbiology (P)	2	36	2	10	40	50
BBMB4P04	Medical Microbiology & Fermentation Technology (P)	2	36	2	10	40	50
Semester V							
BBMB509	Food Microbiology	3	54	3	15	60	75
	Food Microbiology & Agricultural Microbiology (P)	3	54	Evaluation in semester VI			
BBMB5OJT	OJT	-	-	1	40	-	40
BBZO5ST	Study Tour and Visit to Research Institutes	-	-	1	10	20	30

Semester VI							
BBMB610	Agricultural Microbiology	3	54	3	15	60	75
BBMB611	Microbial Waste Management	3	54	3	15	60	75
BBMB6P05	Food Microbiology & Agricultural Microbiology (P)	2	36	2	10	40	50
BBMB6P06	Microbial Waste Management (P)	2	36	1	5	20	25
BBMB6PJ	Project	-	-	1	20	80	100

OPEN COURSE

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
BOMB501	Microbiology in Daily Life	3	54	3	20	80	100

SEMESTER I

BBMB101: FUNDAMENTALS OF MICROBIOLOGY

Total Hours: 36 **Credit: 2**

Objectives:

Define fundamental microbiological concepts and theories.

Explain and demonstrate ground-level techniques of isolation, detection, Enumeration, and identification of bacteria commonly found in the environment

Outcome:

- 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

Module 1 **4 Hrs**

Spontaneous generation theory, contributions of Leuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Joseph Lister, Alexander Fleming, John Tyndall.

Module 2 **10 Hrs**

Principles and application – Bright field, Dark field, Phase contrast, Fluorescence, confocal microscopy, SEM,TEM& STEM, specimen preparation of electron microscopy, ultra sectioning, shadowing, negative staining, freeze etching.

Stains – acidic, basic and neutral stains - Staining techniques- simple staining, differential staining (gram stain and acid fast stain), structural staining (spore, flagella, capsule and granule)

Module 3 **8 Hrs**

Differences between prokaryotes & eukaryotes, size, shape and arrangements of bacteria. Structure and arrangement of bacterial flagella, pili, capsule, structure and composition of Gram positive and Gram negative cell wall. Cytoplasmic membrane, protoplasts, spheroplast, intracellular membrane systems-mesosomes, cytoplasm, vacuoles, nuclear material, endospores and cysts, cell inclusions

Module 4 **8 Hrs**

Sterilization-principles and methods, physical and chemical methods, antiseptics, Antibiotics - classification and a brief account on mechanism of action with one example each .Drug resistance, antibiotic sensitivity tests. Evaluation of antimicrobial agents.

Module 5 **6 Hrs**

Culture media - definition media components: peptone, yeast extract, beef extract, agar, blood/serum – types: selective media, enriched media, enrichment media, indicator media, and differential media, transport media, anaerobic media. Aerobic and anaerobic culture methods, fungal cultivation, culture preservation techniques and culture collection centers.

References

1. Black, J. G. 2013. *Microbiology: Principles and Explorations*. 6th Edition, John Wiley and Sons, Inc.
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. Lim, D. 1998. *Microbiology*. 2nd Edition; McGraw-Hill Publication.
4. Madigan, M. T. and Martinko, J. M. 2006. *Brock's Biology of Microorganisms*. 11th Edition. Pearson Education Inc.
5. Pelczar, M. J. Jr., Chan, E. C. S. and Krieg, N. R. 1993. *Microbiology*, 5th Edition, Tata MacGraw Hill Press.
6. Prescott, L. M., Harley, J. P. and Klein, D. A. 2006. *Microbiology*. 6th Edition. Edition, McGraw Hill Higher Education.
7. Russell, A. D., Hugo, W. B., and Ayliffe, G. A. J. 1999. *Principles and practice of disinfection, preservation and sterilization*, 3rd Edition. Blackwell Science, Oxford.
8. Salle, A. J. 1971. *Fundamental Principles of Bacteriology*. 7th Edition. Tata McGraw Hill Publishing Co.
9. Stainer, R. Y. Ingraham, J. L. Wheolis, H. H. and Painter, P. R. 1986. *The Microbial world*. 5th edition. Eagle Works Cliffs N. J. Prentica Hall.
10. Stanier, R. Y., Adelberg, E. A. and Ingraham, J. L. 1987. *General Microbiology*, 5th Edition. Macmillan Press Ltd.
11. Tortora G. J., Funke B. R. and Case C. L. 2006. *Microbiology: An Introduction*. 8th Edition. Pearson Education Inc.
12. Willey, J. M., Sherwood, L. M. and Woolverton, C. J. 2013. *Prescott's Microbiology*. 8th Edition, McGraw-Hill Higher Education.

BBMB102: MICROBIAL DIVERSITY

Total Hours: 36 **Credit: 2**

Objectives:

Describe special interest microbiology topics such as Mycoplasma, Actinomycete, Fungi, Algae and viruses. To gain detailed knowledge of the microbial diversity and morphological, biochemical and genetic characteristics

Outcome:

- Students will learn the detailed characteristics of various microorganisms
- Students will be introduced to both traditional and modern molecular approaches and methods for recognizing and categorizing microbial diversity

Module 1 **6 Hrs**

Principles of Classification, systems of classification, classification based on morphological characteristics, staining reactions, genetic and molecular characteristics, principles of bacterial taxonomy, Outline classification of Bacteria according to Bergey's manual.

Module 2 **8 Hrs**

Brief account on characteristics of Archaebacteria and extremophiles. Mycoplasma- general properties, structure, cultural characteristics and classification. Actinomycetes – General characteristics and classification, Rickettsiae -classification, morphology and distinguishing characteristics.

Module 3 **8 Hrs**

Viruses - general properties, structure and replication of Bacteriophages, Structure of TMV, HIV. Cultivation of viruses, virions, viroids and prions.

Module 4 **6 Hrs**

Fungi –Morphological features, Classification-Ascomycota, Zygomycota, Basidiomycota, Deuteromycota. Reproduction and economic importance of fungi. Cultivation of fungi, Distinguishing characteristics of *Rhizopus, Mucor, Aspergillus, Penicillium*and *Fusarium*.

Module 5 **8 Hrs**

Algae –distribution, characteristics, classification and economic importance of algae. Cyanobacteria-distribution, characteristics and classification, ultra structure of cyanobacterial cell.

References

1. Madigan, M., Martinko, J., Buckley, D. and Stahl, D. 2014. *Brock Biology of Microorganism.* 14th Edition. Benjamin Cummings, New York.
2. Pelczar, M. J. Jr., Chan, E. C. S., Krieg, N. R. 1986. *Microbiology*. McGraw Hill Book Company**,** London.
3. Rai, M. 2007. *Mycotechnology: Present Status and Future Prospects*. I. K. International Publishing House Pvt. Ltd.
4. Rosa, C. A. and Peter, G. 2006. *Biodiversity and Ecophysiology of Yeasts*. Springer-Verlag Berlin.
5. Russell A. D., Hugo W. B. and Ayliffe G. A. J. 1999. *Principles and practice of disinfection, preservation, and sterilization*, 3rd Edition. Blackwell Science, Oxford.
6. Salle, A. J. 1971. *Fundamental Principles of Bacteriology*, 7th Edition, Tata McGraw Hill Publishing Company Ltd.
7. Stanier, R. Y., Ingraham, J. L., Wheelis, M. L. and Painter, P. R. 2005. *General Microbiology*. 5th Edition. McMillan.
8. Topley, W. W. C., Wilson, G. S., Parker, T. and Collier, L. H. 1990. *Topley and Wilson's Principles of Bacteriology, Virology and Immunology*. 8th Edition. Edward Arnold, London.
9. Tortora, G. J., Funke, B. R. and Case, C. L. 2016.*Microbiology: An Introduction*.12th Edition. Pearson.
10. Willey, J., Sherwood, L. M. and Woolverton, C. J. 2011. Microbial growth. In *Prescott's Microbiology*, 8th Edition. McGraw-Hill Companies Inc.: New York, NY, USA.

Model Question Paper

Reg No:……..

Name:…….

B.Sc. DEGREE (C.S.S) EXAMINATION

First Semester

B.Sc. Zoology and Industrial Microbiology (Double Core)

Core Course: BBMB101 - FUNDAMENTALS OF MICROBIOLOGY

Time: 3hrs **Total marks: 60**

Part A

Brief Answer Questions

Answer any **10** questions. Each question carries **2** marks.

1. Write a note on Kirby-Bauer method?
2. Write down the principle and application of Dark field microscopy?
3. List out Koch's postulates?
4. Explain the principle involved in Gram's staining?
5. Give an account on pour plate technique?
6. Write down the contributions of Edward Jenner?
7. Briefly describe structure and arrangement of bacterial flagella?
8. Discuss the various anaerobic culture methods of bacteria?
9. Briefly explain Negative staining?
10. What is dry heat sterilization? Describe the methods?
11. What is the difference between Protoplast and Spheroplast?
12. Comment on Transport medium? **(10X2=20 Marks)**

Part B

Short Essay type Questions

Answer any **six** questions. Each question carries **4** marks.

13. Discuss the various culture preservation techniques?
14. Differentiate gram positive and gram negative bacterial cell wall?
15. Explain various chemical methods of sterilization?
16. Describe the techniques for isolation of pure cultures?
17. Give an account on various culture media used in microbiological laboratories?
18. Write down the contributions of Louis Pasteur?
19. Write an account on mechanism of antibiotic resistance?
20. Give an account on structures external to bacterial cell wall?

21. Explain on culture preservation centers**?** **(6x4=24 marks)**

Part C

Long Essay type Questions.

Answer any **two** questions. Each question carries **8** marks.

22. With suitable diagram, describe the fine structure of a typical bacterium?

23. Write an essay on electron microscopy?

24. Describe the types of staining of bacteria?

25. Explain the classification and mechanism of action of antibiotics?

(2x8=16 marks)

Reg No:……..

Name:…….

B.Sc. DEGREE (C.S.S) EXAMINATION

First Semester

B.Sc. Zoology and Industrial Microbiology (Double Core)

Core Course: BBMB102 MICROBIAL DIVERSITY

Time: 3 Hrs **Total Marks: 60**

Part A

Brief Answer Questions

Answer any **10** questions.Each question carries **2** marks**.**

1. Outline the general properties of Penicillium.
2. Comment on algal pigments
3. How does archeal cell wall differ from bacteria?
4. Briefly describe the economic importance of Cyanobacteria
5. Differentiate between viriods and virusoids.
6. Write down the Structural properties of TMV
7. Discuss the morphology and distinguishing characters of Rickettsiae.
8. Summarize the general characters of Actinomycetes
9. Give an account on fungal cultivation methods
10. Mention the significance of 16SrRNA sequencing in microbial taxonomy
11. Comment on taxonomic ranking with an example?
12. Write a note on heterocyst and mention its significance

(10X2=20 Marks)

Part B

Short Essay type Questions

Answer any **six** questions.Each question carries **4 marks.**

13. Summarize the major characteristics of Cyanobacteria.
14. Explain the principles of microbial taxonomy
15. Give an account on Human Immunodeficiency Virus
16. Write down the classification of Fungi
17. Explain polyphasic taxonomy
18. Describe the various methods of viral cultivation
19. Classify bacteria based on staining reactions
20. Briefly explain the morphology and structure of mycoplasma

21. Briefly explain the classification of algae

(6x4=24 marks)

Part C

Long Essay type Questions

Answer any **two** questions.Each question carries **8** marks.

22. Elaborate the general characteristics and economic importance of Actinomycetes with examples.

23. Explain the structural properties and replication of bacteriophages.

24. Summarize the morphology and distinguishing characters of fungi with suitable examples.

25. What are Archae? Briefly describe their characters and economic importance

(2x8=16 marks)

SEMESTER II

BBMB203: MICROBIAL PHYSIOLOGY

Total Hours: 36 **Credit: 2**

Objectives:

The Microbial Physiology course is an advanced course that addresses various aspects of microbial physiology. The following subjects are dealt with in the lectures: 1. Bioenergetics of microbial processes, 2. Microbial growth, 3. Catabolic and anabolic pathways, 5. photosynthesis

Outcome:

- Explain the principles of the energy-yielding and -consuming reactions, the various catabolic and anabolic pathways, the transport systems and the mechanisms of energy conservation in microbial metabolism;
- Identify the various nutritional and physiological groups of bacteria

Module 1 **4 Hrs**

Microbial Nutrition -Nutritional requirements - C, N, P, S, and minerals, Nutritional classification of bacteria. Uptake of nutrients - passive diffusion, facilitated diffusion, active transport, group translocation, growth factors.

Module 2 **10 Hrs**

Bacterial growth, bacterial growth curve and generation time. Continuous culturing of bacteria- chemostat, turbidostat, synchronous growth. Effect of temperature, pH, oxygen water activity and radiation on bacterial growth. Enumeration methods of bacteria- SPC, direct microscopic count, turbidometric estimation. Reproduction and growth: modes of cell division- binary fission, budding, fragmentation.

Module 3 **8 Hrs**

Photosynthesis-photosynthetic microorganisms, photosynthetic apparatus in prokaryotes and eukaryotes, photosynthetic pigments, mechanism of cyclic and non-cyclic photophosphorylation, Calvin cycle.

Module 4 **8 Hrs**

Microbial Metabolism- Glycolysis, Krebs's cycle, Pentose Phosphate Pathway, gluconeogenesis, ED pathway. Substrate level phosphorylation, electron transport chain and oxidative phosphorylation.

Module 5 **6 Hrs**

Nitrogen metabolism -nitrogen cycle, nitrification, denitrification and ammonification. Transamination and deamination reactions, Fermentation -alcoholic fermentation, homo and hetero-lactic acid fermentation, mixed acid fermentations

References

1. Black, J. G. 2005. *Microbiology, Principles and exploration*. 6th Edition. John Wiley & Sons.
2. Barsanti, L. and Gualtieri, P. 2014. *Algae: Anatomy, Biochemistry and Biotechnology*. 2nd Edition. CRC Press, Taylor and Francis Group.
3. Lim, D. V. 2002. *Microbiology*. Dubuque, IA: Kendall/Hunt.
4. Ingraham, J. L. and Ingraham, C. A. 2004. *Introduction to Microbiology: A case history approach*. 3rd Edition. Thomson Brooks/Cole, Pacific Grove, Ca.
5. Willey, J. M., Sherwood, L. M. and Woolverton, C. J. 2013. *Prescott's Microbiology*. 9th Edition, McGraw-Hill Higher Education.
6. Prescott, L. M., Harley, J. P. and Klein, D. A. 2006. *Microbiology*. 6th Edition. Edition, McGraw Hill Higher Education.
7. Nelson, D. L. and Cox, M. M. 2012. Lehninger Principles of Biochemistry. 6th Edition, W. H. Freeman and Company.
8. Atlas, R. M. 1995. *Principles of Microbiology*. McGraw-Hill Inc., US.
9. Balows, A., Trüper, H. G., Dworkin, M., Harder, W. and Schleifer, K. H. 1992. *The Prokaryotes. A Handbook on the Biology of Bacteria: Ecophysiology, Isolation, Identification, Applications*. Springer-Verlag, New York.
10. Landecker, E. M. 1996. *Fundamentals of the fungi*. 4thedition. Benjamin Cummings.
11. Logan, N.A. 1994. *Bacterial Systematics*. 2nd Edition. Wiley-Blackwell.
12. Madigan, M., Martinko, J., Buckley, D. and Stahl, D. 2014. *Brock Biology of Microorganisms*. 14thEdition. Benjamin Cummings, New York.
13. Moat, A. G., Foster, J. W. and Spector, M. P. 2002. *Microbial Physiology*. 4th edition. Wiley-Liss, Inc.
14. Pelczar, M. J. Jr., Chan, E. C. S. and Krieg, N. R. 1993. *Microbiology*, 5th Edition, Tata McGraw Hill Press.
15. Ratledge, C. and Wilkinson, S. G. 1988. Microbial lipids. Vol 1 & 2. Academic Press.
16. White, D. 2000. *Physiology and Biochemistry of Prokaryotes*. 2nd Edition. Oxford University Press, New York.

17. White, D., Drummond, J. and Fuqua, C.2000. *The Physiology and Biochemistry of Prokaryotes*. Oxford University Press.
18. Zubay, G. L. 1998. *Biochemistry*. William C Brown Publishers.

BBMB204: IMMUNOLOGY

Total Hours: 36 **Credit: 2**

Objectives:

Study key concepts in immunology along with overall organization of the immune system

Outcome:

- To make them understand the salient features of antigen antibody reaction & its uses in diagnostics and various other studies.
- Conceptualize how the innate and adaptive immune responses coordinate to fight invading pathogens.
- Appreciate the significance of maintaining a state of immune tolerance sufficient to prevent the emergence of autoimmunity

Module 1 **5 Hrs**

Infection, types of infectious diseases, types of immunity, innate immunity, adaptive immunity, active and passive immunity, mechanisms of innate immunity. Factors affecting immunity.

Module 2 **6 hrs**

Antigens andtypes of antigens, epitopes, haptens, antigenicity, immunogenicity, factors influencing antigenicity, basic structure of immunoglobulin. Immunoglobulin classes and functions. Isotype, allotype and idiotype. Vaccines – types, toxoids and adjuvants

Module 3 **6 Hrs**

Antigen-antibody reactions-precipitation reactions, agglutination reactions, immunodiffusion, complement fixation test, ELISA, western blotting, immunofluorescence

Module 4 **10 Hrs**

Primary and secondary lymphoid organs. Cells of the immune system. MHC,HLA, Complement system and its biological importance, humoral immune response, primary and secondary responses, cell mediated immunity, monoclonal antibodies – production and applications.

Module 5 **9 Hrs**

Anomalies in immune response- brief account onautoimmune diseases (Any 2 diseases), hypersensitivity reactions- type I anaphylaxis and atopy, immuno-deficiency disease-AIDS, organ transplantation-allograft rejection

Immunohematology, immunology of blood transfusion, erythroblastosisfoetalis.

References

1. Abbas A. and Litchman A. H. 2010. *Basic Immunology - Functions and Disorders of Immune System*. 3rd edition.Saunders Elsevier.
2. Abbas A., Lichtman, A. H. and Pillai, S. 2017. *Cellular and Molecular Immunology*. 9th edition. Elsevier.
3. Ananthanarayan, R. and Panicker, C. K. J. 2009. *Ananthanarayan and Paniker's Textbook of Microbiology*. Orient Longman Limited Universities Press (India) Pvt. Ltd.
4. Austyn, J. M. and Wood, K. J. 1993. *Principles of Molecular and Cellular Immunology*. 1st Edition. Oxford University Press.
5. Barret, J. T. 1983. *Textbook of immunology: An introduction to immunochemistry and immunobiology*. 4th edition. Mosby.
6. Bendelac, A., Savage, P. B. and Teyton, L. 2007. The biology of NKT Cells. *Annu Rev Immunol.*,**25**: 297–336.
7. Boyd, W. C. 1956. *Fundamentals of Immunology*. 3rd edition. Interscience Publishers.
8. Chatterjee, C. C. 2016. *Human Physiology* Vol. 1. 11th Edition. CBS Publishers and Distributors, Pvt. Ltd.
9. Coleman, R. M. 1992. *Fundamentals of Immunology*. McGraw-Hill Higher Education.
10. Delves, P. J., Martin, S. J., Burton, D. R. and Roitt, I. M. 2012. *Roitt's Essential Immunology*. 13th edition. Wiley-Blackwell.
11. Diwanay, S., Gautam, M. and Patwardhan, B. 2004. Cytoprotection and Imunomodulationin Cancer Therapy. *Curr Med Chem Anticancer Agents*, **4**(6): 479-490.
12. Frank, S. A. 2002. *Immunology and Evolution of Infectious Disease.* Princeton University Press.
13. Gangal, S. and Sontakke, S. 2013. *Textbook of Basic and Clinical Immunology*. Orient Blackswan.
14. Garcia, K. C. and Adams, E. J. 2005. How the T cell receptor sees antigen—a structural view. *Cell*, **122**(3): 333–336.
15. Hafler, D. A. 2007. Cytokines and interventional immunology. *Nature Reviews Immunology*, **7**: 423.
16. Hall, J., Guyton, A. C. and Hall, J. 2005. *Textbook of Medical Physiology.* Saunders Elsevier.

17. Hapel, H., Harney, M., Misbah, S., and Snowden, N. 2006. *Essentials of Clinical Immunology*. 5th Edition. Blackwell Publishing Company.
18. Heritage, J., Evans, E. G. V. and Killungten, R. A. 2007. *Introductory Microbiology*. Cambridge University Press.
19. Janeway, C. A., Travers, P., Walport, M. and Shlomchik, M. J. 2001. *Immunobiology - The Immune System in Health and Disease*. 5th edition. Garland Science, New York.
20. Kindt, T. J., Goldsby, R. A. and Osborne, B. A. 2007. *Kuby Immunology*. 6th Edition. W. H. Freeman and Co, New York.
21. Levinson, W. E. 2014.*Review of Medical Microbiology and Immunology*. 13th edition. McGraw-Hill Education.
22. Malati, T. 2007. Tumor Markers: An Overview. *Indian Journal of Clinical Biochemistry*, **22**(2): 17-31.
23. Park, K. 2002. *Parks Text Book of Preventive and Social Medicine*. 17th Edition. Jabalpur: M/S Banarsidas Bhanot.
24. Patwardhan, B., Gautam, M. and Diwanay, S. 2006. Botanical Immunomodulators and Chemoprotectants in Cancer Therapy. Chapter 16. **In:***Drug discovery and Development: Volume I - Drug discovery*. Pg: 425-456. https://onlinelibrary.wiley.com/doi/book/10.1002/0471780103
25. Paul W. E. 2012. *Fundamental Immunology*. 7th edition. Lippincott Williams and Wilkins
26. Punt, J., Strandford, S., Jones, P. Owen, J. A. 2018. *Kuby Immunology*. 8th edition. W. H. Freeman, New York.
27. Schlegel, H. G. 1993. *General Microbiology*. 7th Edition. Cambridge University Press, New York, USA.
28. Sharma, K. 2009. *Manual of Microbiology: Tools and Techniques*. 2nd Edition. Anes Book's Pvt. Ltd., New Delhi.
29. Stuhler, G. and Walden, P. 2002. *Cancer immune therapy – current and future strategies*. Weinheim; [Cambridge]: Wiley-VCH.
30. Wise, D. J. and Carter, G. R. 2004. *Immunology - A Comprehensive Review*. Iowa State University Press, Blackwell Science Co.
31. Yoshimura, K., Naka T. and Kubo, M. 2007. SOCS proteins, cytokine signalling and immune regulation. *Nature Reviews Immunology*, **7**(6): 454-465.

BBMB2P01: FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL PHYSIOLOGY

(semester I and II combined)

Total Hours: 72 **Credit: 2**

Part A- FUNDAMENTALS OF MICROBIOLOGY

1. General rules in microbiology laboratory
2. Instrumentation
   a. Microscopy
   b. Incubator
   c. Hot air oven
   d. Autoclave
   e. Quebec colony counter
   f. water bath
3. Sterilization of glass wares
4. Preparation of cotton plug
5. Preparation of media
   Solid media- Nutrient agar, Mac Conkey agar, Blood agar , Chocolate agar, SDA, PDA (for fungi)
   Liquid media- Nutrient broth and Glucose broth
6. Isolation methods
   a. Serial dilution
   b. Pour plate
   c. Spread plate
   d. Streak plate
   e. Lawn culture
   f. Stab culture
7. Bacterial motility analysis
   a. Hanging drop technique

PART B- MICROBIAL PHYSIOLOGY

1. Effect of pH on the growth of bacteria on solid media
2. Effect of salts on the growth of microorganisms.
3. Effect of temperature on growth of microorganisms.

4. Effects of antibiotics on bacterial growth.
7. Measurement of size – Micrometer
8. Measurement of cell number- Haemocytometer
9. Biochemical test:
   a. IMVIC Test
   b. Triple sugar iron agar test
   c. Urease test
   d. Catalase test
   e. Amylase production test
   f. protease production test
   g. lipase production test
   h. Oxidase test
9. Determination of growth curve of E.coli

References

1. Aneja, K. R. 2001. *Experiments in microbiology, plant pathology, tissue culture and mushroom production technology*. 3rd Edition. New Age International (P) Limited.
2. Aneja, K. R. 2003. *Experiments in Microbiology, Plant Pathology and Biotechnology*. 4th Edition. New Age International (P) Limited, New Delhi.
3. Cappuccino, J. and Sherman, N. 2013. *Microbiology: A Laboratory Manual*. 10th Edition. Benjamin-Cummings Publishing Company, Subs Of Addison Wesley Longman, Inc.
4. Chakraborty, P. and Chakraborty, G. 2005. *Practical pathology*. Vol. 33. Kolkata: New Central Book Agency (P) Ltd.
5. Dubey, R. C. and Maheswari, D. K. 2002. *Practical Microbiology*. 2nd Edition, S. Chand & Co., New Delhi.
6. Goldman, E. and Green, L. H. 2008. *Practical Handbook of Microbiology*. 2nd Edition. CRP Press.
7. Gunasekaran, P. 2002. *Laboratory manual in microbiology*. 2nd Edition, New Age International (P) Limited, New Delhi.
8. Kalaichelvan, P. T. 2005. *Microbiology and Biotechnology Laboratory manual*. MJP Publishers, Chennai.
9. Kannan, N. 2002. *Laboratory manual in general microbiology*. 2nd Edition, Panima Publishing Co., New Delhi.

10. Lammert, J. M. 2006. *Techniques for Microbiology: A Student Handbook*. Benjamin Cummings.
11. Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.

BBMB2P02: MICROBIAL DIVERSITY AND IMMUNOLOGY

(semester I and II combined)

Total Hours: 72 **Credit: 2**

PART A - MICROBIAL DIVERSITY

I. Staining techniques

1. Simple staining
2. Differential staining
   a. Gram's staining
   b. Acid fast staining
3. Structural staining
   a. Endospore staining
   b. Granule staining
   c. Capsule staining
   d. Negative staining
4. Fungal staining
   a) Lactophenol cotton blue mounting

PART B - IMMUNOLOGY

1. Determination of ABO blood groups and Rh factor
2. Study through photographs/ illustration, the primary and secondary organs of immune system in Man.
3. Study through photographs/ illustration, cells of immune system.
4. ELISA
5. WIDAL Test
6. RPR test

References

1. Aneja, K. R. 2001. *Experiments in microbiology, plant pathology, tissue culture and mushroom production technology*. 3rd Edition. New Age International (P) Limited.
2. Cappuccino, J. and Sherman, N. 2013. *Microbiology: A Laboratory Manual*. 10th Edition. Benjamin-Cummings Publishing Company, Subs Of Addison Wesley Longman, Inc.

3. Chakraborty, P. and Chakraborty, G. 2005. *Practical pathology*. Vol. 33. Kolkata: New Central Book Agency (P) Ltd.
4. Dubey, R. C. and Maheswari, D. K. 2002. *Practical Microbiology*. 2nd Edition, S. Chand & Co., New Delhi.
5. Goldman, E. and Green, L. H. 2008. *Practical Handbook of Microbiology*. 2nd Edition. CRP Press.
6. Gunasekaran, P. 2002. *Laboratory manual in microbiology*. 2nd Edition, New Age International (P) Limited, New Delhi.
7. Hay, F. C. and Westwood, O. M. R. 2002. *Practical Immunology*. 4th Edition. Wiley-Blackwell.
8. Kalaichelvan, P. T. 2005. *Microbiology and Biotechnology Laboratory manual*. MJP Publishers, Chennai.
9. Kannan, N. 2002. *Laboratory manual in general microbiology*. 2nd Edition, Panima Publishing Co., New Delhi.
10. Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.

Model Question Paper

Reg.No……

Name……..

B.Sc. DEGREE (C.S.S) EXAMINATION

Second Semester

B.Sc. Zoology and Industrial Microbiology (Double Core)

Core Course: BBMB203 MICROBIAL PHYSIOLOGY

Time: 3 Hrs **Total Marks: 60**

Part A

Brief Answer Questions

Answer any **10** questions. Each question carries **2** marks.

1. Differentiate chemostat and Turbidostat?
2. Describe the nutritional classification of bacteria?
3. What is meant by substrate level phophorylation?
4. Define the terms bacteriostatic and bacteriocidal?
5. What is the importance of leghaemoglobin in nitrogen fixation?
6. Write the difference between homo lactic acid and hetero lactic acid fermentation?
7. Write a note on photosynthetic apparatus in prokaryotes?
8. Why microorganisms differ in their 0_2 sensitivity , Explain?
9. Give the steps involved in Glycolysis
10. What is oxidative phosphorylation?
11. Comment on group translocation.
12. Explain binary fission?

` (10X2=20 Marks)

Part B

Short Essay type Questions

Answer any **six** questions. Each question carries **4** marks.

13. Explain Kreb's cycle?
14. Describe 0_2 regulation of nitrogen fixation?
15. Briefly describe MPN and membrane filtration technique to measure bacterial growth?
16. Comment on photosynthetic pigments?
17. Explain briefly on transamination deamination reactions?
18. Describe direct microscopic count and SPC?
19. Write a note on nutritional requirements of microorganisms.

20. Give a detailed account on active transport.

21. Explain E D Pathway?

(6X4=24 marks)

Part C

Long Essay type Questions.

Answer any **two** questions. Each question carries **8** marks.

22. Explain the mechanism of symbiotic nitrogen fixation?

23. Describe ATP generating pathways?

24. Explain on various environmental factors affecting microbial growth?

25. Write an essay on bacterial photosynthesis? (2X8=16 Marks)

Reg no:……..

Name:…….

B.Sc. DEGREE (C.S.S) EXAMINATION

Second Semester

B.Sc. Zoology and Industrial Microbiology (Double Core)

Core Course: BBMB204 - IMMUNOLOGY

Time: 3hrs **Total marks: 60**

Part A

Brief Answer Questions

Answer any **10** questions. Each question carries **2** marks.

1. Outline the immunological functions of bone marrow?
2. What is precipitin reaction? Mention its application
3. Mention the role of macrophages in immune function?
4. Describe HLA antigens and ad note on their role in immunity
5. Write down the properties of complement system?
6. Differentiate between primary lymphoid organs & secondary lymphoid organs?
7. Explain the process of phagocytosis?
8. Differentiate active acquired immunity from passive acquired immunity?
9. Describe the ABO blood group system?
10. Give a brief account of the essential factors for antigenicity?
11. Why maternal milk is important for the immune protection of the baby?
12. Mention the role of antigen presenting cell? (10X2=20 Marks)

Part B

Short Essay type Questions

Answer any **six** questions. Each question carries **4** marks.

13. Explain the process of Hematopoesis?
14. Briefly describe the production of monoclonal antibody?
15. Give an account cells of immune system?
16. Summarize the classical pathway of complement system?
17. Describe the basic structure of immunoglobulin?
18. Illustrate the various steps involved in B cell activation?

19. Write a note on vaccines?

20. Explain secondary lymphoid organs?

21. Give a detailed account on graft rejection? (6x4=24 marks)

Part C

Long Essay type Questions

Answer any **two** questions**.** Each question carries **8** marks.

22. Elaborate the process of T cell maturation, activation and differentiation?

23. Write an essay on the types of antigen – antibody reaction?

24. Explain Hypersensitivity reactions and discuss in detail about Type I Hyper Sensitivity reaction?

25. Classify immunity and describe innate immunity in detail?

(2x8=16 marks)

SEMESTER III

BBMB305: MICROBIAL GENETICS AND RECOMBINANT DNA TECHNOLOGY

Total Hours: 54 **Credit: 3**

Objectives:

It is an 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 **14 Hrs**

Bacterial chromosome, DNA replication in prokaryotes. Meselson and Stahl experiment, modes of replication- rolling circle model and theta mode, Prokaryotic transcription and translation, regulation of gene expression in prokaryotes (Lac and trp operon)

Module 2 **8 Hrs**

Mutation- Mutagenesis, Spontaneous and induced mutagenesis, transition, transversion, silent, missense, non-sense, neutral, frame shift and conditional mutations. Forward and reverse mutations. Detection and isolation of mutants.

Module 3 **7 Hrs**

Recombination methods in bacteria: transformation, transduction and conjugation.

Module 4 **17 Hrs**

Vectors- Plasmids, plasmid as cloning vector, brief account on pBR 322, pUC8, phage vectors- M13, lamda and cosmid, phagemid, YAC,BAC

Basic steps involved in recombinant DNA technology. Isolation of DNA, isolation of vector, enzymes in recombinant DNA technology- type II restriction endonucleases, ligases, S1 nuclease, alkaline phosphatase, terminal transferase, DNA polymerases, reverse transcriptase. Production of recombinant DNA, transformation, selection and analysis of recombinant clones

Module 5 **8 Hrs**

Molecular biological techniques, polymerase chain reaction & RT PCR. DNA Sequencing- Maxam and Gilbert method, Sanger's chain termination method and a brief account on new generation sequencing methods.

References:

1. Alcamo, I. E. 2000. *DNA Technology: The Awesome Skill*. 2nd edition. Academic Press.
2. Balasubramanian, D., Bryce, C., Dharmalingam, K., Green, J. and Jayaraman, K. 1996. *Concepts in Biotechnology*. University Press, India.
3. Chaudhuri, K. 2012. *Microbial Genetics*. The Energy and Resources Institute, TERI.
4. Clarke, D. P. and Pazdernik, N. 2012. *Molecular Biology*. 2nd edition. Elsevier Academic Cell.
5. Cresswell, R. C., Ress, T. A. V. and Shah, N. 1989. *Algal and Cyanobacterial Biotechnology*. Longman scientific and Technical New York.
6. Freifelder, S. 1987. *Microbial Genetics*. Jones and Bartlett, Boston.
7. Gardner, E. J., Simmons, M. J. and Snustard, D. P. 1991. *Principles of Genetics*. 8th Edition. John Wiley and Sons, NY.
8. Glazer, A. N. and Nikaido, H. 2007. *Microbial Biotechnology: Fundamentals of Applied Microbiology*. 2nd Edition. Cambridge University Press.
9. Glick, B. R. and Pasternak, J. J. 1994. *Molecular biotechnology*. ASM press. Washington Dc.
10. Klug, W. S., Cummings, M. R. and Spencer, C. A. 2013. *Concepts of Genetics*.11th Edition, Pearson.
11. Lewin, B. 2007. Genes-IX. 9th Revised Edition. Jones and Bartlett Publishers, Inc.
12. Maloy, S. R., Cronan, J. E. and Freifelder, D. 1994. Microbial Genetics. 2nd edition; Jones and Bartlett Publishers.
13. Nicholl, D. S. T. 1994. *An Introduction to Genetic Engineering*. Cambridge University Press
14. Old, R. W. and Primrose, S. B. 2008. *Principles of Gene manipulation*, 4th Edition, Blackwell scientific publications, London.
15. Pierce, B. A. 2013. *Genetics- A Conceptual Approach*. 5thEdition, W. H. Freeman &Co.

16. Prave, P., Paust, V., Sitting, W. and Sukatasch, D. 2004. *Fundamentals of Biotechnology*. Panima.
17. Russell, P. J. 2013. *iGenetics- A Molecular Approach*. 3rd Edition, Pearson International.
18. Sambrook, J. and Russell, D. 2000. *Molecular Cloning: A laboratory manual*. 3rd Revised edition. Cold Spring Harbor Laboratory Press, U.S.
19. Snustad, D. P. and Simmons, M. J.2009. *Principles of Genetics*. 5thEdition, John Wiley & Sons Inc.
20. Snyder, L., Peters, J. E., Henkin, T. M. and Champness, W. 2013. *Molecular Genetics of Bacteria*. 4th edition; ASM press.
21. Sridhar, S. 2005. *Genetics and Microbial Biotechnology*. Dominant Publishers and Distributors.
22. Streips, U. N. and Yasbin, R. E. 2002. *Modern Microbial Genetics*. 2nd edition. Wiley Publishers.
23. Trevan, M. D., Boffey, S., Coulding K. H. and Standury, P. 1990. *Biotechnology. The basic principles*. Tata McGraw Hill Edition.
24. Trun, N. and Trempy, J. 2003. *Fundamental Bacterial Genetics*. Wiley-Blackwell Publishing.
25. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levin, M. and Losick, R. 2017. *Molecular Biology of the Gene*. 7th edition. Pearson education.
26. Watson, J. D., Gilman, M., Witkowski, J. and Zoller, M. 1992. *Recombinant DNA*. 2nd Edition, Scientific American Books.

BBMB306: MEDICAL MICROBIOLOGY

Total Hours: 54 **Credit: 2**

Objectives:

Course provides learning opportunities in the basic principles of medical microbiology and infectious disease. Know the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body

Outcome:

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

Module 1 **12 Hrs**

Normal microbial flora of human body, systematic study of *Staphylococcus aureus, Streptococcus pyogenes, Escherichia coli, Klebsiellapneumoniae, Pseudomonas aeruginosa, Vibriocholerae.*

Module 2 **16 Hrs**

Structure and clinical importance of hepatitis B virus, HIV, influenza virus, Dengue virus, Chikungunya virus.

Fungal diseases – characteristics and classification of fungi

Superficial Mycosis and Deepmycoses, Candidiasis. Laboratory diagnosis of fungal infections; Protozoan Diseases: Malaria, amoebic dysentery.

Module 3 **6 Hrs**

Etiology, Epidemiology, Symptomology, Pathogenesis, Diagnosis and treatment of Tuberculosis, Syphilis, Actinomycosis.

Module 4 **12 Hrs**

An account on collection, handling and transport of clinical specimens. Air borne diseases- disease caused by bacteria, fungi and viruses. Respiratory tract infections – infections of the upper and lower respiratory tract. Laboratory diagnosis of respiratory tract infections.

Module 5 **8 Hrs**

Urinary tract infections, Genital tract infections, sexually transmitted diseases, and nosocomial infections

References

1. Ahrens, W. and Pigeot I. 2014. *Handbook of Epidemiology*. 2nd Edition. Springer-Verlag New York.

2. Ananthanarayan, R. and Paniker, C. K. J. 2006. *Textbook of microbiology*. 7th Edition. Orient Blackswan.
3. Baron, S. 1996. *Medical Microbiology*. 4thEdition. Galveston (TX): University of Texas Medical Branch at Galveston
4. Cann, A. J. 2005. *Principles of Molecular Virology*. 4th Edition. Elsevier Academic Press.
5. Carter, J. and Saunders, V. 2007. *Virology: Principles and Applications*. John Wiley and Sons Ltd.
6. Daw, M. A. 2009. *Medical Microbiology Laboratory Manual*. 2nd Edition. Publisher: ISBN: 978-9959-53-052-3.
7. Dimmock, N. J., Easton, A. J. and Leppard, K. N. 2007. *Introduction to Modern Virology*, 6th Edition. Blackwell Publishing.
8. Emerging Infections and their causative agents. *Clinics in laboratory medicine* (Elsevier), September 2004, **24**(3): 559-848.
9. Emmons, C. W., Binford, C. H., Utz, J. P., Kwon-Chung, K. J. 1977. *Medical Mycology*. 3rd Edition. Philadelphia, Lea &Febiger.
10. Friis, R. H. and Sellers, T. A. 2013. *Epidemiology for Public Health Practice*. 5th edition. Jones & Bartlett Learning.
11. Godkar, P. B. and Godkar, D. P. 2005. *Textbook of Medical Laboratory Technology – Clinical Laboratory Science & Molecular Diagnosis*. 3rd Edition. Bhalani Publishing House.
12. Greenwood, D., Slack, R. C. B., Peutherer, J. F. and Barer, M. R. 2007. *Medical Microbiology: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control*. 17th Edition. Elsevier Health Sciences UK.
13. Janeway, C. A., Travers, P., Walport, M. and Shlomchik, M. J. 2001. *Immunobiology - The Immune System in Health and Disease*. 5th edition. Garland Science, New York.
14. Kapil, A.2013. Ananthnarayan & Paniker's Textbook of Microbiology. 9th Edition, University Press.
15. Kayser F. H., Bienz, K. A., Eckert, J. and Zinkernagel, R. M. 2004. *Medical Microbiology*. Berlin: Thieme Medical.
16. Khan, F. H. 2009. The Elements of Immunology. 1st Edition. Pearson Education.
17. M'ikanatha, N. M., Lynfield, R., Beneden, C. A. V. and Valk, H. D. 2013. *Infectious disease surveillance*. 2nd Revised Edition. Blackwell Publishing.

18. Pathak, S. and Palan, U. 2005. *Immunology – Essential and Fundamental*. 2nd edition. Science Publishers, Inc. New Hampshire, USA.
19. Pichare, A. P. and Nagoba,B. S. 2013.*Medical Microbiology: Prep Manual for Undergraduates*. Elsevier India Pvt. Ltd.
20. *Principles of epidemiology in public health practices*. 2006. 3rdedition. U.S. Department of Health and Human Services. Centers for Disease Control and Prevention (CDC), Atlanta, GA 30333 https://www.cdc.gov/ophss/csels/dsepd/ss1978/ss1978.pdf
21. Punt, J., Strandford, S., Jones, P. Owen, J. A. 2018. *Kuby Immunology*. 8thedition W. H. Freeman, New York.
22. Rippon, J. W. 1988. *Medical mycology: the pathogenic fungi and the pathogenic actinomycetes*. 3rd Edition. Saunder, Philadelphia.
23. Thirunavalli, B. R. and Chadalawada, U. R. 2015. *Textbook of Community Medicine*. 3rdedition. Paras Medical Publishers.
24. Tizard, I. R. 1994. *Immunology - An Introduction*. 4th Revised Edition. Brooks/Cole.
25. Topley, W. W. C., Wilson, G. S., Parker, M. T. and Collier, L. H. 1990. *Topley and Wilson's Principles of Bacteriology, Virology and Immunology*. 8th Edition. London: Edward Arnold.
26. Zinsser, H. and Joklik, W. K. 1992. *Zinsser microbiology*. 20th Edition. Norwalk, CT: Appleton & Lange.

Model Question Paper

Reg .No……

Name……

B.Sc. DEGREE (C.S.S) EXAMINATION

THIRD SEMESTER

B.Sc. Zoology and Industrial Microbiology (Double Core)

Core Course: BBMB305- Microbial Genetics and Recombinant DNA Technology

Time: 3Hrs **Total Marks: 60**

Part A

Brief answer questions

Answer any **10** questions.Each question carries **2** marks.

1. Define Transition and Transversion?
2. Briefly explain Missence mutation with example?
3. What is primer?
4. Define biochemical mutation?
5. What are auxotrophs and prototrophs?
6. Describe the structural genes in lac operon
7. Write a note on Cosmids
8. Briefly explain the structural organization of genome in prokaryotes
9. Describe the structure of tRNA?
10. Write a note on Overlapping Genes?
11. Distinguish between Exons and Introns?
12. What are Transposons? **(10 x 2 = 20 Marks)**

Part B

Short essay type questions

Answer any **six** questions. Each question carries **4** marks.

13. What is rDNA technology? Explain the principles and techniques?

14 Briefly explain DNA replication in Prokaryotes?

15 Comment on southern blotting techniques?

16 Describe Transformation method in detail.

17 What are Plasmids? Describe the characteristics of pBR322.

18 Explain selection of recombinant plasmids by blue versus white screening of colonies.

19 Write a note on PCR with diagrammatic representation?

20 Give a short note on Restriction Enzymes

21 Briefly describe generalized transduction**.** **(6X4=24 Marks)**

Part C

Long essay type questions

Answer any **two** questions**.** Each question carries **8** marks.

22.Illustrate different types of mutation and their molecular mechanism?

23. Write an essay on Translation?

24. Explain the regulation of gene expression in microbes with examples?

25. Write an essay on different types of bacterial conjugation and how was it discovered?

(2X8=16 Marks)

Reg number:……..

Name:……

B.Sc. DEGREE (C.S.S) EXAMINATION

B.Sc. Zoology and Industrial Microbiology (Double core)

Core course:BBMB306 - Medical Microbiology

Time:3hrs **Total marks:60**

Part A

Brief answer questions

Answer any **10** questions.Each question carries **2** marks.

1. Write a note on Nosocomial Infections?
2. Comment on BCG
3. Write a note on prevention of Diphtheria
4. Differentiate hard canker and soft canker
5. Write down the features of Retrovirus
6. Write a note on Diarrheagenic*E. coli*
7. Comment on Enteric fever
8. Write an account on cultivation of Vibrio cholera
9. Write down the pathogenicity of Streptococcus pneumonia
10. Ellucidate the structure of Hepatitis B virus
11. Comment on mantoux test
12. Write a note on pertussis

(10 X 2=20 marks)

Part B

Short essay typequestions

Answer any **six** questions. Each question carries **4** marks.

13. Describe briefly on staphylococcus infections
14. Add a note on anthrax disease
15. Briefly explain on Bacterial pneumonias
16. Comment on Oncogenic viruses
17. Describe on the pathogenesis and laboratory diagnosis of syphilis
18. Write a note on genital tract diseases
19. Describe on actinomycosis
20. Write a detailed account on upper respiratory tract infections

21. Write down the pathogenesis and laborotary diagnosis of chlolera

(6 x 4 = 24 marks)

Part C

Long essay type questions

Answer any**two** questions. Each question carries **8** marks

22. Describe the epidemiology , symptomology, diagnosis and treatment of Tuberculosis

23. Write an essay on Urinary tract infection

24. Explain in detail the epidemiology, cause, pathogenesis, and treatment of AIDS and Herpes

25. Write essay on bacillary dysentery

(2 x 8=16 marks)

SEMESTER IV

BBMB407: INDUSTRIAL MICROBIOLOGY

Total Hours: 36 **Credit: 2**

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. Develop an understanding of fermentation & inoculum media, their formulation and principles & techniques of sterilization

Outcome:

- Get acquainted with techniques applicable for improvement of microorganisms based on known biochemical pathways and regulatory mechanisms.

Module 1 **8 Hrs**

History, development and scope of industrial microbiology, screening of industrially important microorganisms- primary and secondary screening. Strain improvement – mutation, recombination, and protoplast fusion.

Module 2 **8 Hrs**

Preservation and storage of microorganisms. Development of inoculum for industrial fermentation. Fermentation media, formulation of media, saccharine materials, starchy materials, cellulosic materials, nitrogenous materials, enhancers and precursors, antifoams. Industrial sterilization- batch and continuous sterilization.

Module 3 **8 Hrs**

Structure of a typical batch fermenter, types of fermenters: batch fermenter, continuous stirred tank fermenter, fluidized bed fermenter, solid state fermenter, air lift fermenter, tubular fermenter.

Module 4 **4 Hrs**

Fermentation process: surface, submerged and continuous fermentation. Computer control of fermentation process.

Module 5 **8 Hrs**

Downstream processing, intra cellular and extra cellular product recovery. Physical and chemical methods. Cell disruption- methods, solvent extraction, and purification. Drying and crystallization.

References

1. Enfors, S. O. and Häggström, L. 2000. *Bioprocess Technology: Fundamentals and Applications*. Royal Institute of technology, Stockholm, Sweden.
2. Whitaker, A., Stanbury, P. F. and Hall, S. J. 2009. *Principles of Fermentation Techniques*. Elsevier.
3. Okafor, N. 2007. *Modern Industrial Microbiology and Biotechnology*. CRC Press.
4. Casida, L. E. 1968. *Industrial Microbiology*. Wiley, New York; London.
5. Crueger, W., Crueger, A., and Brock, T. D. 1990. *Biotechnology: A Textbook of Industrial Microbiology*. Sinauer Associates.
6. Demain, A. L. and Solomon, N. A. 1986. *Manual of Industrial Microbiology*. Oxford University Press, Oxford.
7. McNeil, B. and Harvey, L. M. 1990. *Fermentation: A Practical Approach.* Oxford; New York: IRL Press.
8. Prescott, S. C., Dunn, C. G., and Reed, G. 1982. *Prescott and Dunn's Industrial Microbiology*, 4th Edition. AVI Pub. Co., Westport, Conn.
9. Waites, M. J. 2001. *Industrial Microbiology*. Blackwell Science, Oxford.
10. Waites, M. J., Morgan, N. L., Rockey, J. S. and Higton, G. 2001. *Industrial Microbiology: An Introduction*. Blackwell Science Ltd.

BBMB408: FERMENTATION TECHNOLOGY

Total Hours: 36 **Credit: 2**

Objectives:

Appreciate the different types of fermentation processes & understand the biochemistry of various fermentations and product recovery methods.

Outcome:

- Get acquainted with techniques applicable for the manufacture of industrial products and acquire knowledge about immobilization of enzymes and cells.

Module 1 **7 Hrs**

Fermentative production of pharmaceuticals, production of penicillin and streptomycin.

Production of vitamins and growth stimulants, riboflavin, cyanocobalamines and gibberellins

Module 2 **10 Hrs**

Fermentative production of acetic acid, citric acid, lactic acid, lysine and glutamic acid, protease and amylase, ethanol and glycerol

Module 3 **7 Hrs**

Production of biofuels – hydrogen and methane

Production of beverages- beer and wine

Production of Single Cell Protein- Baker's Yeast and Spirullina

Module 4 **7 Hrs**

Industrial applications of enzymes, Enzyme immobilization- methods and applications.

Module 5 **5 Hrs**

Microbial recovery of metals- bioleaching of copper, gold and uranium

Microbially enhanced oil recovery (MEOR)

References

1. Doran, P. M. 2012. *Bioprocess Engineering Principles*. 2nd Edition. Elsevier Academic Press.
2. Enfors, S. O. and Häggström, L. 2000. *Bioprocess Technology: Fundamentals and Applications*. Royal Institute of technology, Stockholm, Sweden
3. Gupta, V. K., Schmoll, M., Maki, M., Tuohy, M. and Mazutt M. A. 2013. *Applications of Microbial Engineering*. CRC Press.

4. Hui, Y. H., Meunier-Goddik, L., Hansen, A. L., Josephsen, J., Nip, W.-K., Stanfield, P. S. and Toldra, F. 2004. *Handbook of Food and Beverage Fermentation Technology*. New York: Marcel Dekker Incorporated.
5. Stanbury, P. F., Whittaker, A. and Hall, S. J. 2013. *Principles of Fermentation Technology*. 3rd Edition. Butterworth-Heinemann.
6. Waites, M. J. 2001. *Industrial Microbiology*. Blackwell Science, Oxford.
7. Whitaker, A., Stanbury, P. F. and Hall, S. J. 2009. *Principles of Fermentation Techniques*. Elsevier
8. Reed, G. 2004. *Prescott and Dunn's Industrial Microbiology*. 4th Ed. CBS Publishers and Distributors, New Delhi.
9. Srivastava, M. 2008. Fermentation Technology. Alpha Science International.
10. Rao, D. G. 2010. *Introduction to Biochemical Engineering*. Tata McGraw-Hill Publishing Company.
11. Ratledge, C. and Kristiansen, B. 2001. *Basic Biotechnology*. 3rd Ed. Cambridge University Press, Cambridge.
12. Aiba, S. 1982. *Advances in Biochemical Engineering*. Volume 23. Springer-Verlag.
13. BIOTOL Board. 1992. *Operational Modes of Bioreactors, (BIOTOL series).*Butterworth Heinemann.
14. Casida, L. E. 1968. *Industrial Microbiology*. Wiley, New York; London.
15. Crueger, W., Crueger, A., and Brock, T. D. 1990. *Biotechnology: A Textbook of Industrial Microbiology*. Sinauer Associates.
16. Demain, A. L. and Solomon, N. A. 1986. *Manual of Industrial Microbiology*. Oxford University Press, Oxford.

    .
17. Lydersen B. K., D'Elia N. A. and Nelson K. M. 1993. *Bioprocess Engineering: Systems, Equipment and Facilities*. 1st Edition. Wiley-Interscience.
18. McNeil, B. and Harvey, L. M. 1990. *Fermentation: A Practical Approach.* Oxford; New York: IRL Press.
19. Peppler, H. J. 1995. *Microbial Technology: Fermentation technology*. Academic Press.
20. Ponkshe S. 1991. *Management of Intellectual Property: patents, designs, trademarks and copyright*. Bhate and Ponkhshe Prakasham, Pune.
21. Prescott, S. C., Dunn, C. G., and Reed, G. 1982. *Prescott and Dunn's Industrial Microbiology*, 4th Edition. AVI Pub. Co., Westport, Conn.

BBMB4P03: MICROBIAL GENETICS AND RECOMBINANT DNA TECHNOLOGY AND INDUSTRIAL MICROBIOLOGY

(semester III and IV combined)

Total Hours: 72 **Credit: 2**

PART A - MICROBIAL GENETICS AND RECOMBINANT DNA TECHNOLOGY

1. Isolation of chromosomal DNA from *E.coli*
2. Isolation of plasmid DNA
3. Agarose gel electrophoresis
4. Estimation of DNA
5. Bacterial transformation, transduction &conjugation.
6. Replica plate technique
7. Polymerase chain reaction
8. Vector maps of pBR 322, pUC8
9. Immobilization of yeast cells by sodium alginate method

PART B - INDUSTRIAL MICROBIOLOGY

1. Crowded plate technique for screening microbial production of antibiotics
2. Solid state fermentation – production of mushroom using husk
3. Submerged fermentation
4. Preservation techniques:
   a. Serial sub culturing
   b. Over laying with mineral oil
   c. Lyophilization
   d. Liquid nitrogen storage.
   e. Methods for the storage of fungi
5. Estimation of lactic acid from milk.
6. Identification of industrially important fungi

References

1. Aneja, K. R. 2003. *Experiments in Microbiology, Plant Pathology and Biotechnology*. 4th Edition. New Age International (P) Limited, New Delhi.
2. Aneja, K. R. 2001. *Experiments in microbiology, plant pathology, tissue culture and mushroom production technology*. 3rd Edition. New Age International (P) Limited.

3. Baltz, R. H., Davies, J. E. and Demain, A. L. 2012. *Manual of Industrial Microbiology and Biotechnology*. 3rd Edition. Washington DC: American Society of Microbiology.
4. Dubey, R. C. and Maheswari, D. K. 2002. *Practical Microbiology*. 2nd Edition, S. Chand & Co., New Delhi.
5. Goldman, E. and Green, L. H. 2008.*Practical Handbook of Microbiology*. 2nd Edition. CRP Press.
6. Gunasekaran, P. 2002. *Laboratory manual in microbiology*. 2nd Edition, New Age International (P) Limited, New Delhi.
7. Kalaichelvan, P. T. 2005. *Microbiology and Biotechnology Laboratory manual*. MJP Publishers, Chennai.
8. Kannan, N. 2002. *Laboratory manual in general microbiology*. 2nd Edition, Panima Publishing Co., New Delhi.
9. Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.

BBMB4P04: MEDICAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY

(semester III and IV combined)

Total Hours: 72 **Credit: 2**

PART A - MEDICAL MICROBIOLOGY

1 .Microbiology of laboratory safety, General concept for specimen collection, handling.

2. Study of the morphology, staining characters, cultural characters and biochemical identification of *Staphylococci, Streptococci, E.coli, Klebsiella, Pseudomonas* and *Vibrio*
3. Test for hemolytic property of bacteria.
4. Isolation and identification of bacteria from clinical samples
5. Culture methods for isolation and identification of fungi- KOH mount preparation, Lacto phenol cotton blue staining, Slide culture technique, Germ tube test etc.
6. Study of normal microbial flora of human being
7. Isolation of bacteria from air

PART B - FERMENTATION TECHNOLOGY

1. Study of alcoholic fermentation of fruit juice by yeast.
2. Quantitative estimation of ethanol produced during yeast fermentation.
3. Production of citric acid by *Aspergillus niger*
4. Estimation of citric acid.
5. Production of Pencillin & testing of antimicrobial activity.

References

1. Aneja, K. R. 2003. *Experiments in Microbiology, Plant Pathology and Biotechnology*. 4th Edition. New Age International (P) Limited, New Delhi.
2. Aneja, K. R. 2001. *Experiments in microbiology, plant pathology, tissue culture and mushroom production technology*. 3rd Edition. New Age International (P) Limited.
3. Dubey, R. C. and Maheswari, D. K. 2002. *Practical Microbiology*. 2nd Edition, S. Chand & Co., New Delhi.
4. Gunasekaran, P. 2002. *Laboratory manual in microbiology*. 2nd Edition, New Age International (P) Limited, New Delhi.
5. Kalaichelvan, P. T. 2005. *Microbiology and Biotechnology Laboratory manual*. MJP Publishers, Chennai.

6. Kannan, N. 2002. *Laboratory manual in general microbiology*. 2nd Edition, Panima Publishing Co., New Delhi.
7. Kulandaivelu, S. and Janarthanan, S. 2012. *Practical Manual on Fermentation Technology*. International Publishing House Pvt. Limited.
8. McNeil, B. and Harvey, L. M. 2008.*Practical Fermentation Technology*. John Wiley & Sons, Ltd, Chichester.
9. Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.

Model Question Paper

Reg. No.:……..

Name:……

B.Sc. DEGREE (C.S.S) EXAMINATION

B.Sc Zoology and Industrial Microbiology (Double core)

Core course: BBMB407- Industrial Microbiology

Time:3Hrs **Total marks:60**

Part A

Brief answer questions

Answer any **10** questions.Each question carries **2** marks**.**

1. Describe the contributions of Louis Pasteur.
2. Explain crowded plate technique.
3. Give the use of fluidized bed fermenter.
4. Explain the working of a chemostat .
5. Describe the method of lyophilisation.
6. Explain solid shear.
7. Write short notes on liquid -liquid extraction.
8. Describe shortly rotary vacuum filtration.
9. What is crystallization.
10. Write a note on Tubular fermenter
11. Comment on antifoams
12. Mention the role of baffles and in industrial fermentation process**.**

(10 x 2=20 marks)

Part B

Short essay type questions

Answer any **six** questions. Each question carries **4** marks.

13 Describe primary screening technique.

14 Discuss in detail the strain development techniques.

15 Write a note on Industrial sterilization.

16 Explain different methods of cell disruption.

17 Write a note on fermentation media.

18 Distinguish between surface, submerged and continuous fermentations.

19 Write an account on computer control of fermentation process.

20 Discuss on aeration devices in a fermentor.

21 Write a detailed account on whole broth processing**.**

(6 x 4 = 24 marks)

Part C

Long essay type questions

Answer any **two** questions. Each question carries **8** marks

22 Elaborate the history of Industrial Microbiology.

23. Explain the various methods used for the preservation of microorganisms.

24. Write an essay on inoculum development methods for industrial fermentation.

25. Describe downstream processing in fermentation**.** **(2 x 8=16 marks)**

Reg. No……

Name……..

B.Sc. DEGREE (C.S.S) EXAMINATION

Fourth Semester

B.Sc. Zoology and Industrial Microbiology (Double Core)

Core course:BBMB408- Fermentation Technology

Time: 3 Hrs **Total Marks: 60**

Part A

Brief answer questions

Answer any **10** questions. Each question carries **2** marks**.**

1. Summarize the major steps involved in the production of glycerol
2. Write down the optimum fermentation conditions required for Vitamin B 2 production.
3. Mention the role gibberellins in plants and discuss how it is produced by fermentation technique.
4. Describe the role of precursors in streptomycin production.
5. Aeration is not necessary for lactic acid production. Justify.
6. Elaborate the method adopted in the leaching of uranium.
7. Differentiate between bacterial protease and fungal protease.
8. Why *Aspergillus niger* is preferred for citric acid production
9. Explain the preparation of inoculum for the production of cyanocobalamine
10. Write down the various steps involved in the recovery of citric acid.
11. Explain the production of acid protease production**?**
12. Comment on vitamin B12

(10X2=20 Marks)

Part B

Short essay type questions

Answer any **six** questions. Each question carries **4** marks.

13. Write down the various steps involved in the microbial transformation of steroids.
14. Briefly explain the process of biomethanation.
15. Give an account on the production of lactic acid.
16. Explain the bioleaching of gold and copper.
17. How penicillin can be produced by fermentation.

18. Briefly explain surface fermentation with an example

19. Explain the production of beer?

20. Describe any two methods used in MEOR

21. Write a note on gibberellins (6 X4=24 Marks)

Part C.

Long Essay type questions

Answer any **two** questions. Each question carries **8** marks

22. Explain the production of ethyl alcohol in detail

23. Elaborate the fermentative production of antibiotics with examples.

24.Write an essay on Microbial Enhanced Oil Recovery.

25. Explain the industrial production of acetic acid. (2X8=16 Marks)

SEMESTER V

BBMB509: FOOD MICROBIOLOGY

Total Hours: 54 **Credit: 3**

Objectives:

The course deals with the scientific study of microorganisms both in food and used for production of food and also deals with microbiological analysis of food to determine the safety and quality of food

Outcome:

- Understand the beneficial role of microorganisms in food processing and the microbiology of different types of fermented foods.
- Recognize and describe the characteristics of important food borne pathogens and learn various methods for their isolation, detection and identification and understand the basis of food safety regulations

Module1 **10 Hrs**

A brief account of microorganisms important in food industry- molds, yeasts and bacteria, factors affecting microbial growth in food, extrinsic, intrinsic, implicit and processing factors.

Module 2 **12 Hrs**

Principles of food preservation - asepsis, removal of microorganisms, anaerobic conditions, high and low temperatures, drying, radiation, pascalization. Chemical preservatives -food additives. Principles of canning.

Module 3 **12 Hrs**

A brief account of microbiological basis of spoilage of vegetables, fruits, milk, egg, meat and fish. Microbial role in production of Bread, vinegar, sauerkraut, beer, and wine. Cultivation of mushrooms.

Module 4 **10 Hrs**

Bacteriological examination of milk. Preservation of milk, pasteurization - different methods. Fermented dairy products- cheese, yoghurt, kefir, butter and butter milk.

Module 5 **10 Hrs**

Food poisoning and food born infections. Brief account on Mycotoxins, Hazard Analysis Critical Control Points (HACCP) microbiological standards of food- water & beverages.

References

1. Adams, M. R. and Moss, M. O. 2008. *Food Microbiology*, 3rd Edition. RSC Publishers.
2. Jay, J. M., Loessner, M. J. and Golden, D. A. 2005. *Modern Food Microbiology*. Springer Science & Business Media.
3. Frazier, W. C. and Westhoff, D. C. 2004. *Food Microbiology*. Tata McGraw Hills Publishing Company Limited.
4. Doyle, M. P., Beuchat, L. R. and Montville, T. J. 2001. *Food Microbiology: Fundamentals and Frontiers.* 2nd Edition. ASM Press, Washington, D.C.
5. Ray, B. 2003. *Fundamentals of Food Microbiology*. Boca Raton, FL: CRC Press.
6. Waites, M. J. 2001. *Industrial Microbiology*. Blackwell Science, Oxford.

7. Ayres, J. C., Mundt, J. O. and Sandine, W. E. 1980. *Microbiology of foods*. Freeman, San Francisco.
8. Casida, L. E. 1968. *Industrial Microbiology*. Wiley, New York; London.
9. Garbutt, J. H. 1997. *Essentials of food microbiology*. Arnold, London.
10. McNeil, B. and Harvey, L. M. 1990. *Fermentation: A Practical Approach.* Oxford; New York: IRL Press.
11. Prescott, S. C., Dunn, C. G. and Reed, G. 1982. *Prescott and Dunn's Industrial Microbiology*. 4th Edition. AVI Pub. Co., Westport, Conn.
12. Robinson, R. K. 1990. *Dairy Microbiology*. 2nd Edition. Elsevier Science Pub. Co., London; New York.
13. Rose, A. H. 1983. *Food microbiology*. Academic Press, London.
14. Wood, B. J. B. 1998. *Microbiology of fermented foods*. 2nd Edition. Blackie Academic and Professional, London.

Model Question Paper

Reg.No……

Name……...

B.Sc. DEGREE (C.S.S) EXAMINATION

Fifth Semester

B.Sc. Zoology and Industrial Microbiology (Double Core)

Core Course: BBMB509 FOOD MICROBIOLOGY

Time: 3 Hrs **Total Marks: 60**

Part A

Brief answer questions

Answer any **10** questions. Each question carries **2** marks

1. What is TDP and TDT?
2. Discuss on asepsis?
3. Give a note on blue milk?
4. What are the difference between Probiotics and prebiotics?
5. What is SCP?
6. Define pasteurization?
7. Explain the nutritional value of mushrooms?
8. Describe the production of Kefir?
9. Differentiate between food born infections and food born intoxication?
10. Write down the principles of canning?
11. Write a note on food additives?
12. What is aflatoxin? (10X 2=20 Marks)

Part B

Short essay type questions

Answer any **six** questions. Each question carries **4** marks.

13. Describe spoilage of meat?
14. Briefly describe the production of vinegar?
15. Give an account on different Preservation methods?
16. Briefly explain the dye reduction test of milk.
17. Explain HACCP in detail?
18. Briefly explain the cultivation of mushroom?
19. Write a note on microorganisms important in food industry?

20. Describe briefly the production of sauerkraut.

21. Write a note on spoilage of milk and milk products. (6x4=24 Marks)

Part C

Long essay type questions

Answer any **two** questions. Each question carries **8** marks.

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

23. Write an essay on different Preservation methods?

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

25. Explain the production of cheese in detail? (2X8=16 Marks)

SEMESTER VI

BBMB610: AGRICULTURAL MICROBIOLOGY

Total Hours: 54 **Credits: 3**

Objectives:

The course deals with the study of the composition, physiology and significance of microbial communities in the environment and agriculture. It also includes plant microbe interactions and bio fertilizers,

Outcome:

- Appreciate the diversity of microorganisms and learn the abundance, distribution and significance of microorganism in agriculture.
- Understand the various biogeochemical cycles
- Learn in detail the types and mechanisms of nitrogen fixation, bio fertilizers and their production techniques.

Module 1 **16 Hrs**

Distribution of microorganisms in soil. Soil microorganisms and microbial interactions - mutualism, synergism (protocooperation), commensalisms. Amensalism, competition, parasitism, predation, neutralism. Role of microorganisms in cycling of elements- nitrogen, carbon, sulfur, phosphorus cycles

Module 2 **10 Hrs**

Plant –microbe interaction -microorganisms of rhizosphere, rhizoplane, phylloplane and myccorhizae-ectomycorrhizae, endomycorrhizae and vesicular arbuscularmyccorrhizae

Biological nitrogen fixation - Biochemistry and physiology of nitrogen fixation, *nif* genes & nod genes.

Module 3 **12 Hrs**

Microbial diseases of plants

Bacterial diseases**:** Bacterial leaf blight of rice, Citrus canker

Fungal diseases: Root rot of pepper, Downy mildew of grapes, and Tikka disease of groundnut.

Mycoplasmal diseases - Sandal spike, Grassy shoot disease of sugar cane

Actinomycetes diseases- Potato scab disease

Viral Disease – TMV, Bunchy top disease of banana

Module 4 **10 Hrs**

Bio fertilizers: Types and importance. Production and quality control: *Rhizobium, Azotobacter, Azospirillum*, Cyanobacteria, mycorrhizae: vesicular arbuscularmycorrhizae. Phosphate solubilizing bacteria. Advantages & disadvantages over chemical fertilizers.

Module 5 **6 Hrs**

Biopesticides: bacterial, viral and fungal pesticides. Biological control of plant diseases. Integrated pest management.

References

1. Agrios, G. 2005. *Plant Pathology*. 5th Edition, Academic Press.
2. Ahmad, I., Ahmad, F. and Pichtel, J. 2011.*Microbes and Microbial Technology: Agricultural and Environmental Applications*. Springer, New York.
3. Atlas, R. N. and Bartha, R. 1998. *Microbial Ecology: Fundamentals & Applications*.4thEdition. Benjamin & Cummings Science Publishing, California.
4. Bagyaraj, D. J. and Rangaswami, G. 2005. *Agricultural microbiology*. 2ndEdition, Prentice Hall of India.
5. Campbell, R. E. 1983. *Microbial ecology*. 2nd Edition, Blackwell Scientific Publications, Oxford; Boston.
6. Dart, R. K. 1980 *Microbiological aspects of pollution control*. 2nd Edition. Elsevier Scientific, Amsterdam.
7. Hull, R. 2002. *Matthew's Plant Virology*. 4th Edition, Academic Press.
8. Jan Dirk van Elsas. 1997. *Modern Soil Microbiology*. Taylor and Francis.
9. Mitchell, R. 1974. *Introduction to environmental microbiology*. Prentice-Hall, Englewood Cliffs, N. J.
10. Rajvaidya, N. and Markandey, D. K. 2006. *Agricultural Applications of Microbiology*. APH Publishers.
11. Rheinheimer, G. 1991. *Aquatic microbiology*, 4th Edition, John Wiley and Sons.
12. SubbaRao, M. S. 1995. *Soil microorganisms and plant growth*. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

BBMB611: MICROBIAL WASTE MANAGEMENT

Total Hours: 54 **Credits: 3**

Objective:

It deals with the study of the composition, physiology and significance of microbial communities in the environment and the microbial degradation of organic matter.

Outcome:

- Competently explain various aspects of environmental microbiology and comprehend about water pollution, water-borne diseases and their transmission.
- Methods of determination of sanitary quality of water and sewage treatment methods employed in waste water treatment.
- Acquire knowledge about the significance of microorganisms in bioremediation.

Module 1 **12 Hrs**

Solid waste- types and sources of solid waste

Solid waste disposal; sanitary landfills, composting; static pile, aerated pile, and feed reactor, role of microorganisms in composting

Vermicomposting –biomethanation

Module 2 **12 Hrs**

Liquid waste- sources of liquid waste, components of industrial wastewater, treatment of liquid waste; microbiology of municipal sewage

Sewage treatment - primary treatment- screening, sedimentation, floatation, coagulation and flocculation, secondary treatment - trickling filter, RBC, activated sludge, oxidation pond and tertiary treatments

Anaerobic sludge digestion process

Module 3 **6 Hrs**

Disinfections- chlorination – methods of chlorination- break point chlorination, super chlorination, chloramines, and chlorine dioxide. UV and Ozone treatment.

Disposal of treated sewage

Module 4 **12 Hrs**

Microbial indicators of water pollution, BOD, COD, eutrophication. Microbiological water quality standards. Aspects of water pollution- biofilm, bio corrosion, bio augmentation. Bacteriological techniques for the examination of water – total count, most probable number, membrane filter technique. Water borne diseases

Module 5 **12 Hrs**

Bioremediation- in situ and ex situ techniques Bioremediation of xenobiotic compounds- oil, dyes, pesticides and plastics. Hospital waste management, biosorption.

References

1. Barthwal, R. R. 2012. *Environmental Impact Assessment*. New Age International Publishers.
2. Glasson, J., Therivel, R. and Chadwick. A. 2012. *Introduction to Environmental Impact Assessment*. 4th Edition. Routledge.
3. Odum, E. P. and Barrett, G. W. 2005. *Fundamentals of Ecology*. 5th Edition. Thomson Brooks/Cole, Belmont, CA.
4. Hurst, C. J., Crawford, R. L., Garland, J. L., Lipson, D. A. and Mills, A. L. 2007. *Manual of Environmental Microbiology*. ASM Press.
5. Kuhad, R. C. and Singh, A. 2007. *Lignocellulose Biotechnology: Future Prospects*. I. K. International.
6. Maier, R., Pepper, I. and Gerba, C. 2008. *Environmental Microbiology*. Academic Press.
7. Prakash S. 2009. *Biotechnology for Water and Wastewater Treatment*. Navyug Publishers & Distributors, New Delhi.
8. Rajendran, P. and Gunasekaran, P. 2006. *Microbial Bioremediation*. MJP Publishers, Chennai.
9. Mitchel, R. 2009. *Environmental Microbiology*. 2nd Edition, Wiley-Blackwell
10. Jjemba, P. K. 2004. *Environmental Microbiology: Principles and Applications*. Science Publishing Inc.
11. Patwardhan, A. D. 2009. *Industrial Waste Water Treatment*. PHI.
12. Atlas, R. M., Bartha, R. and Cummings, B. 1998. *Microbial Ecology*. 4th Edition. Publishing Co, Redwood City, CA.
13. Daniel, J. C. 1999. *Environment Aspects of Microbiology*. 1st Edition, Bright Sun Publications, Chennai.
14. Eckenfelder, W. W. Jr. 1999. *Industrial Water Pollution Control*. 3rd Edition. McGraw Hill Science.
15. Edmonds, P. 1978. *Microbiology: An environmental Perspective*. Macmillan, New York.

16. Eriksson, K-E. L., Blanchettee, R. A. and Ander, P. 1990. *Microbial and Enzymatic Degradation of Wood and Wood components*. Springer.
17. Forster C. 2003. *Wastewater Treatment and Technology*. Thomas Telford Publishing, London, UK.
18. Grant, W. D. and Long, P. E. 1981. *Environmental Microbiology*. Kluwer Academic Publishers.
19. Rangaswam, G. and Bagyaraj, D. J. 1992. *Agricultural Microbiology*, Asia Publishing House, New Delhi.
20. Schaechter, M. 2009. *Encyclopedia of Microbiology*. Six-Volume Set, 1-6. Academic press.
21. Shrivastava, A. K. 2003. *Environmental Impact Assessment*. APH Publishing.
22. Singh, A. and Ward, O. P. 2004. *Applied Bioremediation and Phytoremediation*. Springer.
23. Singh, A., Kuhad R. C. and Ward, O. P. 2009. *Advances in Applied Bioremediation*. Springer.
24. Tchobanoglous, G. and Burton, F. L. 1991. *Wastewater Engineering: Treatment, Disposal Reuse*.3rd Edition. McGraw-Hill.
25. Varnam, A. H. and Evans, M. G. 2000. *Environmental Microbiology*. Manson Publishing Ltd.

BBMB6P05: FOOD MICROBIOLOGY AND AGRICULTURAL MICROBIOLOGY

(Semester V and VI combined)

Total Hours: 90 **Credit: 2**

PART A - FOOD MICROBIOLOGY

1. Microbiological examination of food
2. Isolation of bacteria from idli batter &curd.
3. Microbiological examination of soft drinks.
4. Standard plate count of milk.
5. Determination of quality of milk sample by methylene blue reduction test.
6. Detection of number of bacteria in milk by breed count.
7. Quality testing of milk by Resazurin test.
8. Determination of phosphatase activity of milk.
9. Detection of mastitis through milk test.
10. Cultivation of Edible mushroom

PART B - AGRICULTURAL MICROBIOLOGY

1. Isolation & enumeration of microorganism from soil.
2. Isolation &cultivation of rhizobium
3. Morphological observation of rhizobium from root nodules
4. Isolation of *Azotobacter* sps.from soil
5. Isolation of microorganism from rhisosphere and calculation of R: S Ratio
6. Study of antagonism between soil microorganisms.
7. Study of symptoms of various plant diseases
   a. Downy mildew of grapes.
   b. Potato scab disease.
   c. Citrus canker.
   d. Bacterial leaf blight of rice.
   e. Bunchy top disease of banana
   f. Phytopthora root rot of pepper

References

1. Aneja, K. R. 2001. *Experiments in microbiology, plant pathology, tissue culture and mushroom production technology*. 3rd Edition. New Age International (P) Limited.

2. Aneja, K. R. 2003. *Experiments in Microbiology, Plant Pathology and Biotechnology*. 4th Edition. New Age International (P) Limited, New Delhi.
3. Dubey, R. C. and Maheswari, D. K. 2002. *Practical Microbiology*. 2nd Edition, S. Chand & Co., New Delhi.
4. Gunasekaran, P. 2002. *Laboratory manual in microbiology*. 2ndEdition, New Age International (P) Limited, New Delhi.
5. Kalaichelvan, P. T. 2005. *Microbiology and Biotechnology Laboratory manual*.MJP Publishers, Chennai.
6. Kannan, N. 2002. *Laboratory manual in general microbiology*. 2nd Edition, Panima Publishing Co., New Delhi.
7. Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.
8. Rozar, A. 2002. *Practical Methods for Environmental Microbiology and Biotechnology*. Krishna Prakashan Media Ltd., Meerut
9. Schmidt, E. L.1967. *A Practical Manual of Soil Microbiology Laboratory Methods*. Food and Agriculture Organization of the United Nations.

BBMB6P06: MICROBIAL WASTE MANAGEMENT

Total Hours: 36 **Credit: 1**

1. Bacterial examination of water by MPN technique and IMVIC test
2. Bacterial examination of water by membrane filter technique
3. Analysis of water by standard plate count
4. Determination of dissolved Oxygen
5. Estimation of BOD water, raw / treated sewage
6. Estimation of COD water, raw / treated sewage

References

1. Aneja, K. R. 2001. *Experiments in microbiology, plant pathology, tissue culture and mushroom production technology*. 3rd Edition. New Age International (P) Limited.
2. Aneja, K. R. 2003.*Experiments in microbiology, plant pathology, tissue culture and mushroom production technology*. 4thEdition. New Age International (P) Limited.
3. Dubey, R. C. and Maheswari, D. K. 2002. *Practical Microbiology*. 2nd Edition. S. Chand & Co., New Delhi.
4. Kalaichel van, P. T. 2005. *Microbiology and Biotechnology Laboratory manual*. MJP Publisher.
5. Kannan, N. 2002.*Laboratory manual in general microbiology*.2nd Edition. Panima Publishing Co., New Delhi.
6. Gunasekaran, P. 2002.*Laboratory manual in microbiology*. 2nd Edition. New Age International (P) Limited, New Delhi.
7. Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.

Model Question Paper

Reg. No……

Name……..

B.Sc. DEGREE (C.S.S) EXAMINATION

Sixth Semester

B.Sc. Zoology and Industrial Microbiology (Double Core)

Core course: BBMB610 AGRICULTURAL MICROBIOLOGY

Time: 3 Hrs **Total Marks: 60**

Part A

Brief answer questions

Answer any **10** questions.Each question carries **2** marks.

1. What is proto co-operation
2. Comment on commensalism
3. Write on rhizosphere bacteria
4. Comment on nitrogenase
5. Comment on the importance on VAM
6. Write on the symptoms of Bacterial leaf blight of rice
7. Comment on the pathogenicity of Downy mildew of grapes
8. What is YEMA?
9. What is the mechanism of non symbiotic nitrogen fixation
10. Mention Leg hemoglobin
11. What is Rhizosphere effect
12. Comment on Phylloplane (10 X 2 =20 Marks)

Part B

Short essay type questions

Answer any **six** questions. Each question carries **4** marks.

13. Briefly describe the effect of plant on rhizosphere microbial community
14. Describe the two way relationship between mycorrhizal fungi and the plant host.
15. Explain briefly on the production of acetobacter
16. Write the difference between Amensalism and Synergism
17. Briefly explain Nif genes and its importance.
18. Explain symbiotic nitrogen fixation
19. Write the etiology, symptoms, treatment and prevention of grassy shoot of sugarcane.
20. Explain the cultivation methods of phosphate biofertilizers

21. Briefly describe the effect of plant on rhizosphere microbial community

(6X4=24 Marks)

Part C

Long essay type questions

Answer any **two** questions. Each question carries **8** marks.

22. Write an essay on soil microorganisms.

23. Explain briefly on bacterial plant infections

24. What are different microbial interactions? Explain negative interactions among microbial populations in detail.

25. What are biofertilizers? Explain the production of rhizobium biofertilizers?

(2 X 8= 16Marks)

Reg No:……..

Name:…….

B.Sc. DEGREE (C.S.S) EXAMINATION

Sixth Semester

B.Sc. Zoology and Industrial Microbiology (Double Core)

Core Course:BBMB611: Microbial Waste Management

Time: 3 Hrs **Total Marks: 60**

Part A

Brief Answer Questions

Answer any **10** questions.Each question carries **2** marks.

1. Explain activated sludge process
2. Write a note on bio remediation.
3. What is biosorption?
4. Explain COD
5. Septic tanks.
6. Biodegradation of lignin
7. What are trickling filters
8. Comment on eutrophication.
9. Biodegradation of cellulose
10. Comment on bio augmentation
11. Give a note on biofilm formation
12. Comment on land fill (10X2=20 Marks)

Part B

Short Essay type Questions

Answer any **six** questions. Each question carries **4** marks.

13. Explain about biodegradation of dyes?
14. Describe the process of composting
15. Give an account on categories and sources of solid waste?
16. Biodegradation of pesticides.
17. Describe oxidation ponds.
18. Write down the disinfection of sewage
19. Microbial indicators of water pollution
20. Briefly explain MPN method
21. Give an account on bio corrosion (6x4=24 marks)

Part C

Long Essay type Questions

Answer any **two** questions. Each question carries **8** marks.

22. Describe various methods of waste water treatment?
23. Explain hospital waste management strategies.
24. Write an essay on the treatment of solid waste
25. Explain the bacteriological techniques for the examination of water (2x8=16 marks)

OPEN COURSE

BOMB501: MICROBIOLOGY IN DAILY LIFE

Total Hours: 54 **Credits: 3**

Objectives:

Students acquire a brief knowledge about the various fields in microbiology

Outcome:

- Understand the beneficial role of microorganisms in food processing and the microbiology of different types of fermented foods.
- Appreciate the diversity of microorganisms and learn the abundance, distribution and significance of microorganism in agriculture**.**
- Get acquainted with techniques applicable for the manufacture of industrial products
- Competently explain various aspects of environmental microbiology and comprehend about water pollution, water-borne diseases and their transmission
- Explain the basic principles of medical microbiology and infectious disease

Module 1 Food and Dairy Microbiology **18 Hrs**

Production of beverages - beer and wine.

Production of organic acid- vinegar

Production of mushroom

Production of Single Cell Protein - Spirullina

Fermented dairy products- Dahi, cheese, and yoghurt.

Module 2 Agricultural Microbiology **8 Hrs**

Bio fertilizers: Production of *Rhizobium* and *Azotobacter*

Bio pesticides – *Bacillus thuringiensis*

Advantages & Disadvantages of biofertilizers amd biopesticides

Module 3 Industrial Microbiology **8 Hrs**

Production of biofuel – Methane

Fermentative production of ethanol

Production of antibiotic - Pencillin

Module 4 Water Microbiology **16 Hrs**

Bacteriological examination of water – MPN, SPC and membrane filter

Waterborne diseases – cholera, typhoid, shigella dysentery and hepatitis A

Module 5 Medical Microbiology **4 Hrs**

Infections-Classification of infections, sources of infections, methods of transmission, types of infectious disease

References

1. Adams, M. R. and Moss, M. O. 2008. *Food Microbiology*, 3rd Edition. RSC Publishers.
2. Jay, J. M., Loessner, M. J. and Golden, D. A. 2005. *Modern Food Microbiology*. Springer Science & Business Media.
3. Frazier, W. C. and Westhoff, D. C. 2004. *Food Microbiology*. Tata McGraw Hills Publishing Company Limited.
4. Doyle, M. P., Beuchat, L. R. and Montville, T. J. 2001. *Food Microbiology: Fundamentals and Frontiers.* 2nd Edition. ASM Press, Washington, D.C.
5. Agrios, G. 2005. *Plant Pathology*. 5th Edition, Academic Press.
6. Ahmad, I., Ahmad, F. and Pichtel, J. 2011.*Microbes and Microbial Technology: Agricultural and Environmental Applications*. Springer, New York.
7. Atlas, R. N. and Bartha, R. 1998. *Microbial Ecology: Fundamentals & Applications*.4thEdition. Benjamin & Cummings Science Publishing, California.
8. Enfors, S. O. and Häggström, L. 2000. *Bioprocess Technology: Fundamentals and Applications*. Royal Institute of technology, Stockholm, Sweden.
9. Whitaker, A., Stanbury, P. F. and Hall, S. J. 2009. *Principles of Fermentation Techniques*. Elsevier.
10. Okafor, N. 2007. *Modern Industrial Microbiology and Biotechnology*. CRC Press.
11. Casida, L. E. 1968. *Industrial Microbiology*. Wiley, New York; London.
12. Barthwal, R. R. 2012. *Environmental Impact Assessment*. New Age International Publishers.
13. Glasson, J., Therivel, R. and Chadwick. A. 2012. *Introduction to Environmental Impact Assessment.* 4th Edition. Routledge.
14. Odum, E. P. and Barrett, G. W. 2005. *Fundamentals of Ecology*. 5th Edition. Thomson Brooks/Cole, Belmont, CA.
15. Hurst, C. J., Crawford, R. L., Garland, J. L., Lipson, D. A. and Mills, A. L. 2007. *Manual of Environmental Microbiology*. ASM Press.
16. Emerging Infections and their causative agents. *Clinics in laboratory medicine* (Elsevier), September 2004, **24**(3): 559-848.

17. Ananthanarayan, R. and Paniker, C. K. J. 2006. *Textbook of microbiology*. 7th Edition. Orient Blackswan.
18. Robinson, R. K. 1990. *Dairy Microbiology*. Volume II and I. Elsevier Applied Science, London.
19. Dey, S. 1994. *Outlines of Dairy Technology*. Oxford Univ. Press, New Delhi.
20. Law, B. A. 1997. Microbiology and Biochemistry of Cheese and Fermented Milk. 2nd edition. Blackie Academic & Professional, London.

Model Question Paper

Reg. No……

Name……..

B.Sc. DEGREE (C.S.S) EXAMINATION

Fifth Semester

BBEMB 501 - MICROBIOLOGY IN DAILY LIFE

(OPEN COURSE - For B.Sc. Botany& Biotechnology)

Time : 3Hrs **Total Marks: 80**

Part A

Brief Answer Questions

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

1. Mention on fringe generator?
2. Give a note on mashing?
3. Write down the advantages of biofertilizers?
4. What is infectious disease?
5. Define pasteurization?
6. Comment on nutritive value of mushroom?
7. Explain the various steps in MPN?
8. Define antibiotics? List out the stages in penicillin production?
9. What is sterilization?
10. What are methanogens. Give examples
11. Which are the methods of transmission of infections?
12. List out the stages of vinegar production? (10x2=20 marks)

Part B

Short Essay type Questions

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

13. Write a note on biopesticides?
14. Describe the production of wine?
15. Explain on infections?
16. Briefly describe the production of ethanol?
17. Write a note on water borne diseases?
18. Give an account on production of mushrooms?
19. Explain the production of ethanol?
20. What is SCP? Give an account on production of spirulina.

21. Write a note on methanogenesis? (6 X5=30 Marks)

Part C

Long Essay type Questions

(Answer any **two** questions. Each question carries **15** marks)

22. Explain the production of beer?

23. Write an essay on fermented milk product?

24. Give a detailed account on bacteriological examination of water?

25. Write an essay on production of biofertilizers? (2x15=30marks)

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