DEPARTMENT OF MICROBIOLOGY

CURRICULUM AND SYLLABUS FOR MODEL III BSc INDUSTRIAL MICROBIOLOGY AND ZOOLOGY (DOUBLE CORE) PROGRAMME

(with effect from 2015 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.

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. **Chairperson**

   Dr. Jose D. Kaipallil

   Associate Professor

   Department of Zoology

   S. B College

   Changanassery

2. **Dr. Jisha M. S.**

   Associate Professor

   School of Biosciences

   M.G University

   Kottayam

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

   Assistant Professor

   School of Biosciences

   M.G University

   Kottayam

4. **Dr. Lincy Sara Varghese**

   Assistant Professor

   Department of Microbiology

   Bishop Kurialacherry College for Women,

   Amalagiri, Kottayam

5. **Dr. Girilal M.**

   Adjunct Faculty

   School of Biosciences

   M.G University

   Kottayam

6. **Dr. Saji Varghese**

   Managing Director

   Mangalam Diagnostic Centre

   Kottayam

7. **K. J. Jacob**

   Director

   Agro Bio-Tech Research Centre Ltd,

   Industrial Area, Poovanthuruthu P.O.

   Kottayam

8. **Dr. Jomon K. V.**
   Assistant Professor
   Department of Zoology
   S.B College
   Changanassery
9. **Jeena M John**
   Assistant Professor
   Department of Microbiology & Biochemistry
   S.B College
   Changanassery
10. **Sweety K Ennacheril**
    Assistant Professor
    Department of Microbiology & Biochemistry
    S.B College
    Changanassery
11. **Jiji Jacob**
    Assistant Professor
    Department of Microbiology & Biochemistry
    S.B College
    Changanassery
12. **Dr. Vincy Mary Varghese**
    Assistant Professor
    Department of Zoology
    S.B College
    Changanassery
13. **Anju Susan Joy**
    Assistant Professor
    Department of Zoology
    S.B College, Changanassery

REGULATIONS FOR UNDERGRADUATE PROGRAMME IN INDUSTRIAL MICROBIOLOGY AND ZOOLOGY UNDER CREDIT SEMESTER SYSTEM (SB-CSS-UG) 2015

1. SHORT TITLE

1.1 These Regulations shall be called St. Berchmans College (Autonomous) Regulations (2015) governing undergraduate programme in Industrial Microbiology & Zoology under the Credit Semester System.

1.2 These Regulations shall come into force with effect from the academic year 2015 - 2016 onwards.

2. SCOPE

2.1 The regulation provided herein shall apply to undergraduate programme in Industrial Microbiology & Zoology conducted by St. Berchmans College (Autonomous) with effect from the academic year 2015 - 2016.

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 Autonomy Ordinance, Government of Kerala.

3.5 'Parent Department' means the Department of Microbiology.

3.6 'Department Council' means the body of all teachers of the Department of Microbiology.

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.

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 of 450 contact hours distributed over 90 working days, inclusive of examination days, within 18 five-day academic weeks.

3.11 'Course' means a segment of subject matter to be covered in a semester. Each Course is to be designed under lectures/tutorials/laboratory or field work/ seminar/ project/

practical/ assignments/ evaluation / OJT etc., to meet effective teaching and learning needs.

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

3.13 'Core Course' means a course that the student admitted to the undergraduate programme in Industrial Microbiology & Zoology must successfully complete to receive the Degree and which cannot be substituted by any other course.

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 The selection of Common Course I is compulsory for all students undergoing undergraduate programmes.

3.17 'Open Course' means a course outside the field specialization of the student, which can be opted by a student.

3.18 '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. The extra credits are not mandatory for a pass in the programme.

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

3.20 '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.

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

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

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

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

3.25 'Evaluation' means every student shall be evaluated by in-semester assessment (20%) and end-semester assessment (80%).

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

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

3.28 'Improvement Course' is a course registered by a student for improving the performance in that particular course.

3.29 'Supplementary Course' is a course that is repeated by a student for having failed in that course in an earlier registration.

3.30 The minimum credits required for completing undergraduate programme in Industrial Microbiology & Zoology is one hundred and twenty (120).

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

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

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

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

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

3.36 'Semester Credit Point Average' (SCPA) 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.

3.37 'Cumulative Credit Point Average' (CCPA) 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.

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

3.39 '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.

3.40 '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.

3.41 First, Second, Third, Fourth and Fifth position shall be awarded to students who come in the first five places on the basis of overall marks in the programme in the first chance itself.

4. PROGRAMME STRUCTURE

4.1 Students shall be admitted into the six semester undergraduate programme in Industrial Microbiology & Zoology.

4.2 The programme shall include Core courses, Complementary courses, Common courses and Open course. There shall be a Project with dissertation to be undertaken by all students. The programme will also include assignments, seminars, practical, viva-voce, OJT, field visit etc.

4.3 Total credits for the programme is one hundred and twenty (120). The credit distribution for the programmes is shown below.

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

4.4 **Project**

All students shall do a project in the sixth semester. The project shall be done individually or as a group of maximum five (5) students. The topic can be selected either from Core I (Industrial Microbiology) or Core II (Zoology). The projects shall be identified during the fourth semester of the programme with the help of the supervising teacher. The report of the project shall be submitted to the department during sixth semester and shall be produced before the examiners appointed by the College. The project report shall be subject to internal and external evaluation followed by a viva-voce.

4.5 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.

4.6 In-semester assessment

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

For all courses without practical

There are three components for ISA, which include attendance, assignment/seminar/viva-voce and in-semester examination. All the three components of the internal assessment are mandatory.

Components of ISA	Marks
Attendance	5
Assignment/Seminar/Viva-Voce	5
In-semester examination (2×5 = 10)	10
Total	**20**

Marks for attendance

% 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)

For all courses with practical

Internal assessment of theory courses

There are three components for ISA of theory courses, which include attendance, assignment/seminar/viva-voce and in-semester examination. All the three components of the internal assessment are mandatory.

ISA - Components of Theory	Marks
Attendance	2
Assignment/Seminar/Viva-Voce	3
In-semester examination (2×2.5 = 5)	5
Total	**10**

Marks for attendance

% of Attendance	Marks
90 and above	2
75 - 89	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 in each semester. The components for internal assessment are given below.

Internal assessment of practical courses evaluated in each semester

ISA - Components of Practical	Marks
Attendance	2
Lab involvement	2
Record*	3
Test (one)	1
Viva-Voce	2
Total	**10**

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

Marks for attendance

% of Attendance	Marks
90 and above	2
75 - 89	1

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

The components and marks for lab involvement shall be decided by the Board of Studies in Microbiology.

4.7 **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.

4.8 **OJT/Industrial Training**

The On Job training (OJT)/Industrial training programme is intended to bring the curriculum to the reality of the world of work. This programme enables the students to apply their classroom knowledge to live situations under the joint supervision of the tutor and a mentor. The OJT/industrial training is implemented during semester III and semester. At the end of each OJT/industrial training students are expected to produce an attendance certificate and a detailed report of the OJT/industrial training assignments (Internal assessment only). A system of continuous evaluation will be followed during the OJT/industrial training programme. The Mentor at the training organization/institute and the tutor will jointly assess the OJT/industrial training programme of the student.

Industrial training

Component	Marks
Attendance and punctuality	10
Report	20
Total	**30**

OJT

Component	Marks
Attendance and punctuality	10
Technical competence	5
Group –interpersonal skill	5
Report	20
Total	**40**

4.9 **Field visit to biodiversity rich area (Core II- Zoology)**

As a part of Core II - Zoology, a field visit to a biodiversity rich area shall be conducted during semester I. The visit is intended to study the biodiversity and conservation status of the area and forms a part of the practical course during semester I. Each student shall prepare a report of the visit, which will be evaluated during the practical examination at the end of the semester.

4.10 **Field visit/Study tour/Visit to Research Institutes**

Study tour and visit to research institutes shall be conducted preferably during Semester V. During the study tour, students are expected to visit different habitats, zoos, aquaria and other places of zoological importance. They must also visit research institutes to familiarize themselves with the process of research in biological sciences. A report of the study tour is to be prepared and submitted. The report shall be evaluated and a viva-

voce shall be conducted along with the practical examination of 'Perspectives in Ecology' course at the end of Semester V.

Components of Study Tour Evaluation	Marks
Attendance (Internal)	10
Study tour report (External)	10
Viva-voce (External)	10
Total	**30**

4.11 **In-semester examination**

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

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

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

4.14 **End-semester assessment**

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

4.15 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.

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

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

For all courses without practical

Section	Type of Questions	Number of Questions to be answered	Marks	Total Marks
A	Very short answer type	10 out of 10	1	10
B	Short answer type	8 out of 12	2	16
C	Short essay/problem solving type	6 out of 9	4	24
D	Essay type	2 out of 4	15	30
		26 out of 35	**-**	**80**

For all courses with practical

Section	Type of Questions	Number of Questions to be answered	Marks	Total Marks
A	Very short answer type	8 out of 8	1	8
B	Short answer type	6 out of 10	2	12
C	Short essay/problem solving type	4 out of 6	4	16
D	Essay type	2 out of 4	12	24
		20 out of 28	**-**	**60**

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

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

4.20 Practical examination shall be conducted by one external examiner and one internal examiner. The question paper setting and evaluation of answer scripts shall be done as per the directions in the examination manual of the College.

4.21 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

4.22 The project report 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 College and the Head of the Department or his nominee. A viva-voce related to the project work shall be conducted by the external evaluation board and students have to attend the viva-voce individually.

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

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

4.24 For all courses (theory and practical) an indirect grading system based on a ten (10) 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**
90 and above	A+	Outstanding	10
80 - 89	A	Excellent	9
70 - 79	B	Very Good	8
60 - 69	C	Good	7
50 - 59	D	Satisfactory	6
40 - 49	E	Adequate	5
Below 40	F	Failure	-

5. CREDIT POINT AND CREDIT POINT AVERAGE

5.1 Credit Point

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

CP = C × GP

where C = Credit; GP = Grade Point

5.2 Semester Credit Point Average

Semester Credit Point Average (SCPA) is calculated using the formula

SCPA = TCP/TC

where TCP = Total Credit Point of all the courses in the semester; TC = Total Credits in the semester

CPA shall be rounded off to two decimal places.

5.3 **Cumulative Credit Point Average**

Cumulative Credit Point Average (CCPA) is calculated using the formula

CCPA = TCP/TC

where TCP = Total Credit Point of all the courses in the whole programme; TC = Total Credit in the whole programme

CPA shall be rounded off to two decimal places.

Grades for the different semesters, Semester Credit Point Average (SCPA) and grades for overall programme, Cumulative Credit Point Average (CCPA) are given based on the corresponding Credit Point Average (CPA) as shown below:

CPA	Grade	Performance
9.00 and above	A+	Outstanding
8.00 - 8.99	A	Excellent
7.00 - 7.99	B	Very Good
6.00 - 6.99	C	Good
5.00 - 5.99	D	Satisfactory
4.00 - 4.99	E	Adequate
Below 4.00	F	Failure

5.4 A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 40% are required for a pass in a course.

5.5 For a pass in a programme, a separate minimum of grade E is required for all the individual courses.

5.6 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 E grade or above within the permitted period.

5.7 Candidate who secures E grade and above will be eligible for higher studies.

6. SUPPLEMENTARY/IMPROVEMENT EXAMINATION

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

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.

7.2 If a student represents 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., he/she shall be eligible to claim the attendance for the actual number of days participated subject to a maximum of ten (10) days in a semester based 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.

8. BOARD OF STUDIES AND COURSES

8.1 The Board of Studies in Microbiology shall design all the courses offered in the undergraduate programme in Industrial Microbiology & Zoology. 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 course shall include the title of the course, contact hours, the number of credits and reference materials.

8.3 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.

8.4 Every Programme conducted under Credit Semester System shall be monitored by the Academic Council.

9. REGISTRATION

9.1 A student shall be permitted to register for the programme at the time of admission.

9.2 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.

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

9.4 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.

9.5 Those students who possess the required minimum attendance and progress during an academic year/semester and could not register for the annual/semester examination in time are permitted to apply for Notional Registration to the examinations concerned enabling them to get promoted to the next semester.

10. ADMISSION

10.1 The admission to the undergraduate programme in Industrial Microbiology & Zoology 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 a uniform academic and examination calendar prepared by the College for the conduct of the programmes.

11. ADMISSION REQUIREMENTS

11.1 Candidates for admission to the first semester of the undergraduate programme in Industrial Microbiology & Zoology through SB-CSS-UG shall be required to have passed Plus Two or equivalent examination or any other examination of any recognized authority, accepted by the Academic council of Mahatma Gandhi University as equivalent thereto.

11.2 Students admitted under this programme are governed by the Regulations in force.

12. PROMOTION

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

13. MARK CUM GRADE CARD

13.1 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, SCPA and Letter Grade in the semester

xii. Weighted Average Score

xiii. Result

13.2 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 CCPA and the overall letter grade of a student for the entire programme.

14. AWARD OF DEGREE

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

15. MONITORING COMMITTEE

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

16. GRIEVANCE REDRESSAL MECHANISM

16.1 In order to address the grievance of students regarding ISA, a two-level Grievance Redressal mechanism is envisaged.

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

16.3 Department level: The Principal shall form a Grievance Redressal 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.

16.4 College level: There shall be a College level Grievance Redressal 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.

17. 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.

Model Mark cum Grade Card (Semester I)

St Berchmans College
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Changanassery, Kottayam, Kerala, India-686101

MARK CUM GRADE CARD

Date:

Name of the Candidate :
Register Number :
Degree : Bachelor of Science
Programme : Industrial Microbiology and Zoology
Stream : Model III
Name of Examination : First Semester SB-CSS-UG Examination, Month YYYY

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												
	Common Course - II												
	Core Course												
	Complementary Course												
	Total												
	Weighted Average Score												
	Semester Result												
	SCPA												
	End of Statement												

Entered by:

Verified by:

Controller of Examinations

Principal

Model Mark cum Grade Card (Semester V)

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MARK CUM GRADE CARD

Date:

Name of the Candidate :
Register Number :
Degree : Bachelor of Science
Programme : Industrial Microbiology and Zoology
Stream : Model III
Name of Examination : Fifth Semester SB-CSS-UG Examination, Month YYYY

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					
	Core Course												
	Open Course												
	Total												
	Weighted Average Score												
	Semester Result												
	SCPA												
	End of Statement												

Entered by:

Verified by:

Controller of Examinations

Principal

Model Mark cum Grade Card (Semester VI)

St Berchmans College
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MARK CUM GRADE CARD

Date:

Name of the Candidate :
Register Number :
Degree : Bachelor of Science
Programme : Industrial Microbiology and Zoology
Stream : Model III
Name of Examination : Sixth Semester SB-CSS-UG Examination, Month YYYY

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					
	Core Course												
	Project												
	Total												
	Weighted Average Score												
	Semester Result												
	SCPA												

Semester Results								Programme Part Results					
Semester	Marks Awarded	Maximum Marks	Credits	SCPA	Grade	Month & Year of Passing	Result	Course Category and Subject Studied	Marks Awarded	Maximum Marks	Credits	CCPA	Grade
I								Common Course I					
II								Common Course II					
III								Core Course					
IV								Complementary Course					
V								Complementary Course					
VI								Open Course					
								Project					
								Elective Course					
								Total					

Final Result
Cumulative Credit Point Average (CCPA):
Grade 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 ten (10) point scale based on the percentage of Total Marks (ISA + ESA) as given in Table 1.

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

Percentage of Marks	Grade	Performance	Grade Point
90 and above	A+	Outstanding	10
80 - 89	A	Excellent	9
70 - 79	B	Very Good	8
60 - 69	C	Good	7
50 - 59	D	Satisfactory	6
40 - 49	E	Adequate	5
Below 40	F	Failure	-

Table 1

Semester Credit Point Average (SCPA) and Cumulative Credit Point Average (CCPA)

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

CPA	Grade	Performance
9.00 and above	A^+	Outstanding
8.00 - 8.99	A	Excellent
7.00 - 7.99	B	Very Good
6.00 - 6.99	C	Good
5.00 - 5.99	D	Satisfactory
4.00 - 4.99	E	Adequate
Below 4.00	F	Failure

Table 2

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

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

where C = Credit; GP = Grade Point

Credit Point Average (CPA) of a Semester/Programme is calculated using the formula

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

where TCP = Total Credit Point; TC = Total Credit

CPA shall be rounded off to two decimal places.

A **separate minimum of 30% marks** is required for a pass for both internal assessment and external assessment in each course.

An **aggregate minimum of 40% marks** is required for a pass in each course

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PROGRAMME STRUCTURE

Semester I

Sl. No.	Course Title	Hours/ week	Credits	Marks
1	Common Course I	5	4	100
2	Core Course: Industrial Microbiology	2	2	70
3	Core Course: Industrial Microbiology	2	2	70
4	Core Course: Zoology	2	2	70
5	Core Course Practical: Industrial Microbiology	2	1	30
6	Core Course Practical: Industrial Microbiology	2	1	30
7	Core Course Practical: Zoology	2	1	30
8	Complementary Course: Biochemistry	2	2	70
9	Complementary Course: Computer Science	2	2	70
10	Complementary Course Practical: Biochemistry	2	1	30
11	Complementary Course Practical: Computer Science	2	1	30
	Total	**25**	**19**	**600**

Semester II

Sl. No.	Course Title	Hours/ week	Credits	Marks
1	Common Course I	5	4	100
2	Core Course: Industrial Microbiology	2	2	70
3	Core Course: Industrial Microbiology	2	2	70
4	Core Course: Zoology	2	2	70
5	Core Course Practical: Industrial Microbiology	2	1	30
6	Core Course Practical: Industrial Microbiology	2	1	30
7	Core Course Practical: Zoology	2	1	30
8	Complementary Course: Biochemistry	2	2	70
9	Complementary Course: Computer Science	2	2	70
10	Complementary Course Practical: Biochemistry	2	1	30
11	Complementary Course Practical: Computer Science	2	1	30
	Total	**25**	**19**	**600**

Semester III

Sl. No.	Course Title	Hours/ week	Credits	Marks
1	Core Course: Industrial Microbiology	3	3	70
2	Core Course: Industrial Microbiology	3	2	70
3	Core Course: Zoology	3	3	70
4	Core Course Practical: Industrial Microbiology	2	1	30
5	Core Course Practical: Industrial Microbiology	2	1	30
6	Core Course Practical: Zoology	2	1	30
7	Complementary Course: Biochemistry	3	3	70
8	Complementary Course: Computer Science	3	3	70
9	Complementary Course Practical: Biochemistry	2	1	30
10	Complementary Course Practical: Computer Science	2	1	30
11	Industrial Training	-	1	30
	Total	**25**	**20**	**530**

Semester IV

Sl. No.	Course Title	Hours/ week	Credits	Marks
1	Core Course: Industrial Microbiology	2	2	70
2	Core Course: Industrial Microbiology	2	2	70
3	Core Course: Zoology	3	3	70
4	Core Course: Zoology	2	2	100
5	Core Course Practical: Industrial Microbiology	2	1	30
6	Core Course Practical: Industrial Microbiology	2	1	30
7	Core Course Practical: Zoology	2	1	30
8	Complementary Course: Biochemistry	3	3	70
9	Complementary Course: Computer Science	3	3	70
10	Complementary Course Practical: Biochemistry	2	1	30
11	Complementary Course Practical: Computer Science	2	1	30
	Total	**25**	**20**	**600**

Semester V

Sl. No.	Course Title	Hours/ week	Credits	Marks
1	Core Course: Industrial Microbiology	3	3	70
2	Core Course: Zoology	3	3	70
3	Core Course: Zoology	3	3	70
4	Core Course: Zoology	3	3	70
5	Core Course Practical: Industrial Microbiology	3	1	30
6	Core Course Practical: Zoology	2	1	30
7	Core Course Practical: Zoology	2	1	30
8	Core Course Practical: Zoology	2	1	30
9	Open Course	4	3	100
10	OJT	-	1	40
11	Study Tour & Visit to Research Institutes	-	1	30
	Total	**25**	**21**	**570**

Semester VI

Sl. No.	Course Title	Hours/ week	Credits	Marks
1	Core Course: Industrial Microbiology	3	3	70
2	Core Course: Industrial Microbiology	3	3	70
3	Core Course: Zoology	3	3	70
4	Core Course: Zoology	3	3	70
5	Core Course: Zoology	3	3	70
6	Core Course Practical: Industrial Microbiology	2	1	30
7	Core Course Practical: Industrial Microbiology	2	1	30
8	Core Course Practical: Zoology	2	1	30
9	Core Course Practical: Zoology	2	1	30
10	Core Course Practical: Zoology	2	1	30
11	Project (Either from Core I or Core II)	-	1	100
	Total	**25**	**21**	**600**
	Grand Total		**120**	**3500**

OUTLINE OF THE CORE COURSES

Course Code	Title of the Course	Instructional hours/week	Instructional hours for the course	Credits	ISA	ESA	Total
Semester I							
ABMB101	Fundamentals of Microbiology	2	36	2	10	60	70
ABMB102	Microbial Diversity	2	36	2	10	60	70
ABZO101	Fundamentals of Biodiversity and Biosystematics	2	36	2	10	60	70
ABMB1P01	Fundamentals of Microbiology (P)	2	36	1	10	20	30
ABMB1P02	Microbial Diversity (P)	2	36	1	10	20	30
ABZO1P01	Fundamentals of Biodiversity and Biosystematics (P)	2	36	1	10	20	30
Semester II							
ABMB203	Microbial Physiology	2	36	2	10	60	70
ABMB204	Immunology	2	36	2	10	60	70
ABZO202	Evolutionary Biology and Zoogeography	2	36	2	10	60	70
ABMB2P03	Microbial Physiology (P)	2	36	1	10	20	30
ABMB2P04	Immunology (P)	2	36	1	10	20	30
ABZO2P02	Evolutionary Biology and Zoogeography (P)	2	36	1	10	20	30
Semester III							
ABMB305	Microbial Genetics and Recombinant DNA Technology	3	54	3	10	60	70
ABMB306	Medical Microbiology	3	54	2	10	60	70
ABZO303	Animal Diversity - Non Chordata	3	54	3	10	60	70
ABMB3P05	Genetics and Microbial Biotechnology (P)	2	36	1	10	20	30
ABMB3P06	Medical Microbiology (P)	2	36	1	10	20	30
ABZO3P03	Animal Diversity - Non Chordata (P)	2	36	1	10	20	30
ABMB3IT	Industrial Training			1	30		30
Semester IV							
ABMB407	Industrial Microbiology	2	36	2	10	60	70
ABMB408	Fermentation Technology	2	36	2	10	60	70
ABZO404	Animal Diversity - Chordata	3	54	3	10	60	70
ABZO405	Research Methodology and Biostatistics	2	36	2	20	80	100
ABMB4P07	Industrial Microbiology (P)	2	36	1	10	20	30
ABMB4P08	Fermentation Technology (P)	2	36	1	10	20	30
ABZO4P04	Animal Diversity - Chordata (P)	2	36	1	10	20	30

Course Code	Title of the Course	Instructional hours/week	Instructional hours for the course	Credits	ISA	ESA	Total
Semester V							
ABMB509	Food Microbiology	3	54	3	10	60	70
ABZO507	Cell biology and Molecular Biology	3	54	3	10	60	70
ABZO508	Perspectives in Ecology	3	54	3	10	60	70
ABZO510	Animal Physiology	3	54	3	10	60	70
ABMB5P09	Food Microbiology (P)	3	54	1	10	20	30
ABZO5P06	Cell biology and Molecular Biology (P)	2	36	1	10	20	30
ABZO5P07	Perspectives in Ecology (P)	2	36	1	10	20	30
ABZO5P09	Animal Physiology (P)	2	36	1	10	20	30
ABMB5OJT	OJT	-	-	1	40	-	40
ABZO5ST	Study Tour & Visit to Research Institutes	-	-	1	10	20	30
Semester VI							
ABMB610	Agricultural Microbiology	3	54	2	10	60	70
ABMB611	Microbial Waste Management	3	54	2	10	60	70
ABZO611	Genetics, Biotechnology and Bioinformatics	3	54	3	10	60	70
ABZO613	Endocrinology, Reproductive Biology and Ethology	3	54	3	10	60	70
ABZO614	Developmental Biology	3	54	3	10	60	70
ABMB6P10	Agricultural Microbiology (P)	2	36	1	10	20	30
ABMB6P11	Microbial Waste Management (P)	2	36	1	10	20	30
ABZO6P10	Genetics, Biotechnology and Bioinformatics (P)	2	36	1	10	20	30
ABZO6P12	Endocrinology, Reproductive Biology and Ethology (P)	2	36	1	10	20	30
ABZO6P13	Developmental Biology (P)	2	36	1	10	20	30
ABMB6PJ	Project	-	-	1	20	80	100

SEMESTER I

ABMB101: FUNDAMENTALS OF MICROBIOLOGY

Total Hours: 36 **Credits: 2**

Module 1 **4 Hrs.**

History and Scope of Microbiology

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

Module 2 **8 Hrs.**

Morphology and Structure of bacteria

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, spheroplasts, intracellular membrane systems, mesosomes, cytoplasm, vacuoles, nuclear material, endospores and cysts, cell inclusions

Module 3 **8 Hrs.**

Sterilization and disinfection

Sterilization-Principles and methods, physical and chemical methods. Antibiotics - classification and mechanism of action. Drug resistance, Antibiotic sensitivity tests. Evaluation of antimicrobial agents.

Module 4 **8 Hrs.**

Culture media and methods

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. Culture preservation techniques and Culture collection centers. 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 5 **8 Hrs.**

Microscopy- principles and application – Bright field, Dark field, Phase contrast, Fluorescence, SEM and TEM, Specimen preparation of electron microscopy, Ultra sectioning, shadowing, negative staining, freeze etching.

Reference

1. Lim, D. 1998. *Microbiology*. 2nd Edition; McGraw-Hill Publication.
2. Ingraham, J. L. and Ingraham, C. A. 2004. *Introduction to Microbiology: A case history approach*. 3rd Edition. Thomson Brooks/Cole, Pacific Grove, Ca.
3. Madigan, M. T. and Martinko, J. M. 2006. *Brock's Biology of Microorganisms*. 11th Edition. Pearson Education Inc.
4. Pelczar, M. J. Jr., Chan, E. C. S. and Krieg, N. R. 1993. *Microbiology*, 5th Edition, Tata MacGraw Hill Press.
5. Prescott, L. M., Harley, J. P. and Klein, D. A. 2005. *Microbiology*. 6th Edition. MacGraw Hill Companies Inc.
6. Prescott, L. M., Harley, J. P. and Klein, D. A. 2006. *Microbiology*. 6th Edition. Edition, McGraw Hill Higher Education.
7. Willey, J. M., Sherwood, L. M. and Woolverton, C. J. 2013. *Prescott's Microbiology*. 8th Edition, McGraw-Hill Higher Education.
8. Salle, A. J. 1971. *Fundamental Principles of Bacteriology*. 7th Edition. Tata MacGraw Hill Publishing Co.
9. Stanier, R. Y., Adelberg, E. A. and Ingraham, J. L. 1987. *General Microbiology*, 5th Edition. Macmillan Press Ltd.
10. Tortora G. J., Funke B. R. and Case C. L. 2006. *Microbiology: An Introduction*. 8th Edition. Pearson Education Inc.
11. Russell, A. D., Hugo, W. B., and Ayliffe, G. A. J. 1999. *Principles and practice of disinfection, preservation and sterilization*, 3rdEdition. Blackwell Science, Oxford.
12. Black, J. G. 2013. *Microbiology: Principles and Explorations*. 6th Edition, John Wiley and Sons, Inc.

ABMB102: MICROBIAL DIVERSITY

Total Hours: 36 **Credits: 2**

Module 1 **6 Hrs.**

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

Module II **8 Hrs.**

Archaebacteria and extremophiles, brief account on characteristics.Mycoplasma- general properties, structure, cultural characteristics and classification. Actinomycetes – General characteristics and classification, Rickettsiae -Classification, Morphology and distinguishing characteristics

Module III **8 Hrs**

Viruses - general properties, Structure and Replication of Bacteriophages, TMV, HIV. Cultivation of viruses, Virions, Viroids and Prions

Module IV **6 Hrs**

Fungi –morphological features, classification, reproduction and economic importance, ascomycota, basidiomycota, zygomycota, deuteromycota. Cultivation of fungi, distinguishing characteristics of *Rhizopus, Mucor, Aspergillus, Penicillium*and*Fusarium*.Yeasts – a brief account on *Candida* and *Saccharomyces*.

Module V **8 Hrs.**

Algae- characteristics, morphology and structure. Algal pigments, motility, reproduction, classificationand economic importance of algae.Cyanobacteria- distribution, characteristics and classification, Ultra structure of cyanobacterial cell.

References

1. Topley, W. W. C., Wilson, G. S., Parker, T. and Collier, L. H. 1990. *Topley and Wilson's*
2. *Principles of Bacteriology, Virology and Immunology*. 8th Edition. Edward Arnold, London.
3. Black, J. G. 2005. *Microbiology, Principles and exploration*. 6th Edition. John Wiley & Sons.

4. Tortora, G. J., Funke, B. R. and Case, C. L. 2012. *Microbiology: An Introduction*. 11th Edition. Pearson education Pvt. Ltd. Singapore.
5. Lim, D. V. 2002. *Microbiology*.Dubuque, IA: Kendall/Hunt.
6. 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.
7. Salle, A. J. 1971. *Fundamental Principles of Bacteriology*,7th Edition, Tata MacGraw Hill Publishing Company Ltd.
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11. Madigan, M., Martinko, J., Buckley, D. and Stahl, D. 2014. *Brock Biology of Microorganisms*, 14th Edition. Benjamin Cummings, New York.

ABZO101: FUNDAMENTALS OF BIODIVERSITY AND BIOSYSTEMATICS

Instructional Hours: 36

Credits: 2

PART I – BIODIVERSITY (24 hrs)

Module I - Introduction to Biodiversity (12 hrs)

Biodiversity and its significance; Biodiversity as a natural resource

Levels of biodiversity - species, domesticated, genetic, alpha, beta, gamma.

Biodiversity distribution - tropical, temperate and polar

Biological hot spots- significance, global, Indian

Western ghats - ecological, social, cultural and economic aspects

Values of biodiversity; Threats to biodiversity; Role of invasive species

Module II - Conservation & Management of Biodiversity (8 hrs)

Need for biodiversity conservation; Global measures; 3Rs in biodiversity

Importance of wetlands; Types of wetlands; Significance of mangroves; Importance of Kuttanad biodiversity

Endemic species and their conservation; Red Data Book and its significance; Conservation methods: Ex- situ, In-situ

Module III - Biodiversity Estimation (4 hrs)

Biodiversity aspects: species richness, abundance, evenness

Biodiversity indices: Shannon- Weinner index, Simpson index, Pilou's index

Sampling techniques: Quadrate, Transect

Remote sensing

PART II - BIOSYSTEMATICS (12 hrs)

Module IV - Introduction to Biosystematics (4 hrs)

Importance of systematics; Animal classification-hierarchy; ICZN code; Nomenclature: Linnaean, Trinomial

Morphological, numerical and phylogenetic systems of classification; DNA bar-coding

Module V - Animal collection and preservation techniques (8 hrs)

Collection and preservation techniques

Taxidermy - definition and methods, (reptiles, birds and mammals)

References:

1. Andrew S. Pullin 2002. *Conservation Biology*. Cambridge University Press, Cambridge, UK.
2. Anne E. Magurran 2004. *Measuring Biological Diversity* .Blackwell Publishing, MA, USA.
3. Chapman J.L. & M. J. Reiss 2006 Ecology, Principles and Applications. Sec Edition Cambridge University Press.
4. Daily G.C. (Ed.), 1997.*Nature's Services: Societal Dependence on Natural Ecosystems*. Island Press, Washington D C.
5. Forman, R.T and M. Gordaon. 1986. *Landscape Ecology.* John Wiley &Sons, NY, USA.
6. Kapoor, V.C.1998. Theory and Practice of Animal Taxonomy. Oxford and IBH Pub. Co, New Delhi
7. Karunakaran, C.K. 2003. Politics of vanishing forests in Kerala. Kerala Sastra Sahitya Parishat, Thiruvananthapuram.
8. Land resource based perspective plan for 2020 AD. Kerala State Land Use Board, Thiruvananthapuram
9. Myers, Norman.1984. *The Primary Source: Tropical Forests and Our Future*. W.W. Nortan & Company, NY.
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12. Nair, M.P., Pushpangathan, P., Rajasekharan, S., Narayanan Nair.K. and Dan Mathew. "*Jaivavaividhyam*" (Biodiversity). State Institute of Languages, Thiruvananthapuram
13. Ramesh, B.R and Rajan Gurukkal., 2007.*Forest Landscapes of the Southern Western Ghats, India Biodiversity, Human Ecology and management Strategies*. French Institute of Pondicherry, India.
14. State of the Environment Report, Kerala. (Annual Publication), Kerala State Council for Science, Technology and Environment, Thiruvananthapuram
15. Supriyo Chakraborty.2004 *Biodiversity*. Pointer Publishers, Jaipur, India.
16. Wilson E.O., 1988 (Editor). *Biodiversity*. National Academy press, Washington DC, USA.

PRACTICAL

ABMB1P01: FUNDAMENTALS OF MICROBIOLOGY

Total Hours: 36 **Credits: 1**

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. Antibiotic sensitivity tests

Reference:

1. Lammert, J. M. 2006. *Techniques for Microbiology: A Student Handbook.* Benjamin Cummings.
2. Aneja, K. R. 2003. *Experiments in Microbiology, Plant Pathology and Biotechnology*. 4th Edition. New Age International (P) Limited, New Delhi.

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4. Dubey, R. C. and Maheswari, D. K. 2002. *Practical Microbiology*. 2nd Edition, S. Chand & Co., New Delhi.
5. Kannan, N. 2002. *Laboratory manual in general microbiology*. 2nd Edition, Panima Publishing Co., New Delhi.
6. Gunasekaran, P. 2002. *Laboratory manual in microbiology*. 2ndEdition, New Age International (P) Limited, New Delhi.
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9. Goldman, E. and Green, L. H. 2008. *Practical Handbook of Microbiology*.2nd Edition. CRP Press.

ABMB1P02: MICROBIAL DIVERSITY

Total Hours: 36 **Credits: 1**

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) lacto phenol cotton blue mounting

b) Scotch tape preparation

II. Preparation of permanent slides of bacteria (2 slides / student)

III. Bacterial motility analysis

a.Hanging drop technique

b.Wet mount method

Reference:

1. Lammert, J. M. 2006. *Techniques for Microbiology: A Student Handbook*. Benjamin Cummings.
2. Aneja, K. R. 2003. *Experiments in Microbiology, Plant Pathology and Biotechnology*. 4th Edition. New Age International (P) Limited, New Delhi.
3. Aneja, K. R. 2001. *Experiments in microbiology, plant pathology, tissue culture and mushroom production technology*. 3rd Edition. New Age International (P) Limited.
4. Dubey, R. C. and Maheswari, D. K. 2002. *Practical Microbiology*. 2nd Edition, S. Chand & Co., New Delhi.
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6. Gunasekaran, P. 2002. *Laboratory manual in microbiology*. 2nd Edition, New Age International (P) Limited, New Delhi.
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9. Goldman, E. and Green, L. H. 2008. *Practical Handbook of Microbiology*.2nd Edition. CRP Press.
10. Cappuccino, J. and Sherman, N. 2013. *Microbiology: A Laboratory Manual*. 10th Edition. Benjamin-Cummings Publishing Company, Subs Of Addison Wesley Longman, Inc.

ABZO1P01: FUNDAMENTALS OF BIODIVERSITY AND BIOSYSTEMATICS

Total Hours: 36 **Credits: 1**

1. Sampling
2. Quadrate study
3. Transect study
4. Species area curve
5. Identification of Biodiversity hot spots using Google Earth
6. Identification using keys (4 specimens each)
    - Insect
    - Fish
    - Snake
7. Taxa identification techniques
    - Bird body parts
    - Butterfly/ dragonfly body parts and venation
8. Simple identification of any 20 local animals representing different taxa
    - Common name and scientific name
9. Field study:
    - Visit a biodiversity rich area and submit a report on the biodiversity and conservation efforts there. (*Individual report should be submitted by each student.*)

SEMESTER II

ABMB203: MICROBIAL PHYSIOLOGY

Total Hours: 36 **Credits: 2**

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.

Module 2 **10Hrs**

Bacterial Growth, Bacterial growth curve and generation time.Continuous culturing of bacteria- chemostat, turbidostat, Synchronous growth. Effect of Temperature, pH, Oxygen concentration 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 and Spore formation.

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. Fermentation -Alcoholic fermentation, Homo and hetro-lacticacid fermentation, mixed acid fermentations.

Module 5 **6 Hrs.**

Nitrogen metabolism -Nitrogen Cycle, nitrification, denitrification and ammonification. Transamination and deamination reactions, Nitrogen fixation in symbiotic, associative and free living system, oxygen regulation of nitrogen fixation.

References

1. Doelle, H. W. 1975. *Bacterial Metabolism*. 2nd Edition. Academic Press.
2. Moat, A. G. and Foster, J. W. 1988. *Microbial physiology*. 2nd Edition. Springer Verlag.

3. White, D. 2000. *Physiology and Biochemistry of Prokaryotes*. 2nd Edition. Oxford University Press, New York.
4. Caldwell, D. R. 1995. *Microbial physiology and Metabolism*. Wm. C Brown Publishers, England.
5. Madigan, M. T., Martinko, J. M., Stahl, D. A. and Clark, D. P. 2012. *Brock Biology of Microorganisms*, 13th Edition, Benjamin Cummings, San Francisco.
6. Lim, D. 1998. *Microbiology*. 2nd Edition; McGraw-Hill Publication.
7. Ingraham, J. L. and Ingraham, C. A. 2004. *Introduction to Microbiology: A case history approach*. 3rd Edition. Thomson Brooks/Cole, Pacific Grove, Ca.
8. Madigan, M. T. and Martinko, J. M. 2006. *Brock's Biology of Microorganisms*. 11th Edition. Pearson Education Inc.
9. Pelczar, M. J. Jr., Chan, E. C. S. and Krieg, N. R. 1993. *Microbiology*, 5th Edition, Tata MacGraw Hill Press.
10. Prescott, L. M., Harley, J. P. and Klein, D. A. 2005. *Microbiology*. 6th Edition. MacGraw Hill Companies Inc.
11. Prescott, L. M., Harley, J. P. and Klein, D. A. 2006. *Microbiology*. 6th Edition. Edition, McGraw Hill Higher Education.
12. Willey, J. M., Sherwood, L. M. and Woolverton, C. J. 2013. *Prescott's Microbiology*. 8th Edition, McGraw-Hill Higher Education.

ABMB204: IMMUNOLOGY

Total Hours: 36 **Credits: 2**

Module 1 **5 hrs.**

Infection, Types of infectious diseases, Types of immunity, innate immunity, adaptive immunity, Active and Passive immunity, Mechanisms of innate immunity.

Module 2 **6 hrs.**

Antigens andTypes of Antigens, Epitopes, Haptens, Antigenicity, Immunogenicity, Factors influencing antigenicity, Basic structure of immunoglobulin. Immunoglobulin classes and functions

Module 3 **6 hrs.**

Antigen-antibody reactions, Precipitation reactions, Agglutination reactions, Complement fixation test, ELISA, Western Blotting,Immunofluorescence.

Module 4 **8hrs.**

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, Cytokines -Interferon , Interleukins and TNFs. Monoclonal antibodies – production and applications.

Module 5 **11 hrs.**

Hypersensitivity reactions and types, Anaphylaxis and atopy, immune complex disease, Arthus reaction, Serum sickness and delayed type of hypersensitivity.

Immunology of transplantation- graft rejection.

Immuno-haematology, Immunology of blood transfusion, Erythroblastosis foetalis. Immuno-deficiency disease – AIDS, Vaccines – types, toxoids and adjutants

References

1. Ananthanarayan, R. and Panicker, C. K. J. 2008. *Textbook of Microbiology*. Orient Longman Private Ltd.
2. Ananthanarayan, R. and Panicker, C. K. J. 2009. *Ananthanarayan and Paniker's Textbook of Microbiology*. Orient Longman Limited Universities Press (India) Pvt. Ltd.
3. Coleman, R. M. 1992. *Fundamentals of Immunology*. McGraw-Hill Higher Education.
4. Wise, D. J. and Carter, G. R. 2004. *Immunology - A Comprehensive Review*. Iowa State University Press, Blackwell Science Co.

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7. Heritage, J., Evaus, E. G. V. and Killungten, R. A. 2007. *Introductory Microbiology*. Cambridge University Press.
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9. Park, K. 2002. *Parks Text Book of Preventive and Social Medicine*. 17th Edition. Jabalpur: M/S Banarsidas Bhanot.
10. Kindt, T. J. Goldsby, R. A.and Osborne, B. A. 2007. *Kuby Immunology*. 6th Edition. W. H. Freeman and Co, New York.
11. Frank, S. A. 2002. *Immunology and Evolution of Infectious Disease.*Princeton University Press.
12. Sharma, K. 2009. *Manual of Microbiology: Tools and Techniques*. 2nd Edition. Anes Book's Pvt. Ltd., New Delhi.

ABZO202: EVOLUTIONARY BIOLOGY AND ZOOGEOGRAPHY

Instructional Hours: 36

Credits: 2

PART I – EVOLUTIONARY BIOLOGY (27 hrs)

Module I –Origin and History of life (3 hrs)

Introduction, Chemical evolution, Miller-Urey experiment, Haldane and Oparin theory

Geological time scale, Mass extinction

Module II – Theories of organic evolution (5 hrs)

Lamarckism- principles, examples and criticism

Darwinism- Natural selection theory, examples and criticism

Modern Synthetic theory (Neo Darwinism)

Neutral theory of molecular evolution

Module III – Evidences for evolution (5 hrs)

Evidences from morphology and anatomy, Physiology and biochemistry, Embryology, Palaeontology

Types of fossils, Dating of fossils

Module IV – Patterns of evolution (4 hrs)

Adaptive radiation, convergent evolution and parallel evolution

Microevolution, Macroevolution and Mega evolution

Gradualism, case study of horse evolution; Punctuated equilibrium, case study of foraminiferans

Module V – Population genetics and evolution (5 hrs)

Genetic basis of variation, Hardy Weinberg equilibrium, Change in gene frequencies, Factors affecting gene frequencies

Module VI – Species and speciation (5 hrs)

Species concept – Morphological, biological, evolutionary and phylogenetic Speciation – types and mechanism; Isolating mechanisms

PART II – ZOOGEOGRAPHY (9 hrs)

Module VII – Zoogeographical Realms (5hrs)

Origin of continents- Plate tectonics/ continental drift

Zoogeographical realms; Biogeography of India

Insular fauna: Continental Island- Madagascar; Oceanic Island- Galapagos

Module VIII – Animal Distribution (4 hrs)

Kinds of animal distribution

Factors and means of animal distribution

Barriers in animal distribution

References:

Evolutionary Biology

1. Barnes, C.W. 1988. *Earth, Time and Life*. John Wiley &Sons, New York
2. Bendall, D. S. (ed.) 1983.Evolution *from Molecules to Man*. Cambridge University Press, U.K.
3. Bull J.J and H.A.Wichman.2001.Applied Evolution. *Annu. Rev. Ecol. Syst.* 32:183-217 (Visit the Annual Reviews home page at www.AnnulReviews.org.)
4. Chattopadhyay Sajib.2002. *Life Origin, Evolution and Adaptation*. Books and Allied (P) Ltd. Kolkata, India.
5. Goodwin, B. 1996. *How the Leopard Changed its Spots: The Evolution of Complexity*. Simon &Schuster, NY, USA.
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7. Rob Desalle and Ian Tattersall 2008.*Human Origins: What Bones and Genomes Tell Us about Ourselves*. Texas A&M University Press, USA.
8. Sean B. Carroll and David M. Kingsley .2005 *Evolution: Constant Change and Common Threads*. Holiday Lectures on Science. Webcast or DVD available at www.hhmi.org/biointeractive/evolution.
9. Strickberger, M.W.2000. *Evolution*. Jones and Bartlett, Boston.
10. Verma P.S. and Agarwal V.K 2007 *Cell biology, Genetics, Molecular Biology, Evolution and Ecology*, S. Chand & Company New Delhi

Zoogeography

1. A.R. Wallace, 1962. The geographical distribution of animals. Hafner Publ. Co.

2. Alfred Russel Wallace, 1876. The Geographical Distribution of Animals, With a Study of the Relations of Living and Extinct Faunas as Elucidating the Past Changes of the Earth's Surface. (New York: Harper and Brothers, 1876).
3. Bartholomew, J. G.; Grimshaw, Percy H.; Osgood, Wilfred H. Atlas of Zoogeography. *Science,* Volume 34, Issue 874, pp. 410-412.
4. Carl L. Hubbs (Editor), 1974. Zoogeography (Hardcover). 509 pages. Ayer Co Pub; Reprint edition (September 1974).
5. Frank Evers Beddard, 2008. A Text-Book of Zoogeography. Published by Biblio Bazaar, LLC, 2008. 192 pages.
6. Joachim Illies, 1974. Introduction to Zoogeography. Macmillan (January 1974).
7. John C. Briggs, 1974. Marine Zoogeography (Population Biology).
8. John R. Merrick, 2006. Evolution and Biogeography of Australasian Vertebrates. 942 pages. Publisher: Ausci (January 2006)
9. L F De Beaufort, 1951. Zoogeography of the Land & Inland Waters.
10. Miklos D. F Udvardy, 1969. Dynamic zoogeography: With special reference to land animals. 445 pages. Van Nostrand Reinhold (1969).
11. P.J. Darlington, 1957. The zoogeography: The geographical distribution of animals. Wiley Publ. New York. 675 pages. Krieger Pub. Co. (June 1980).
12. Paul Muller, 1974. Aspects of Zoogeography. Junk Pub. (January 1974).
13. S K Tiwari, Faunal Regions of the World. Vedams eBooks (P) Ltd (India) Shivkumar Tiwari, 1985. Readings in Indian Zoogeography (vol.1). Today & Tomorrow Printers & Publishers.
14. S. K. Tiwari, 2006. Fundamentals of World Zoogeography. Vedams eBooks (P) Ltd (India). 384 pages. (Sarup & Sons, Ansari Rd. Daryaganj, Delhi).
15. S.K. Tiwari, 1985. Zoogeography of India and South East Asia. International Book Dist. Dehra Dun.
16. S.K. Tiwari, Zoogeography of Indian Amphibians. Today & Tomorrow Printers and Publishers.
17. Wilma George, 1962. Animal geography. Heinemann Edu. Books Ltd. 142 pages.

PRACTICAL

ABMB2P03: MICROBIAL PHYSIOLOGY

Total Hours: 36 **Credits: 1**

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.
5. Measurement of size – Micrometer
6. Measurement of cell number- Haemocytometer
5. **Biochemical test:**
   a. IMVIC Test
   b. Triple sugar iron agar test
   c. Urease test
   d. Catalase test
   e. Amylase production test
   f. Oxidase test
6. Determination of growth curve of *E.coli*

References

1. Lammert, J. M. 2006. *Techniques for Microbiology: A Student Handbook.* Benjamin Cummings.
2. Aneja, K. R. 2003. *Experiments in Microbiology, Plant Pathology and Biotechnology*. 4th Edition. New Age International (P) Limited, New Delhi.
3. Aneja, K. R. 2001. *Experiments in microbiology, plant pathology, tissue culture and mushroom production technology*. 3rd Edition. New Age International (P) Limited.
4. Dubey, R. C. and Maheswari, D. K. 2002. *Practical Microbiology*. 2nd Edition, S. Chand & Co., New Delhi.
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8. Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.
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10. Cappuccino, J. and Sherman, N. 2013. *Microbiology: A Laboratory Manual*. 10th Edition. Benjamin-Cummings Publishing Company, Subs Of Addison Wesley Longman, Inc.
11. Chakraborty, P. and Chakraborty, G. 2005. *Practical pathology*. Vol. 33. Kolkata: New Central Book Agency (P) Ltd.

ABMB2P04: IMMUNOLOGY

Total Hours: 36 **Credits: 1**

1. Determination of ABO blood groups and Rh factor
2. Study through photographs/ illustration, the primary andsecondary organs of immune system in Man.
3. ELISA
4. WIDAL Test
5. VDRL 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. Dubey, R. C. and Maheswari, D. K. 2002. *Practical Microbiology*. 2nd Edition, S. Chand & Co., New Delhi.
3. Kannan, N. 2002. *Laboratory manual in general microbiology*. 2nd Edition, Panima Publishing 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. Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.
7. Goldman, E. and Green, L. H. 2008. *Practical Handbook of Microbiology*. 2nd Edition. CRP Press.
8. Cappuccino, J. and Sherman, N. 2013. *Microbiology: A Laboratory Manual*. 10th Edition. Benjamin-Cummings Publishing Company, Subs Of Addison Wesley Longman, Inc.
9. Chakraborty, P. and Chakraborty, G. 2005. *Practical pathology*. Vol. 33. Kolkata: New Central Book Agency (P) Ltd.
10. Hay, F. C. and Westwood, O. M. R. 2002. *Practical Immunology*. 4th Edition. Wiley-Blackwell.

ABZO2P02: EVOLUTIONARY BIOLOGY AND ZOOGEOGRAPHY

Total Hours: 36 **Credits: 1**

1. Identification of Zoogeographical realms using Google Earth
2. Study of endemic species of each realm
3. Study of evolution of animals using Virtual lab
4. Study of Homology / Analogy
5. Study of connecting links
6. Study of living fossils
7. Study of Geological time scale
8. Study of vestigial organs
9. Calculation of gene/ allele frequency using Hardy- Weinberg equilibrium
10. Identification of Drosophila mutants

SEMESTER III

ABMB305: MICROBIAL GENETICS AND RECOMBINANT DNA TECHNOLOGY

Total Hours: 54 **Credits: 3**

Module 1 **12 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 Mutation **8 Hrs.**

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

Module 3 Recombination **7 Hrs.**

Recombination methods in bacteria: transformation, transduction and conjugation.

Module 4 Vectors **5 Hrs.**

Plasmids, plasmid as cloning vector, brief account on pBR 322, pUC 8, phage vectors- M13, lamda and cosmids

Module 5 **12 Hrs.**

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 polymerase I, reverse transcriptase. Production of Recombinant DNA, Transformation, Selection and analysis of Recombinant Clones

Module 6 **10 Hrs.**

Molecular biological techniques,polymerase chain reaction and types, DNA Sequencing- Maxam and Gilbert method, Sangers chain termination method and a brief account on new generation sequencing methods, Blotting techniques- southern, northern, and western blotting

References:

1. Primrose, S., Twyman, R. and Old, B. 2001. *Principles of Gene Manipulation*, 6thEdition, Blackwell Science Ltd.
2. Chakravarty, A. K. 2013. *Introduction to Biotechnology*. OUP India.

3. Chaudhuri, K. 2012. *Microbial Genetics*. The Energy and Resources Institute, TERI.
4. Sridhar, S. 2005. *Genetics and Microbial Biotechnology*. Dominant Publishers and Distributors.
5. Nicholl, D. S. T. 1994. *An Introduction to Genetic Engineering*. Cambridge University Press.
6. Old, R. W. and Primrose, S. B. 2008. *Principles of Gene manipulation*, 4th Edition, Blackwell scientific publications, London.
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10. Watson, J. D., Gilman, M., Witkowski, J. and Zoller, M. 1992. *Recombinant DNA*. 2nd Edition, Scientific American Books.
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14. Freifelder, S. 1987. *Microbial Genetics*. Jones and Bartlett, Boston.
15. Klug, W. S. and Cummings, M. R. 1996. *Essentials of Genetics*. Mentics Hail. New Jersey.
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17. Glazer, A. N. and Nikaido, H. 2007. *Microbial Biotechnology: Fundamentals of Applied Microbiology*. 2nd Edition. Cambridge University Press.

ABMB306: MEDICAL MICROBIOLOGY

Total Hours: 54 **Credits: 2**

Module 1 **12 Hrs.**

Normal microbial flora of Human body, systematic study of *Staphylococcus aureus, Streptococcus pyogenes, Escherichia coli, Klebsiella pneumonia, Pseudomonas aeruginosa, Vibriocholerae.*

Module 2 **12 Hrs.**

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

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

Module 3 **12 Hrs.**

A brief account on air borne diseases, Respiratory tract infections – Infections of the upper and lower respiratory tract

Module 4 **9 Hrs.**

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

Module 5 **9 Hrs.**

Fungal diseases -Superficial and deep mycoses

Protozoan Diseases: Malaria., amoebic dysentery, Sleeping sickness.

References

1. Cann, A. J. 2005. *Principles of Molecular Virology*. 4th Edition. Elsevier Academic Press.
2. Pichare, A. P. and Nagoba, B. S. 2013.*Medical Microbiology: Prep Manual for Undergraduates*. Elsevier India Pvt. Ltd.
3. Carter, J. and Saunders, V. 2007. *Virology: Principles and Applications*. John Wiley and Sons Ltd.
4. Dimmock, N. J., Easton, A. J. and Leppard, K. N. 2007. *Introduction to Modern Virology*, 6th Edition. Blackwell Publishing.
5. Kayser F. H., Bienz, K. A., Eckert, J. and Zinkernagel, R. M. 2004. *Medical Microbiology*. Berlin: Thieme Medical.
6. Baron, S. 1996. *Medical Microbiology*, 4th Edition. Galveston (TX): University of Texas Medical Branch at Galveston

7. 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.
8. 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.
9. Zinsser, H. and Joklik, W. K. 1992. *Zinsser microbiology*. 20th Edition. Norwalk, CT: Appleton & Lange.
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11. Emmons, C. W., Binford, C. H., Utz, J. P., Kwon-Chung, K. J. 1977. *Medical Mycology*. 3rd Edition. Philadelphia, Lea & Febiger.
12. Rippon, J. W. 1988. *Medical mycology: the pathogenic fungi and the pathogenic actinomycetes*. 3rd Edition. Saunder, Philadelphia.

ABZO303: ANIMAL DIVERSITY - NON CHORDATA

Instructional Hours: 54 **Credits: 3**

Module I - Introduction to invertebrates **(2 hrs)**

Outlines of classification

Phylogeny- cell number, embryology and body symmetry, developmental pattern

Module II - Kingdom Protista **(7 hrs)**

General characteristics and outline classification

Type: Paramecium

Life history of parasitic protozoan –Plasmodium

A brief description of Entamoeba, Trypanosoma, Leishmania.

Module III - Kingdom Animalia **(1 hr)**

Outline classification; Mesosoa and Metazoa

Phylum Mesozoa - Rhopalura

Module IV – Subkingdom Metazoa **(2 hrs)**

Levels of animal organization; Body layers; Symmetry; Coelom; Metamerism

Germ layers; Protostomes and Dueterostomes; Cephalisation

Body plan of animals- Blind sac and Tube within tube

Module V – Phylum Porifera & Placozoa **(2 hrs)**

Phylum Porifera: General characteristics; Outline classification; Canal system in Sponges

Class Calcarea - Leucosollenia

Class Desmospongia - Spongilla

Class Hexactinellida – Euplectella

Phylum Placozoa - *Trycoplax adherens*

Module VI – Phylum Coelenterata **(3 hrs)**

General characteristics; Outline classification

Class Hydrozoa – Hydra, Obelia

Class Scyphozoa - Aurelia

Class Anthozoa - Sea Anemone

Polymorphism in Coelentrates; Coral reefs with reference to Indian ocean; Threats and conservation of coral reefs

Module VII – Phylum Ctenophora **(1 hr)**

Major characteristics (Mention the affinities of Ctenophores)

Pleurobrachia

Module VIII - Phylum Platyhelminthes **(5 hrs)**

General characteristics; Outline classification

Class Turbellaria - Bipalium

Class Digenea(Trematoda) - Fasciola and its life cycle

Class Aspidogastra - Aspidogaster

Class Monogenea - Entobdella

Class Cestoda - Tape worm

Module IX – Phylum Aschelminthes **(4 hrs)**

General characteristics; Outline classification

Class Nematoda - Ascaris

Class Nematomorpha - Gordius

Class Gastrotrichia - Chaetonotus

Class Kinorhyncha - Echinoderes

Brief study of parasitic nematodes -Enterobius, Blood fluke, Hook worm, Filarial worm

Module X – Phylum Annelida **(4 hrs)**

General characteristics; Outline classification

Class Polychaeta - Nereis

Class Archiannelida - Polygordis

Class Oligochaeta - Earth worm

Class Hirudinea – Hirudinaria, Haemadipsa

Vermicomposting; Economically important earthworm species

Module XI - Phylum Arthropoda **(13 hrs)**

General characteristics; Outline classification

Type: Penaeus

Subphylum Trilobitomorpha

Class Trilobita (Extinct)

Subphylum Chelicerata

Class Merostoma – Limulus

Class Arachinida – Spider

Class Pycnogonida – Nymphon

Subphylum Mandibulata

Class Crustacea – Daphnia

Class Chilopoda - Centepede

Class Symphyla - Scutigerella

Class Diplopoda - Millipede

Class Pauropoda - Pauropus

Class Insecta – Butterfly

Beneficial Insects: Honey bee, Lac insect, Silk insect

Vectors and vector borne diseases: Dengue, JE, Chickungunya

Insect pests of agricultural importance – Paddy, Coconut

Pests of Fruits and Vegetables (Brief mention only)

Prawn and Lobster fisheries

Module XII - Phylum Mollusca **(4 hrs)**

General characteristics; Outline classification

Class Monoplacophora - Neopilina

Class Amphineura - Chiton

Class Scaphopoda - Dentalium

Class Gastropoda - Pila

Class Bivalvia - Lamellidens

Class Cephalopoda - Loligo

Pearl culture and Mussel culture

Module XIII – Phylum Echinodermata **(3 hrs)**

General characteristics; Outline classification

Class Asteroidea – Astropecten

Class Ophiuroidea - Ophiothrix

Class Echinoidea – Echinus

Class Holothuroidea – Cucumaria

Class Crinoidea – Antedon

Water vascular system in Echinoderms

Module XIV - Phylum Hemichordata (1 hr)

General characteristics – Balanoglossus

Module XV - Minor Phyla (2 hrs)

Sipunculida; Chaetognatha; Rotifera; Onychophora, Acantocephala

References:

1. Barnes, R.D., 1987. Invertebrate Zoology (W.B. Saunders, New York).
2. Barrington, E.J.W., 1967. Invertebrate Structure and function (ELBS and Nelson, London).
3. Dhami, P.S. and Dhami, J.K. 1979. Invertebrate Zoology (R. Chand and Co. New Delhi).
4. Ekamberanatha Ayyar M. (1990) A Manual of Zoology, Volume I. Invertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.
5. Groove, A.J. and Newell, G.E. 1974. Animal Biology – Indian Reprint (University Book Stall, New Delhi).
6. Hyman, L.H. The Invertebrate vols. (McGraw-Hill) 1942. Comparative vertebrate Anatomy (The University of Chicago Press).
7. James R.D. (1987). Invertebrate Zoology, W.B. Saunders, New York.
8. Kapoor V.C. (1994). Theory and Practice of Animal Taxonomy.
9. Kapoor, V.C. 1994. Theory and Practice of Animal Taxonomy (Oxford and IBH Publishing Co., New Delhi.)
10. Kotpal R.L. Agarwal S.K. and R.P. Khetharpal (2002). Modern Text Book of Zoology.
11. Parker T.J and Haswell W.A. (1962). Text Book of Zoology Vol. I. Invertebrate (ELBS & Macmillan, London).
12. Marshall, A.J. and Williams, W.D. 1972. Text Book of Zoology Vol. Invertebrates (ELBS and Macmillan, London).
13. Mayer, E. 1980. Principles of Systematic Zoology (Tata McGraw Hill Publishing Co., New Delhi.)
14. Nair, K.K. Ananthakrishnan, T.N. David, B.V. 1976. General and Applied Entomology (T.M.H. New Delhi).
15. Pechenik J A (2005) Biology of Invertebrates, Tata McGraw Hill Publishing Co., New Delhi

PRACTICAL

ABMB3P05: GENETICS AND MICROBIAL BIOTECHNOLOGY

Total Hours: 36 **Credits: 1**

1. Isolation of chromosomal DNA from *E.coli*
2. Isolation of plasmid DNA
3. Agarose gel electrophoresis
4. Bacterial transformation
5. Immobilization of yeast cells by sodium alginate method
6. Polymerase chain reaction
7. Blotting techniques
   a. Western blotting
8. Vector maps of pBR 322, pUC8

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. Dubey, R. C. and Maheswari, D. K. 2002. *Practical Microbiology*. 2nd Edition, S. Chand & Co., New Delhi.
3. Kannan, N. 2002. *Laboratory manual in general microbiology*. 2nd Edition, Panima Publishing 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. Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.
7. Janarthanan, S.and Vincent, S. 2007. *Practical Biotechnology: Methods and Protocols*. Orient BlackSwan/Universities Press.
8. Jane, M., ValanArasu, M. and Duraipandiyan, V. 2012. *Practical Handbook in Microbial Biotechnology*. Lambert Academic Publishing.

ABMB3P06: MEDICAL MICROBIOLOGY

Total Hours: 36 **Credits: 1**

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

2. Study of the morphology, staining characters, cultural characters and 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 etc.

6. Study of normal microbial flora of human being

7. Estimation of hemoglobin content in blood

References

1. Cheesbrough, M. 2006. *District Laboratory Practice in Tropical countries*. 2nd Edition. Cambridge, University Press.
2. Rowland, S. S., Walsh,S. R., Teel, L. D. and Carnahan, A. M. 1994*Pathogenic and Clinical Microbiology: A Laboratory Manua*l. Lippincott Williams and Wilkins.
3. Gradwohl, R. B. H., Sonnenwirth, A. C. and Jarett, L. 1980. *Gradwohl's clinical laboratory methods and diagnosis*. 8th Edition. Mosby, London.
4. Cappuccino, J. G. and Sherman, N. 2008. *Microbiology: A Laboratory Manual*. 9th Edition. Pearson/Benjamin Cummings.
5. Prince, C. P. 2009. *Practical Manual of Medical Microbiology*. Jaypee Brothers Medical Publishers (p) Ltd., New Delhi.
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ABZO3P03: ANIMAL DIVERSITY - NON CHORDATA

Instructional Hours: 36

Credits: 1

Scientific Drawing:-

Make scientific drawings of 5 locally available invertebrate specimens belonging to different phyla.

Anatomy:-

Study of sections

1. Hydra.
2. Ascaris (male or female)
3. Fasciola
4. Earthworm (TS through intestine)

Study of nervous system in Prawn

Study of digestive system in Cockroach

Identification of common mosquitoes (4 genuses)

Mounting:-

1. Mouth parts – House fly and Honey Bee
2. Prawn appendages.

Identification:-

General identification- The students are expected to identify the following Phylum –wise number of animals by their scientific names. Protista -2, Porifera-1, Coelenterata-2, Platyhelminthes-1, Annelida-2, Arthropoda-3, Mollusca- 2, Echinodermata-2

SEMESTER IV

ABMB407: INDUSTRIAL MICROBIOLOGY

Total Hours: 36 **Credits: 2**

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. Product recovery.

References

1. Whitaker, A., Stanbury, P. F. and Hall, S. J. 2009. *Principles of Fermentation Techniques*. Elsevier.
2. Demain, A. L. and Solomon, N. A. 1986. *Manual of Industrial Microbiology*. Oxford University Press, Oxford.
3. Waites, M. J., Morgan, N. L., Rockey, J. S. and Higton, G. 2001. *Industrial Microbiology: An Introduction*. Blackwell Science Ltd.

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ABMB408: FERMENTATION TECHNOLOGY

Total Hours: 36 **Credits: 2**

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. Whitaker, A., Stanbury, P. F. and Hall, S. J. 2009. *Principles of Fermentation Techniques*. Elsevier.
2. Demain, A. L. and Solomon, N. A. 1986. *Manual of Industrial Microbiology*. Oxford University Press, Oxford.
3. Prescott, S. C., Dunn, C. G., and Reed, G. 1982. *Prescott and Dunn's Industrial Microbiology*, 4th Edition. AVI Pub. Co., Westport, Conn.
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5. Waites, M. J. 2001. *Industrial Microbiology*. Blackwell Science, Oxford.
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7. Peppler, H. J. 1995. *Microbial Technology: Fermentation technology*.Academic Press.
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11. Casida, L. E. 1968. *Industrial Microbiology*. Wiley, New York; London.

ABZO404: ANIMAL DIVERSITY – CHORDATA

Total Hours: 54 **Credits: 3**

54 hrs - Credits 3

Module I - Introduction to Phylum Chordata (**1 hr)**

General characteristics

(Classification up to order – Sub Phylum, Super class, Class, Sub class, Order)

Module II - Sub phylum Urochordata **(3 hrs)**

Class I : Larvacea - Oikopleura

Class II: Ascidiacea - Ascidia (Mention Retrogressive Metamorphosis)

Class III: Thaliacea - Doliolum

Module III - Sub phylum Cephalochordata (**1 hr)**

Amphioxus

Module IV - Division Agnatha (**2 hrs)**

Class I: Ostracodermi - Cephalaspis

Class II: Cyclostomata - Petromyzon, Myxine

Module V - Division Gnathostomata (**12 hrs)**

Super class Pisces

Class I: Chondrichthyes

Sub class Elasmobranchi - Narcine

Sub class Holocephali - Chimaera

Class II: Osteichthyes

Sub class Choanichthyes

Order I: Crossopterigii - Latimeria

Order II: Dipnoi - Lepidosiren

Sub class Actinopterygii

Super order 1. Chondrostei - Acipencer

Super order 2. Holostei - Amia

Super order 3. Teleostei – Sardine

Accessory respiratory organs in fish; Scales in fishes; Common culture fishes of Kerala (traditional and recent trends)

Fresh water fishes of Kerala (Brief mention only)

Module VI - Super class Tetrapoda **(4 hrs)**

Class: Amphibia

Order I: Anura - Euphlyctis

Order II: Urodela - Amblystoma (Axolotl larva and neoteny)

Order III: Apoda - Ichthyophis

Frogs and toads of Kerala (Brief mention only)

Module VII – Class Reptilia (5 **hrs)**

Sub class I: Anapsida

Order Chelonia - Chelone

Sub class II: Parapsida - Ichthyosaurus

Sub class III: Diapsida

Order I Rhynchocephalia - Sphenodon

Order II Squamata - Chameleon

Sub class IV: Synapsida - Cynognathus

Identification of poisonous and non poisonous snakes; Snakes of Kerala

Module VIII - Class Aves (**6 hrs)**

Sub class I: Archaeornithes - Archaeopteryx (Affinities)

Sub class II: Neornithes

Super order I: Palaeognathae - Struthio

Super order II: Neognathae - Brahminy kite

Flight adaptations in birds; Migration in Birds;

Birds of Kerala (Brief mention only)

Module IX - Class Mammalia **(20 hrs)**

Type: *Homo sapiens*

Sub class I: Prototheria - Echidna

Sub class II: Metatheria - Macropus

Sub class III: Eutheria

Order 1. Insectivora - Talpa

Order 2. Dermoptera - Galeopithecus

Order 3. Chiroptera - Pteropus

Order 4. Primates - Loris

Order 5. Carnivora - Panthera

Order 6. Edentata - Armadillo

Order 7. Pholibota - Manis

Order 8. Proboscidea - Elephas

Order 9. Hydracoidea - Procavia

Order 10. Sirenia - Dugong

Order 11. Perissodactyla - Zebra

Order 12. Artiodactyla - Cameleus

Order 13. Lagomorpha - Oryctolagus

Order 14. Rodentia - Porcupine

Order 15. Tubulidentata - Orycteropus

Order 16. Cetacea - Delphinus

Dentition in Mammals; Aquatic Mammals

Mammals of Kerala (Brief mention only)

References:

1. Ashok Captain and Romulus Whitaker (2008). Snakes of India -The Field Guide. Draco Books.
2. Charpurey K. G. (2008). The Snakes of India. Fabri Press.
3. Daniel J.C (2002). The Book of Indian Reptiles and Amphibians First Edition. Oxford University Press
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19. Young J.Z. (2006). The life of Vertebrates Oxford University Press (Third Ed.) India

ABZO405: RESEARCH METHODOLOGY AND BIOSTATISTICS

Total Hours: 36 **Credits: 2**

PART I - RESEARCH METHODOLOGY (24 hrs)

Module I - Introduction (4 hrs)

Basic concepts of research: Meaning, Objectives

Types of Research: Descriptive/Analytical, Applied/Fundamental, Quantitative/Qualitative, Conceptual/Empirical

Module II - Research Design (4 hrs)

Basic principles; Meaning, need and features of good design; Types of research designs

Module III – Research Documentation & Presentation (4 hrs)

Scientific documentation and communication; Research report writing (Thesis and dissertations, Research articles, Oral communications); Bibliography formats; Plagiarism

Presentation techniques: Assignment, Seminar, Debate, Workshop, Colloquium, Conference

Module IV – Measurements (8 hrs)

Units of measurements; Calculations and related conversions of measurement units

Metric system- length; surface; weight; Square measures; Cubic measures; Volumetric; Circular or angular measure

Concentration - percent volume; ppt; ppm

Chemical – Molarity, Normality

Temperature- Celsius, centigrade, Fahrenheit

Module V - Bioethics (4 hrs)

Introduction; Animal rights and animal laws in India; Animal use in research and education; Laboratory animal use, care and welfare; Animal protection initiatives; Animal Welfare Board of India

Working with Humans: harm, risk, and benefits; Consent.

PART II – BIOSTATISTICS (12 hrs)

Module VI - Sample & Sampling techniques (5 hrs)

Collection of data; Classification of data; Frequency distribution tables

Graphical representation: - Bar diagrams, Histogram, Pie diagram and Frequency curves

Module VII - Measures of Central Tendency (2 hrs)

Mean, Median, Mode (Direct method only)

Module VIII - Measures of dispersion (5 hrs)

Range; Quartile Deviation; Mean Deviation; Standard Deviation; Standard error (Merits & demerits)

References:

Research Methodology

1. Anderson, J, Durston, B.H. and Poole, M. 1992. Thesis and assignment writing. Wiley Eastern Ltd.
2. Baker Kathy (Ed.), 1998, At the Bench: A Laboratory Navigator, Cold Spring Harbor Laboratory Press, New York, 460 pp.
3. Day, R.A. 1993. How to write and publish a scientific paper. Cambridge University Press.
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5. Debbies Holmes, Peter Moody and Diana Dine 2006 Research methods for the Biosciences. International student Edition: Oxford University Press. Chapters.1-8.
6. Gupta K.C, Bhamrah, H.S and G.S. Sandhu 2006.Research Techniques in Biological Sciences. Dominant Publishers and Distributors, New Delhi.
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Biostatistics

1. Bailey, N.T.J. 1994. *Statistical Methods in Biology* (3rdedn). Cambridge University Press.
2. Chap T.Le.2003. *Introductory Biostatistics*. John Wiley &Sons, NJ, USA.
3. Daniel, W.W. 2006. *Biostatistics: A Foundation for Analysis in the Health Sciences* (7th edn). John Wiley & Sons, New York.
4. Sundar Rao, P.S.S and J.Richard.2006. *Introduction to Biostatistics and Research Methods* (4th edn). Prentice Hall, New Delhi.
5. Zar, Jerrold H. 2008. *Biostatistical Analysis* (3rdedn.). Pearson Education Inc., New Delhi.

PRACTICAL

ABMB4P07: INDUSTRIAL MICROBIOLOGY

Total Hours: 36 **Credits: 1**

1. Crowded plate technique for screening microbial production of enzymes and antibiotics
2. Solid state fermentation
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.

Reference:

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.
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4. Kannan, N. 2002. *Laboratory manual in general microbiology*. 2nd Edition, Panima Publishing Co., New Delhi.
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6. Kalaichelvan, P. T. 2005. *Microbiology and Biotechnology Laboratory manual*. MJP Publishers, Chennai.
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9. 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.

ABMB4P08: FERMENTATION TECHNOLOGY

Total Hours: 36 **Credits: 1**

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 *Aspergillusniger*
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.
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6. Kalaichelvan, P. T. 2005. *Microbiology and Biotechnology Laboratory manual*. MJP Publishers, Chennai.
7. Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.
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9. Kulandaivelu, S, Janarthanan, S. 2012. *Practical Manual on Fermentation Technology*. International Publishing House Pvt. Limited.

ABZO4P04: ANIMAL DIVERSITY – CHORDATA

Instructional Hours: 36

Credits: 1

1. **Morphology**

   Scientific Drawing: Make scientific drawing of 5 locally available vertebrate specimens belonging to different classes

   Mounting of placoid scales/cycloid/ctenoid scales

2. **Study of Human Anatomy using Virtual lab**

   1. Viscera
   2. Digestive System
   3. Heart
   4. Respiratory System
   5. Excretory System
   6. Brain
   7. Reproductive System – Male & Female

3. **Study of sections**

   Human skin, Cartilage, Bone

4. **Osteology**

   Human vertebrae (Typical, Atlas, Axis, Lumbar)

   Pectoral and pelvic girdles of Man

5. Dentition in Mammals (Dog, Rabbit, Man)

6. Study of feathers

7. Identification:-

General identification of poisonous snakes (Cobra, Viper, Krait)

Non poisonous (Rat snake, Natrix, Python)

Identify animals by their scientific names: Protochordata-1, Pisces-4, Amphibia-3, Reptilia- 4, Aves-1, Mammalia-2.

8. Taxonomic identification with key:-

i) Identification of fishes up to the level of order.

ii) Identification of snakes up to family.

SEMESTER V

ABMB509: FOOD MICROBIOLOGY

Total Hours: 54 **Credits: 3**

Module1 **10 Hrs.**

A brief account of micro-organisms 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. 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 **12 Hrs.**

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

Module 5 **8 Hrs.**

Food borne Diseases- Food poisoning and food born infections and intoxication. Mycotoxins - Aflatoxins. Hazard Analysis Critical Control Points (HACCP)

References

1. Casida, L. E. 1968. *Industrial Microbiology*. Wiley, New York; London.
2. Doyle, M. P., Beuchat, L. R. and Montville, T. J. 2001. *Food Microbiology: Fundamentals and Frontiers.* 2nd Edition. ASM Press, Washington, D.C.
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4. Rose, A. H. 1983. *Food microbiology*. Academic Press, London.
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ABZO507: CELL BIOLOGY AND MOLECULAR BIOLOGY

Instructional Hours: 54

Credits: 3

PART I - CELL BIOLOGY (27 hrs)

Module I - Introduction **(2 hrs)**

Cell theory

Eukaryote, Prokaryote; Mycoplasma; Virus; Viroid; Prion

Module II - Cell membrane & Permeability **(6 hrs)**

Molecular models of cell membrane: Sandwich model; Unit membrane model; Fluid mosaic model

Modifications of plasma membrane: Microvilli; Tight junction; Gap junction; Desmosomes

Cell permeability – Diffusion; Osmosis; Passive transport; Active transport

Cell coat and Cell recognition

Module III - Ultra structure of Cytoplasm **(6 hrs)**

Cytoskeleton: Microtubules; Microfilaments; Intermediate Filaments

Endoplasmic reticulum - Structure and functions

Ribosomes (Prokaryotic and Eukaryotic)

Golgi complex - Structure and functions

Lysosomes - Polymorphism; GERL concept; functions

Mitochondria - Structure and functions; Symbiont hypothesis

Module IV- Nucleus **(6 hrs)**

Structure and functions of interphase nucleus

Nuclear membrane; Pore complex

Structure and functions of nucleolus

Chromosome structure; Nucleosomes; Heterochromatin; Euchromatin

Polytene chromosomes, Balbiani rings, Endomitosis; Lamp brush chromosomes

Module V - Cell Division **(3 hrs)**

Cell cycle - G_1, S, G_2 and M phases

Mitosis, Meiosis and Amitosis

Module VI – Cancer & Ageing **(4 hrs)**

Types of tumors-benign and malignant

Types of cancers-Carcinoma, Sarcoma, Lymphoma, Leukemia

Causes of cancer- Physical, Chemical and Biological

Properties of cancer cells

Brief account on Ageing, Theories of Ageing

PART II - MOLECULAR BIOLOGY (27 hrs)

Module VII - Nature of Genetic Material **(9 hrs)**

Discovery of DNA as genetic material – Griffith's transformation experiments; Hershey Chase experiment of Bacteriophage infection

Structure and types of DNA & RNA

DNA replication

Modern concept of gene (Cistron, Muton, Recon, Viral genes)

Prokaryotic genome; Eukaryotic genome

Brief account of the following - Split genes (introns and exons), Junk genes; Pseudo genes; Overlapping genes; Transposons

Module VIII - Gene Expression **(12 hrs)**

Central Dogma of molecular biology; one gene-one enzyme hypothesis; One gene-one polypeptide hypothesis

Characteristics of genetic code; Contributions of Hargobind Khorana

Protein synthesis - Transcription (Prokaryotic and eukaryotic); Reverse transcription; Post transcriptional modifications

Translation, Post translational modifications

Module IX - Gene Regulation **(6 hrs)**

Prokaryotic: Operon concept - Lac operon and Tryptophan operon; Catabolite repression (Glucose effect).

Brief account of Eukaryotic gene regulation

References:

1. Ariel G Loewy Philip Sickevitz, John R. Menninger and Jonathan A.N. Gallants (1991) Cell structure and function. Saunder's College Publication

2. Arthur & Tania. (1991) DNA Replication. W.H. Freeman & Co. New York.
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7. Daniel & Elizabeth. (1996) Genetics-Principle and Analysis. Jones & Bartlett Publishers
8. David A Micklos & Greg A Freyer. (2006) DNA Science. Cold Spring Harbor Laboratory Press
9. David Latchman. (2006) Gene Regulation. London Unwin Hyman
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21. Malcolm N. Jones & Dennis Chapman. (1991) Micelles, Monolayers and Biomembranes. John Willey & Sons Inc. Publication
22. Michael T.A. Michael, E.R. and Toya S.K. (1975) Electron Microscopy and Cell Structure. Cambridge University Press
23. Mitchison J.M. (1991) The Biology of the Cell Cycle, Cambridge University Press
24. Powar C.B. (1983) Cell Biology (Himalaya Pub. Company)
25. Rastogi S. C. (1998) Cell Biology. Tata Mc Graw Hill Publishing Co., New Delhi
26. Sinnot Dunn & Dobzhanasky. (1991) Principles of Genetics. T.M.H. New Delhi.

27. Sobti R.C. & G. Obe. (2000) Eukaryotic Chromosomes. Narosa Publishing House.
28. Stanley G. Schultz. (2002) Basic Principles of Membrane Transport. Cambridge University Press
29. Stephen L Wolfe. (1981) Biology of the Cell. Wadsworth Publishing Co. Inc.
30. Varma P.S. and Agarwal V.K. (1988) Cytology (S. Chand & Co., New Delhi)
31. Varma P.S. and Agarwal V.K. (2008) Genetics (S. Chand & Co., New Delhi)
32. Veer Bala Rastogi. (2008). Fundamental of Molecular Biology, Ani Books, India
33. West I.C. (2002) Biochemistry of membrane transport. Chapman & Hall, London
34. William & Daphne. (2008) Biochemistry & Molecular Biology. Oxford University Press

ABZO508: PERSPECTIVES IN ECOLOGY

Instructional Hours: 54

Credits: 3

Module I - Introduction **(2 hrs)**

Relevance of ecological studies. Autecology and synecology.

Module II - Ecosystem **(12 hrs)**

Components and classification

Habitat ecology: Fresh water habitat types; Lentic and lotic.

Marine habitat: Intertidal zone, Rocky shore, Muddy shore, Sandy shore; Coral reefs; Open sea; Pelagic realm; Benthic realm

Wetland and Mangroves; Estuarine ecosystem; Ramsar sites in Kerala

Terrestrial biomes

Food chain; Detritus and grazing food chains

Energy flow through the ecosystem, Ecological pyramids and ecological efficiencies.

Module III - Population Ecology **(5 hrs)**

Characteristics of population, population growth curves, r and k selections

Population regulation by density dependent and density independent factors; Life tables, survivorship curves.

Module IV - Community Ecology **(8 hrs)**

Habitat and niche concept

Compartmentation in communities: Trophic levels, guild structure and food webs.

Ecotone and edge effect, Keystone species and dominant species concept

Animal associations with reference to competition, predation. Predator-prey oscillation

Antibiosis, Protocoperation, Commensalism, Mutualism.

Module V - Biogeochemical C**ycles** **(3 hrs)**

The Phosphorus Cycle, Nitrogen Cycle, Carbon Cycle, Sulphur Cycle.

Module VI - Resource Ecology **(6 hrs)**

Natural resources and its sustainable management

Renewable and non-renewable energy resources; Mineral resources; hydropower; tidal power

Green building concept and green technology concept

Module VII - Environmental issues **(7 hrs)**

Global Issues: Global warming and Climate change; Ozone depletion; Greenhouse effect; Acid rain; Nuclear accidents; Carbon trading carbon credit; Carbon sequestration; IPCC/UNFCC

Local issues: Sand mining; Wetland reclamation; Landscape changes; Deforestation; Threats to fresh water resources of Kerala; Tourism and its impact on environment

Module VIII - Pollution **(6 hrs)**

Air pollution; Water pollution; Land pollution; Sound Pollution; Pesticide pollution; Municipal solid waste management; e-waste and its management

Module IX - Disaster Management **(5 hrs)**

Introduction to hazards; Hazards classification; Types of hazards: natural and anthropogenic

Disaster management- introduction; Earthquakes; Cyclone; Tsunami; Floods; Landslides; Droughts

References:

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ABZO510: ANIMAL PHYSIOLOGY

Instructional Hours: 54

Credits: 3

Module I - Nutrition (9hrs)

Types of nutrition; Major and minor nutrients; Importance of fiber in diet; Digestive organs and associated glands in man; Digestion and absorption of carbohydrates, proteins and lipids; Nervous and hormonal control of digestion; Special modes of digestion: ruminant and symbiotic

Balanced diet; Nutritional disorders: Overnutrition, malnutrition, undernutrition, Defects of modern food habits, Obesity, Anorexia, acidity and ulcers, flatulence.

Module II - Respiration (9 hrs)

Respiration in animals: cutaneous, tracheal, branchial, pulmonary.

Respiratory organs in man: exchange and transport of respiratory gases. Respiratory pigments in animals: haemoglobin (mention structure), myoglobin, hemocyanin, haemerythrin, chlorocruorin.

Exchange and transport of respiratory gases, Oxy-hemoglobin curve, Bohr effect, reverse Bohr effect and Haldane effect.

Respiratory disturbances and disorders: Dyspnoea, asthma, emphysema, Anoxia, hypoxia, cyanosis, hypocapnia, hypercapnia and asphyxia; Carbon monoxide poisoning

Respiratory adaptations to high altitudes, Physiological problems of deep sea diving.

Module III – Circulation (9 hrs)

Organs and mechanism of circulation- Types of heart, Structure of human heart

Cardiac cycle, Control and rhythmicity of the heart beat- Pacemakers, Pulse, Blood pressure and disorders, Neural and Hormonal control.

Human Blood and its constituents, Buffer system in blood, Blood clotting mechanism: intrinsic and extrinsic pathways, clotting factors, disorders of blood clotting, anticoagulants, blood groups and transfusion.

Circulatory disorders - Myocardial infarction, angina pectoris, cardiac arrest, thrombus and embolus, arteriosclerosis and atherosclerosis.

Clinical analysis- Electrocardiogram (ECG), Erythrocyte sedimentation rate (ESR), Haematocrit, Total and differential blood cell count

Module IV – Excretion (7 hrs)

Patterns of nitrogen excretion in animals: ammonotelism, ureotelism, uricotelism.

Structure of human kidney, nephron, formation of urine, counter current mechanism, water and salt balance, acid-base control and homeostasis; Hormonal control of kidney functions.

Composition of urine- normal and abnormal constituents, Diseases of the kidney - Kidney stones, Proteinurea, Nephrosis, Pyelonephritis.

Artificial kidney (haemodialysis), Peritonial dialysis and Kidney transplantation.

Module V – Muscle Physiology (7 hrs)

Muscular movements, Types of muscles

Vertebrate skeletal muscle: Structure and function; Mechanism, Biochemistry and Energetics of muscle contraction

Neuromuscular junction

Electrophysiology of muscle, threshold and spike potentials, simple muscle twitch, whole muscle contraction, isotonic and isometric contraction, latent and refractory periods, summation, beneficial effect, tetanus, tonus, staircase phenomenon, fatigue, oxygen debt, rigor mortis.

Module VI – Neurophysiology (6 hrs)

Structure and types of neurons, Nerve fiber and impulse propagation, Synaptic transmission & properties of synapses, neurotransmitters, role of dopamine and serotonin. Neuroreceptors. Reflexes and types of reflexes.

Structure of human brain, Peripheral and Central nervous system

Electroencephalogram (EEG)

Neural disorders- Parkinson’s disease, Dementia, Alzheimer’s disease, Dyslexia, Epilepsy, Schizophrenia.

Module VII – Sensory Physiology (4 hrs)

Chemoreceptors: Gustatory receptors- taste buds, Olfactory receptors

Mechanoreceptors: statoreceptors, phonoreceptors- human ear and its physiology

Touch receptors

Photoreceptors- Human eye and its physiology

Thermoreceptors

Module VIII – Environmental Physiology (2 hrs)

Body Temperature and its Regulation, Poikilotherms, Homeotherms

Physiological adaptation to cold, Shivering, Dormancy, Hibernation, Aestivation, Photoperiodism.

References:

1. Bentley, P.J. 1998. *Comparative Vertebrate Endocrinology* (3rd edn). Cambridge University Press
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PRACTICAL

ABMB5P09: FOOD MICROBIOLOGY

Total Hours: 54 **Credits: 1**

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. Detection of rancidity, peroxide value, acid value.
11. Cultivation of Edible mushroom

Reference:

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.
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ABZO5P06: CELL BIOLOGY AND MOLECULAR BIOLOGY

Instructional Hours: 36

Credits: 1

1. Study of tissues using permanent slides of epithelial tissues (Squamous, Cuboidal, Columnar), striated muscle, smooth muscle, neuron, cartilage and bone.
2. Isolation, staining and mounting of striated muscle fibre.
3. Squash preparation of onion root tip and identification of mitotic stages.
4. Mounting of polytene chromosome (Drosophila/Chironomus).
5. Identification of meiotic stages using permanent slides.
6. Preparation of human blood smear and identification of blood cells.
7. Study of tonicity using RBC.
8. Comparative study of prokaryotic and eukaryotic cells.
9. Identification of cell organelles.
10. Models (DNA, DNA replication, RNA – Different types)

ABZO5P07: PERSPECTIVES IN ECOLOGY

Instructional Hours: 36

Credits: 1

1. Estimation of dissolved oxygen
2. Estimation of dissolved carbon dioxide
3. Collection and identification of freshwater/ marine plankton
4. Plankton count(Fresh water/ marine)
5. Extraction of soil organisms
6. Study of soil types
7. Identification of minerals and rocks
8. Transparency measurements using Secchi disc
9. Study of pond ecosystem and preparation of food web

ABZO5P09: ANIMAL PHYSIOLOGY

Instructional Hours: 54

Credits: 1

1. Preparation of Human blood smear & identification of leucocytes
2. Determination of haemoglobin content of blood
3. Total RBC count using Haemocytometer
4. Total WBC count using Haemocytometer
5. Differential count of WBC
6. Estimation of PCV
7. Identification of human blood groups, A, AB, B and O, Rh factor
8. Effect of different anti-coagulants on blood clotting time
9. Salivary amylase activity on starch
10. Abnormal constituents of Urine- Sugar, Ketone bodies, Albumin
11. Instruments (Principle & use) – Sphygmomanometer , Stethoscope
12. Measurement of blood pressure using a sphygmomanometer

SEMESTER VI

ABMB610: AGRICULTURAL MICROBIOLOGY

Total Hours: 54 **Credits: 3**

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.

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.

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. Hull, R. 2002. *Matthew's Plant Virology*. 4th Edition, Academic Press.
3. Atlas, R. N. and Bartha, R. 1998. *Microbial Ecology: Fundamentals & Applications*.4thEdition. Benjamin & Cummings Science Publishing, California.
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ABMB611: MICROBIAL WASTE MANAGEMENT

Total Hours: 54 **Credits: 3**

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 waste water, treatment of liquid waste; microbiology of municipal sewage;

Sewage treatment - primary treatment- screening, sedimentation, floatation, coagulation and flocculation, secondary treatment - trickling filter, 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 **10 Hrs.**

Microbiology of water pollution

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 **14 Hrs.**

Biodegradation - biodegradation of xenobiotic compounds; stimulating biodegradation, hospital waste management, bioremediation- in situ and ex situ techniques, bio sorption

Bioremediation of hazardous waste, dyes, oil, pesticides;

Biodegradation of lignin, cellulose and plastics.

References

1. Odum, E. P. and Barrett, G. W. 2005. *Fundamentals of Ecology*. 5th Edition. Thomson Brooks/Cole, Belmont, CA.
2. J. C. Daniel, 1999. *Environment Aspects of Microbiology*. 1st Edition, Bright Sun Publications, Chennai.
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ABZO611: GENETICS, BIOTECHNOLOGY AND BIOINFORMATICS

Instructional Hours: 72

Credits: 3

PART I - GENETICS (36 hrs)

Module I - Introduction (**2 hrs)**

Gene and alleles, genotype and phenotype, homozygous and heterozygous, wild type and mutant alleles, Chromosome theory of heredity

Module II - Mendelism **(3hrs)**

Mendel's laws, Dominant and recessive traits, test cross and back cross, reciprocal cross, Mendelian traits in man

Module III - Interaction of genes **(5 hrs)**

Allelic: Incomplete dominance, Co-dominance

Non allelic interactions: Complementary, supplementary

Epistasis: Dominant (feather colour in fowl), Recessive (coat colour in mice)

Polygenes (Skin colour inheritance in man)

Pleiotropism; Modifying genes; Lethal genes (Brief account with one example each)

Multiple alleles (coat colour in rabbits, ABO blood group, Rh factor and its inheritance)

Module IV - Linkage and Recombination (**3hrs)**

Morgan's work in Drosophila (Complete and incomplete linkage)

Arrangement of linked genes-cis and trans

Recombination

Cytological evidence of crossing over (Stern's Experiment)

Module V - Sex determination (**3hrs)**

Sex chromosomes and autosomes

Chromosomal mechanism sex determination (XX-XO, XX-XY, ZW-ZZ)

Sex determination in man; Barr bodies and Lyon hypotheses (Dosage compensation); Role of Y chromosome

Sex determination in honey bees; Sex determination in Drosophila; Intersex; Gynandromorphs

Hormonal influence on sex determination; Sex reversal

Environmental influence; Genic balance theory; Hermaphroditism

Module VI - Sex linked inheritance (**1 hr)**

Definition, Characteristics of sex linked inheritance (criss-cross inheritance)

Haemophilia and colour blindness

Pseudoautosomal genes (incompletely sex-linked genes)

Holandric genes; Sex limited and sex influenced traits in man

Module VII - Mutations (**5hrs)**

Types of Mutations: Somatic and germinal; Induced and random

Chromosomal mutations - structural and numerical changes

Gene mutation (point mutation)

Molecular basis of gene mutations: Transversions, Transitions, Frame shift

Mutagens: Physical, Chemical, Biological

Module VIII - Extra nuclear inheritance (**2hrs)**

Kappa particles in Paramecium

Maternal effect genes in snail

Module IX - Bacterial Genetics **(4 hrs)**

Bacterial genome

Recombination in Bacteria

Bacterial transformation; Transduction; Conjugation; F mediated sexduction

Module X - Human Genetics **(8hrs)**

Pedigree Analysis; Karyotyping- Normal human chromosome complement

Aneuploidy and Non disjunction

Genetic disorders in Man: Chromosomal anomalies- Autosomal: Down syndrome; Edward's syndrome; Cri-du-chat syndrome

Sex chromosomal - Klinefelter's syndrome; Turners syndrome

Single gene disorders (Brief mention): Sickle cell anaemia and Brachydactyly

Inborn errors of metabolism: Phenylketonuria; Alkaptonuria; Albinism and Tyrosinosis

Multifactorial disorders: Polygenic traits - Cleft lip and cleft palate.

Prenatal Diagnosis: Amniocentesis; Choriovillus sampling; Ultrasound scanning; Fetoscopy; Genetic counselling

Eugenics, Euphenics and Euthenics

PART II – BIOTECHNOLOGY (18 hrs)

Module XI - Tools and Techniques of Genetic Engineering (14 hrs)

Tools: Enzymes- Restriction enzymes and DNA ligases

Vectors: Plasmids and Phage vectors

Production of recombinant DNA (Briefly mention)

Gene transfer: Virus mediated and DNA mediated

PCR technique and DNA amplification

Blotting Techniques: Southern Blotting; Northern Blotting; Western Blotting

DNA hybridization: Fluorescence *in-situ* Hybridization (FISH), Colony hybridization

DNA finger printing and its applications

RFLP- markers and applications

Gene libraries; Genomic and cDNA libraries

Potential uses of stem cells

Module XII - Applications of Biotechnology (4 Hrs)

Tissue culture – Principle and uses

Single cell protein (SCP)

Biotechnology and Medicine: Therapeutic cloning; Gene therapy; Monoclonal antibodies; Humulin

Antibiotics; DNA Vaccines

Biotechnology in agriculture: Microbial insecticides; GMO

Problems in Biotechnology: Hazards of genetic engineering; Ethical issues; Biowar

PART III - BIOINFORMATICS (18 hrs)

Module XIII – Biological Information Management (9 hrs)

Introduction, DNA, RNA and Proteins as information molecules

Genome sequencing projects; Storing, accessing and annotating sequence data, role of databases and internet

Bioinformatics Databases - NCBI GenBank, PDB

Database searching

Module XIV - Sequence Analysis (5 hrs)

Sequence alignment: Pair-wise alignment - BLAST, Multiple sequence alignment- CLUSTAL Omega

Molecular Phylogenetics

Module XV – Structural Bioinformatics (4 hrs)

Protein Structure prediction- Computer Aided Drug Discovery

Molecular Visualization Software – Rasmol

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Genetics & Biotechnology

1. Bala Subramanian D., C.F & Bryle & K. Dharmarajan J. Green Kunthala Jayaraman, Concept in Biotechnology. University Press 2007
2. Benjamin Lewin 2004 Gene VIII Oxford University Press
3. Brown C.H., Campbell I & Priest F, G. 1987. Introduction of Biotechnology (Blackwell scientific publishers Oxford)
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11. Jan Vijay Aging of the Genome The dual role of DNA in life and Deaths. Oxford university Press 2008

12. Janarthanan S & Vincent S., Practical Biotechnology, Method of Protocols. University Press. 2007
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16. Prave D. Faustu and Sitting W and Subasten D.A (Eds) 1987 Fundamentals of Biotechnology (VCH publishers. Germany)
17. R.C. Sobte and Suparna. S. Pachauri. Essentials of Biotechnology Ane Book Pvt. Ltd. 2009
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22. Sudha Gangal Biotechnology Principles And & practice of Animal Tissue culture, Universities Press 2007
23. Susantha Gosnalibke – Merged Evolution (Long term implication of Biotechnology and Information Technology) Gordon & Breech Pub. 2005
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25. Verma P.S. and Agarwal V.K. 1988 Genetics (S. Chand and Co. New Delhi)
26. Winchester A.M. 1966. Genetics (Oxford & IBH Publications.

Bioinformatics

1. Claverie & Notredame, Bioinformatics - A Beginners Guide, Wiley-Dreamtech India Pvt Ltd, 2003
2. Dan E. Krane and Michael L. Raymer, Fundamental Concepts of Bio-informatics, Pearson Education.
3. D. Mount, Bioinformatics: sequence & Genome Analysis, Cold spring Harbor press, USA.
4. Introduction to Bioinformatics, Arthur M. Lesk, OXFORD publishers
5. Rastogi et. al., Bioinformatics: Methods and Applications, Prentice Hall of India.
6. Rashidi, Hooman H. and Buehler, Lukas K. 2001. *Bioinformatics:*
7. *Basics applications in biological science and medicine,* CRC Press, Washington, D.C.
8. Xiong, Jin. 2006, *Essential Bioinformatics,* Cambridge University Press, New York.

ABZO613: ENDOCRINOLOGY, REPRODUCTIVE BIOLOGY AND ETHOLOGY

Instructional Hours: 54

Credits: 3

PART I- ENDOCRINOLOGY (20 hrs)

Module I – General Principles (6 hrs)

Hormones as messengers; classification and types of hormones

Mechanism of hormone action, Concept of hormone receptors, Hormonal control of homeostasis.

Module II – Endocrine Glands (14 hrs)

Secretion, regulation, functions and disorders of hormones of Hypothalamus, Hypophysis, Pineal, Thyroid, Parathyroid, Thymus, Islets of Langerhans, Adrenal, Gonads, Placenta

Gastro intestinal hormones

Part II - REPRODUCTIVE BIOLOGY (16 hrs)

Module III - Reproductive Organs and Gametogenesis (8 hrs)

Human reproductive organs; Ultra structure of testes and ovary

Spermatogensis and oogenesis; Structure of human sperm and egg; Hormonal control of gametogenesis

Module IV - Sexual cycle (8 hrs)

Estrus cycle (non-primate) and menstrual cycle (primate cycle); Hormonal control of menstrual cycle

Puberty; Menarche; Menstrual cycle; Pregnancy; Parturition; Lactation; Menopause and associated physiological changes

Part III - ETHOLOGY (18 hrs)

Module V - Introduction (1 hr)

Scope and branches of Ethology

Module VI – Learning & Motivation (5 hrs)

Instinct; Taxes; Kineses

Types of learning with examples; latent learning; Lorenz experiments; Pavlov's experiments in classical conditioning; short and long term memory; Types of motivation

Module VII - Communication (**4 hrs)**

Origin and evolution of communication system

Types of communication with examples-electrical, chemical, olfactory, auditory, visual, echolocation, pheromonal communication in social insects and primates

Module VIII - Orientation and navigation (**5hrs)**

Definition; significance of migration; Migration in fishes, birds and wild animals

Types of migration; Navigational cues

Module IX - Biological rhythm **(3hrs)**

Types of biological rhythms with specific examples: circadian, circannual, lunar, tidal; Biological clock

References:

Endocrinology

1. Barrington, E.J.W. General and Comparative Endocrinology, Oxford, Clarendon Press.
2. Bentley, P.J. Comparative Vertebrate Endocrinology, Cambridge University Press.
3. David O. Norris Vertebrate Endocrinology 3th Edition,
4. Gorbman, A *et. al.* Comparative endocrinology, John Wiley &Sons.
5. Hadley, M.E. 2000. Endocrinology, 5th ed. Prentice Hall, Upper Saddle River, NJ. Martin, C.R. Endocrine Physiology, Oxford University Press
6. Norris, D.O. 1997. Vertebrate Endocrinology, 3rd ed. Academic Press, Sand Diego, CA.
7. Williams, R.H. Textbook of Endocrinology, W.B. Saunders

Reproductive Biology

1. Balnisky B.I 1981 An Introduction to Embryology, W.B. Saunders and Co.
2. Berril, N.J and Kars G. 1986. Developmental biology, Mc Graw Hill
3. Berry A. K - An introduction to embryology.
4. Chatterjee C.C.: Human Physiology, Vol I & II Medical Allied Agency
5. Dutta 2007 Obstrestics , Chuch Livingston 17 Ed
6. Gibbs (2006). Practical guide to developmental biology.
7. Gilbert S. F - Developmental biology
8. Guyton : Text Book of Medical Physiology Saunders

9. Majumdar N. N - Vetebrate embryology
10. Mackenna & Callander: Illustrated Physiology, Churchill Livingstone
11. Melissa A – Gibbs, A practical Guide to Developmental Biology, Oxford university press (Int. student edition) 2006
12. Pattern M.B. and Carlson B.C. 1974 Foundations of Embryology, TMH, New Delhi.
13. Sobte R.C., Sharma V.L. Essentials of Modern Biology Press Book India 2008
14. Vijayakumarn Nair K. and P. V George. A manual of developmental biology, Continental publications, Trivandrum.
15. Werne A Muller. Dev. Biology, Springer Verlay New York 2008
16. Arora M.P. Embryology. Himalaya Publishing House (Module I, Module II)

Ethology

1. Bonner, J.T. 1980. *The Evolution of Culture in Animals*. Princeton University Press. NJ, USA.
2. David McFarland. 1999. *Animal Behaviour*. Pearson Education Ltd. Essex, England.
3. Dawkins, M.S. 1995.*Unravelling Animal Behaviour*. Harlow: Longman.
4. Dunbar, R. 1988. *Primate Social Systems*. Croom Helm, London.
5. Manning Aubrey and Marian Stamp Dawkins 1998. *An Introduction to Animal Behaviour*. Cambridge University Press, UK.
6. Paul W. Sherman and John Alcock.,2001 Exploring Animal Behaviour- Readings from American Scientist 3rd Edn. Sinauer Associates Inc. MA, USA.
7. Wilson, E.O. 1975. Sociobiology. Harvard University Press, Cambridge, Mass. USA

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ABZO614: DEVELOPMENTAL BIOLOGY

Instructional Hours: 54

Credits: 3

Module I - Early History **(1 hr)**

Preformation, Epigenesis, Biogenetic law

Comparative embryology; Evolutionary embryology

Module II - Classification of Eggs **(5 hrs)**

Classification of eggs based on the amount, distribution and position of yolk; Mosaic and regulative, Cleidoic and non cleidoic egg

Influence of yolk on development

Egg polarity; Egg symmetry

Module III - Fertilization and Zygote formation **(5 hrs)**

Attraction of sperm and the egg; Binding of spermatozoa- fertilization tube formation; Cortical reactions; Activation of the egg; Amphimixis; Significance of fertilization

Parthenogenesis: Natural parthenogenesis; Arrhenotoky; Thelytoky; Obligatory and Facultative; Artificial Parthenogenesis; Significance of parthenogenesis

Module IV - Cleavage **(3 hrs)**

Planes of cleavage - Meridional, vertical, equatorial and latitudinal

Types - Holoblastic and Meroblastic

Patterns - radial, bilateral and spiral

Determinate and indeterminate

Cleavage laws

Factors affecting cleavage

Module V - Cell lineage **(1hr)**

Significance; Method of cell lineage with an example

Module VI - Morulation and Blastulation **(4 hrs)**

Formation of morula; Blastula formation, Types of blastula; Factors affecting blastulation

Module VII - Fate maps **(4 hrs)**

Concept of fate maps; Significance of fate map; Construction of fate maps; Natural and artificial fate maps

Vital staining, carbon particle, Radioactive labeling, Histochemical, Cytological and genetical

Fate maps of frog and chick

Module VIII - Gastrulation **(5 hrs)**

Events of gastrulation

Morphogenetic cell movements: Epiboly and Emboly (invagination, involution, delamination, infiltration convergence, divergence, ingression, constriction, extension and concrescence).

Module IX - Tubulation **(1 hr)**

Neurogenesis and neural crest cells; Notogenesis; Mesogenesis

Module X – Germ Layers **(2 hrs)**

Concept of germ layers and their derivatives

Module XI - Stem Cells **(2 hrs)**

Properties and type of stem cells

Totipotency, Pluripotency, Unipotency of embryonic cells

Module XII - Early embryology of Frog **(5 hrs)**

Gametes, fertilization, cleavage, blastulation, fate map, gastrulation, notogenesis, neurulation, development of nervous system and eye

Module XIII - Embryology of Chick **(6 hrs)**

Brief account of 18 hour chick embryo and 24 hour chick embryo.

Extra embryonic membranes in chick.

Module XIV - Mammalian Development **(7 hrs)**

Blastocyst; Implantation

Foetal membranes and placenta; Placenta in mammals; Functions of placenta

Classification of placenta based on nature of contact, mode of implantation and histological intimacy of foetal and maternal tissue

Contraception & birth control; MTP

Infertility- Causes of infertility-male and female; IVF, test tube babies, GIFT & ZIFT; Embryo transfer technology

Module XV - Experimental Embryology (**3 hrs)**

Spemann's constriction and transplantation experiments

Organizer and embryonic induction

References:

1. B.I 1981 An Introduction to Embryology, W.B. Saunders and Co.
2. Berril, N.J and Kars G. 1986. Developmental biology, Mc Graw Hill
3. Berry A. K - An introduction to embryology.
4. Dutta 2007 Obstrestics, Chuch Livingston 17 Ed
5. Gibbs (2006). Practical guide to developmental biology.
6. Gilbert S. F - Developmental biology
7. Harrison, Harriosns Book of Internal Medicine Chruch Livingston 17th Ed.
8. Jain P. C - Elements of developmental biology.
9. John Rigo Fundamental Genetics Cambridge University Press. 2009
10. Julio Collado Vides & Relf Hofestadt Gene Regulation and Metabolism Post genomic Computated Approaches, Ane Book 2004
11. Majumdar N. N - Vetebrate embryology
12. Melissa A – Gibbs, A practical Guide to Developmental Biology, Oxford university press (Int. student edition) 2006
13. Pattern M.B. and Carlson B.C. 1974 Foundations of Embryology, TMH, New Delhi.
14. Sobte R.C., Sharma V.L. Essentials of Modern Biology Press Book India 2008
15. Vijayakumarn Nair K.and P. V George. A manual of developmental biology, Continental publications, Trivandrum.
16. Werne A Muller. Dev. Biology, Springer Verlay New York 2008
17. Arora M.P. Embryology. Himalaya Publishing House (Module I, Module II, Module III)
18. Suresh.C. Goel. *Principles of Animal Developmental Biology*. Himalaya Publishing House.

19. Arumugam. N. *Text Book of Embryology*. Saras Publication. (Module I, Module II, Module III)
20. Sastry & Shukal. *Developmental Biology*. Rastogi publications (Module I, Module II, Module III)

PRACTICAL

ABMB6P10: AGRICULTURAL MICROBIOLOGY

Total Hours: 36 **Credits: 1**

1. Isolation and enumeration of microorganism from soil.

2. Isolation & Cultivation of rhizobium

3. Morphological observation of rhizobium from root nodules

4. Isolation of *Azospirillum*sps. From soil

5. Isolation of microorganism from rhizosphere, and calculation of R: S Ratio

6. Study of antagonism between soil microorganisms.

7. Study of soil bacteria for denitrification.

8. 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. 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. Kannan, N. 2002. *Laboratory manual in general microbiology*. 2nd Edition, Panima Publishing Co., New Delhi.
5. Gunasekaran, P. 2002. *Laboratory manual in microbiology*. 2ndEdition, New Age International (P) Limited, New Delhi.
6. Kalaichelvan, P. T. 2005. *Microbiology and Biotechnology Laboratory manual*.MJP Publishers, Chennai.
7. Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.

8. Schmidt, E. L.1967. *A Practical Manual of Soil Microbiology Laboratory Methods*. Food and Agriculture Organization of the United Nations.
9. Rozar, A. 2002. *Practical Methods for Environmental Microbiology and Biotechnology*. Krishna Prakashan Media Ltd., Meerut.

ABMB6P11: MICROBIAL WASTE MANAGEMENT

Total Hours: 36 **Credits: 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 from water, raw / sewage
7. Determination of total alkalinity of water
8. Determination of chlorine in water.
9. Central pollution control board standards for discharge of treated waste water
10. Indian standard Institute specification for Drinking water.

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. Kannan, N. 2002. *Laboratory manual in general microbiology*. 2nd Edition, Panima Publishing Co., New Delhi.
5. Gunasekaran, P. 2002. *Laboratory manual in microbiology*. 2ndEdition, New Age International (P) Limited, New Delhi.
6. Kalaichelvan, P. T. 2005. *Microbiology and Biotechnology Laboratory manual*.MJP Publishers, Chennai.
7. Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.

ABZO6P10: GENETICS, BIOTECHNOLOGY AND BIOINFORMATICS

Instructional Hours: 36

Credits: 1

1. Genetic problems – (Problems from each type)
   a. Mono and Dihybrid cross (b) Back cross (c) Multiple alleles.
2. Study of barr body in human buccal epithelium.
3. Study through photographs of the Karyotype- Turner's syndrome, Klinefelter's and Down's syndrome.
4. 4. Sex linked inheritance (color blindness, hyper trichosis, ichthyosis, hemophelia)
5. Autosomal disorders (sickle cell anemia, brachydactyly)
6. Sexing of Drosophila melanogaster
7. Isolation of genomic DNA
8. Downloading Nucleotide and Protein sequence files from databases
9. Downloading structure files and visualizing using Rasmol
10. Sequence Analysis using BLAST, CLUSTAL Omega

ABZO6P12: ENDOCRINOLOGY, REPRODUCTIVE BIOLOGY AND ETHOLOGY

Instructional Hours: 36

Credits: 1

1. Study of permanent histological slides of endocrine glands.
    - T.S. of Pituitary gland
    - T.S. of Thyroid gland
    - T.S. of Adrenal Gland
    - T.S. of Islets of langarhance
    - T.S. of Testis
    - T.S. of Ovaries
2. Study of pituitary gland of fishes
3. Study of male and female reproductive system of a teleost fish
4. Pheromone traps
5. Skinner box/T Maze
6. Identification of behaviour showing pictures
7. Experiment to demonstrate phototaxis using Drosophila/House fly

ABZO6P13: DEVELOPMENTAL BIOLOGY

Instructional Hours: 36

Credits: 1

1. Study of egg types
2. Embryological studies- Blastula (frog, chick)
3. Amniocentesis
4. Study of mammalian sperm and ovum
5. Study of placenta- rabbit and man
6. Study of 18 hour & 24 hour chick embryo slides
7. Egg candling
8. Mounting of chick embryo (36 - 48 hr)

OPEN COURSE

Course Code	Title of the Course	Instructional hours/week	Instructional hours for the course	Credits	ISA	ESA	Total
AOMB501	Dairy Microbiology	4	72	3	20	80	100

AOMB501: DAIRY MICROBIOLOGY

Total Hours: 72 **Credits: 3**

Module I **18 Hrs.**

Milk –introduction, composition, microorganisms in milk- bacteria, yeast, mold. Nutritive value of milk.Starter cultures and their biochemical activities- *Streptococcus thermophiles* and *Lactobacillus bulgaricus.* Starter culture preparation. Dairy processing unit operations- clarification, separation, standardization, toning of milk, homogenization.

Module II **14 Hrs.**

Bacteriological examination of milk. Preservation of milk, pasteurization - different methods and advantages, sterilization, dehydration, bacteriological standards and grading of milk.

Module III **16 Hrs.**

General principles underlying spoilage of milk and milk products, sources for contamination of milk, milk borne diseases, antimicrobial systems in milk.

Module IV **12 Hrs.**

Fermented dairy products- cheese, cultured buttermilk, Bulgarian butter milk, ice cream, lassie, condensed and dry milk products, yoghurt; low lactose milk, kefir and kumiss.

Module V **12 Hrs.**

Hygiene in manufacturing milk products, cleaning of dairy equipment's, dairy processing plant sanitation, probiotic role of lactic acid bacteria and fermented milk products, utilization and disposal of dairy byproduct- whey

References

1. Prajapati, J. B.1995. *Fundamentals of Dairy Microbiology*. Akta Prakashal Nadiad, Gujarat.
2. Robinson, R. K. 1990. *Dairy Microbiology*. Volume II and I. Elsevier Applied Science, London.
3. Marth, E. H. and Steele, J. *Applied dairy microbiology*. 2nd Edition. CRC Press.
4. *Milk and Milk Products* - Fourth edition - Clarence Henry Eckles, Tata McGraw Hill publishing company Limited, New Delhi, 1957
5. Dey, S. 1994. *Outlines of Dairy Technology*. Oxford Univ. Press, New Delhi.
6. Robinson, R. K. 1986. *Modern Dairy Technology*. (2 vol. set). Elsevier Applied Science, UK.

7. Rosenthal, I. 1991. *Milk and Milk Products*. VCH, New York.
8. Warner, J. M. 1976. *Principles of Dairy Processing*. Wiley Eastern Ltd. New Delhi.
9. Yarpar, W. J. and Hall, C. W. 1975. *Dairy Technology and Engineering*. AVI, Westport.
10. Rheinhermer, G. 1986. *Aquatic Microbiology*. John Wiley and Sons, NY.
11. Robinson, R. K. 1981. *Dairy Microbiology: The microbiology of milk products*. Applied Science Publishers.
12. Law, B. A. 1997. Microbiology and Biochemistry of Cheese and Fermented Milk. 2nd edition. Blackie Academic & Professional, London.

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