

PONDICHERRY UNIVERSITY
PUDUCHERRY

B.Sc. BIOTECHNOLOGY
(Choice Based Credit System)



Syllabus & Regulations

2017-2018 ONWARDS

REGULATIONS

Choice Based Credit System

1. AIM OF THE COURSE

The degree of Bachelor of Science in Biotechnology (Choice Based Credit System) aims to introduce various aspects of Biotechnology and interdisciplinary subjects to the students. At the end of the course, the students are expected to have good working knowledge in the field of Biotechnology and in addition knowledge gained from courses of interdisciplinary in nature.

2. ELIGIBILITY FOR ADMISSION

Candidate for admission to B.Sc. Biotechnology shall be required to have passed H.Sc. or 10+2 or equivalent course conducted by the Government of Tamilnadu / Andhrapradesh/ Kerala / CBSE with Botany / Zoology / Biology as one of the subjects of study or an examination accepted as equivalent thereto and 35 percentage of marks in part III (aggregate / part III), subject to such conditions as may be prescribed therefore. Maximum age for the duration into B.Sc. Biotechnology programme is 22.

3. DURATION OF THE COURSE

The course shall be of Three years duration spread over six semesters. The maximum duration to complete the course shall be six years (including the completion of arrears, if any).

4. ELIGIBILITY FOR ADMISSION TO EXAMINATION

Seventy-five (75) percentage of attendance for theory.
Seventy-five (75) percentage of attendance for practical

5. MEDIUM

The medium of instruction shall be English.

6. CHOICE BASED CREDIT SYSTEM (CBCS)

The Choice Based Credit System (CBCS) is being introduced in affiliated colleges of Pondicherry University for select UG courses, including B.Sc. Biotechnology, from the academic year 2017-2018 onwards in accordance with the directives of University Grants Commission (UGC). The system provides an opportunity to students to design curriculum to suit individual needs, mobility across related disciplines and institutions in both horizontal and vertical manner.

This System enables a student to obtain a degree in a subject by earning required number of credits prescribed for that degree. Number of credits earned by the student reflects knowledge or

skill acquired and performance in each course is reflected in grades. The grade points earned for each course reflect the student's performance in that course.

The students should study prescribed courses like Discipline Specific Core Courses, Ability Enhancement Compulsory Courses, Skill Enhancement Courses, Public Administration, Environment Awareness etc. They are allowed to exercise choices in selection of courses that are Discipline Specific Elective Courses, General Electives, and Modern Indian Language etc., out of those offered by departments within college or any other college/institution affiliated to Pondicherry University (PU) or any other PU recognized institutions. While allowing students to exercise choices, Pondicherry University notifies regulations by taking into account the practicality. Overall, CBCS is meant to promote student centric education instead of system centric education that is in vogue at present.

7. DEFINITIONS OF KEYWORDS

7.1 Programme: An educational program leading to award of a degree/ diploma/ certificate.

7.2 Programme Committee: Each Program of Study shall have a Programme Committee to oversee implementation of the program.

7.3.1 Course: Usually a course referred to as 'subject' is a component of the Programme of Study. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/term papers/assignments/ presentations/ self-study etc., or a combination of some of these.

7.3.2 Core Course: There shall be Core Courses in the first four semesters. These courses shall be compulsorily studied by a student.

7.3.3 Elective Course: Elective Course is a course which can be chosen from a pool of papers. It may be:

- Supportive to the discipline of study
- Providing an expanded scope
- Enabling an exposure to some other discipline/domain
- Nurturing student's proficiency/skill.

An elective may be "Generic Elective" focusing on those courses which add generic proficiency to the students. An elective may be "Discipline Centric" or may be chosen from an unrelated discipline. It may be called an "Open Elective."

7.3.4 Foundation Course: The Foundation Courses may be of two kinds: Compulsory Foundation and Elective foundation. "Compulsory Foundation" courses are the courses based upon the content that leads to Knowledge enhancement. They are mandatory for all disciplines. Elective Foundation courses are value-based and are aimed at providing ethical and humanistic education.

7.3.5 Repeat Course: If a student gets (i) less than 40% in the internal assessment and fails in the course or (ii) fails to get the required attendance, the student shall repeat the course when offered.

7.4 Choice Based Credit System (CBCS): The CBCS provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses etc.). Under the CBCS, the requirement for awarding a degree / diploma / certificate is prescribed in terms of number of credits to be completed by the students.

7.5 Credit: It is a unit by which the course work is measured. It determines the number of hours of instructions required per week:

Course Name	Credit	Hours of instruction	Weightage (credit/ hours)
MIL	1	1.5	0.66
ENGLISH	1	1.5	0.66
DSC (Theory)	1	1	1.0
DSC (Practical)	1	2	0.5
SEC	1	1	1
DSE (Theory)	1	1	1
DSE (Practical)	1	2	0.5
GE	1	1.3	0.75

7.6 Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, P and F.

7.7 Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale.

7.8 Credit Point: It is the product of grade point and number of credits for a course.

7.9 Semester Grade Point Average (SGPA): It is a measure of performance of work done in a semester. SGPA is the ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

7.10 Cumulative Grade Point Average (CGPA): It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

7.11 Transcript or Grade Card or Certificate: Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester.

7.12 **Academic Year:** Two consecutive (one odd + one even) semesters constitute one Academic year.

7.13 **Semester:** Each semester consist of 15-18 weeks of academic work equivalent to 90 actual teaching days. The odd semester may be scheduled from July to December and even semester from January to June.

8. SCOPE AND COVERAGE

8.1 The CBCS is applicable to all full-time UG Biotechnology approved by the Academic Council.

8.2 Teaching, learning and evaluation shall follow Semester pattern.

8.3 Students who have passed their Higher Secondary Examination under 10+2 system conducted by the Government of Tamil Nadu or any other equivalent system recognized by the Government of Puducherry based on the admission criteria laid down by Pondicherry University are eligible to apply to B.Sc. Biotechnology. The exact eligibility criteria will be as prescribed in the regulations approved by the Academic Council of Pondicherry University on the recommendation of the BOS of the respective Departments from time to time.

8.4 Prescribed B.Sc. Biotechnology consists of six consecutive semesters (three years). The maximum duration allowed for each student to acquire prescribed number of credits in order to complete the Programme of Study shall be twelve consecutive semesters (six years).

8.5 The academic year consists of two consecutive (one odd and one even) semesters.

8.6 The medium of instruction for all the courses, excepting Arabic, Bengali, French, Hindi, Malayalam, Sanskrit, Tamil, and Telugu, shall be English.

9. COURSE STRUCTURE

At least 60% (72 Credits) of the total minimum credit requirement must be earned by the student in DSC and DSE courses put together in order to obtain a degree in a specific discipline.

10. CREDITS

10 .1 One teaching period shall be for 60 minutes duration.

10.2 The minimum number of credits to be earned by a student for the award of B.Sc. Biotechnology is 120. Out of these, minimum 72 credits are mandatory from Discipline Specific Core Courses (DSC) and Discipline Specific Elective Courses (DSE) put together for obtaining a degree in a particular discipline. The minimum number of credits in each semester is 20. All together in six semesters a total of 132 credits is offered for the students who can select the courses under CBCS for the final 120 credits for the award of B.Sc. Biotechnology Degree.

11. REGISTRATION

11.1 Every student will be assigned a Faculty Advisor after his/her completion of admission procedure.

11.2 Based on the advice and consent of the Faculty Advisor the student shall register for a set of courses that he/she plans to take up in each semester from among those denoted by the Principal/ HOD.

11.3 The student must take the consent of the course teacher offering course(s) for registration.

11.4 The student is permitted to register for courses not exceeding 30 credits per semester. However, registration for Repeat Courses is allowed in excess of this limit.

11.5 A student, in order to retain his/her status, should register for at least a minimum of 12 credits in a semester.

11.6 Students shall have to register for the courses within the first week of a semester.

11.7 The maximum number of students to be registered in each course shall depend upon the physical/ laboratory facilities available.

11.8 The information concerning the courses to be offered in every department in a semester with credits and pre-requisites, if any, along with the time-slot shall be made available by the Biotechnology Department of the Institution.

11.9 A student shall not be denied registration for whom the courses are Discipline Specific Core Course (DSC) or Discipline Specific Elective (DSE).

11.10 The registration for all other courses shall be done in the spirit of accommodating as many students as possible in the interest of the students.

11.11 Dropping of courses may be allowed to enable students to opt for the courses of their choice within three weeks from the date of registration.

12. INTRODUCTION OF COURSES

12.1 The course code consists of four alphabets representing the discipline of study followed by three numerals. The first numeral '1' stands for level/ year of the course (year of collegiate education), 2 for second year course and 3 for third year course. The second numeral stands for semester (odd or even) and the third numeral is for the serial number of the course.

12.2 The Course Structure and Syllabus for each UG programme shall be finalized and recommended by the Board of Studies (BOS) to be placed in the School Board, and then, in the Academic Council, for consideration and approval.

7.3 The syllabi of B.Sc. Biotechnology course shall be revised at least once in three years, to keep in tune with recent developments in knowledge and innovations. Minor revisions in the already approved syllabus of a particular course may be approved by the Chairman of the Academic Council provided there is proper justification and recommendations by the Chairpersons of the BOS and School Board.

13. WORKLOAD OF TEACHERS

13.1 Every faculty member shall be assigned workload as per UGC norms.

13.2 In addition to regular handling of classes, teachers are required to participate in preparation of detailed syllabus, designing of the teaching plan, invigilation, paper setting, evaluation of answer scripts during continuous assessment and any other duties as and when assigned by the Principal or University authorities.

13.3 Teachers shall associate with organizing practical lab sessions, field visits, industrial tours, and guided project work etc., as per directions of the Principal/ Head of the institution.

14. PATTERN OF EXAMINATION

14.1 The End-Semester examination (**ESE**) for each course in B.Sc. Biotechnology shall be conducted by the Pondicherry University for a maximum of **75 marks** and Internal Continuous Assessment (**ICA**) for **25 marks**.

14.2 Internal assessment for all theory courses shall be done on the basis of at least two Internal Assessment tests (15 marks), term papers/assignments/seminars/case demonstrations/presentations/ write-ups/viva etc. (5 marks) and attendance (5 marks). The following weightage shall be given to attendance:

95% - 100%	(5 marks)
90% - 94%	(4 marks)
85% - 89%	(3 marks)
80% - 84%	(2 marks)
75% - 79%	(1 mark)

14.3 Internal Assessment for practical courses involving Laboratory/Field work/Project work is 13, marks for Practical Record is 10, 27 marks for Practical end-semester exam.

14.4 A schedule of Internal Assessment tests shall be prepared by each College commonly to all departments in the beginning of each semester. Internal Assessment marks shall be displayed a week before the commencement of end-semester examinations.

14.5 End-semester examination shall be conducted for all courses offered. The duration of the end-semester examination shall be 3 hours.

14.6 Every student has to pay examination fee per Credit basis as fixed by the University.

14.7 A schedule of end-semester examinations will be prepared and displayed by the University much in advance.

14.8 No student with less than 75% in any particular course shall be permitted to attend the end-semester examination and shall be given grade FA-failure due to lack of attendance. However, an overall condonation of 10% is permitted for valid reasons (NCC, NSS, Swachh Bharat) or medical reasons. A student who has been awarded FA shall repeat the course when offered. The Principal/ Head of the Department shall ensure that the candidate is informed about the lack of attendance before the commencement of end-semester examination and confirm that such candidates are not permitted to write the examination.

14.9 To pass a course the student must secure minimum of 40 out of 100 marks (40%) in the internal and the end-semester examination put together.

14.10 A student who has earned the required number of 120 credits by clearing all the required courses shall be declared as pass even if he/she could not clear optional courses which were taken in excess of the required number of courses.

14.11 Result Passing Board for each Programme of Study shall be constituted by the Pondicherry University from time to time.

14.12 Revaluation and re totaling of the answer scripts shall be allowed within the stipulated period of time as decided by the Controller of Examinations (COE) after paying the required amount of fee.

15. SUPPLEMENTARY EXAMINATION

15.1 A failed student who meets the attendance requirement may be permitted to register for the next end-semester examination in the following semester itself for theory paper. (eg. for practical papers, those who failed in odd semester practical paper may be permitted to register for next odd end-semester examination).

15.2 Students who have failed due to insufficient attendance and /or less than 40% Internal Assessment marks should repeat the course as and when offered.

16. PROGRAMME COMMITTEE

16.1 The Programme Committee (PC) of each department shall be chaired by the Principal / Head of the institution. The HOD, all the faculty members offering DSC and DSE course and two students (one male and one female, where possible) from each class shall be Members of PC.

16.2 The PC shall meet at least once in a semester to discuss implementation of the program. The discussions and resolutions should be on adherence to time-table, proper syllabus coverage, introduction of new courses and all other issues concerning academic matters.

16.3 The minutes of the PCM must be communicated to the Chairman of BOS, Controller of Examinations and Dean, College Development Council of Pondicherry University.

17. GRADING AND GRADE CARD

17.1 Letter grades shall be used to assess the performance of students in each course by converting final marks (out of 100) into grades. In case of fractions the marks shall be rounded off to next integer. The following shall be used to convert marks into awarding grades:

Range of Marks	Letter Grade	Grade Point
96-100	O	10
86-95	A+	09
76-85	A	08
66-75	B+	07
56-65	B	06
46-55	C	05
40-45	P	04
Below 40	F	00
Lack of attendance	FA	00

17.2 The SGPA shall also be calculated by taking all courses taken by the student in the semester and CGPA shall also be calculated by taking all the courses taken by the student in all the semesters (refer 16 and 17).

17.3 The University shall award “class” to students who acquired 120 (see 5.6) according to the following:

CGPA	Class
9.00 – 10.00	First Class with Distinction (should not have failed in any course)
7.00 – 8.99	First Class
5.50 – 6.99	Second Class
4.00 – 5.49	Pass

17.4 The Grade card shall be issued to the students containing grades obtained by the student in the previous semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA).

The Grade card shall list the following:

- a. Title of the course taken by the student
- b. Number of credits allotted to the course

- c. The grades secured by the student in each course
- d. Total number of credits earned by the student in that semester
- e. SGPA of the student
- f. Total number of credits earned by the student till that semester
- g. CGPA of the student

18. FAIRNESS IN ASSESSMENT

To ensure fairness of examination and evaluation following shall be followed.

18.1 In case of at least 50% of core courses offered in different programmes across the disciplines, the assessment of the theoretical component towards the end of the semester should be undertaken by external examiners from outside the university conducting examination, who may be appointed by the Controller of Examinations. In such courses, the question papers will be set as well as assessed by external examiners.

18.2 In case of the assessment of core practical courses, the team of examiners should be constituted on 50 – 50 % basis. i.e., half of the examiners in the team should be invited from outside the University for conducting examination.

18.3 In case of the assessment of project reports / thesis / dissertation etc. the work should be undertaken by internal as well as external examiners.

19. COMPUTATION OF SGPA AND CGPA

Following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) shall be followed:

19.1 The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$$\text{SGPA (S}_i\text{)} = \Sigma (\text{C}_i \times \text{G}_i) / \Sigma \text{C}_i$$

where C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

19.2 The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$\text{CGPA} = \Sigma (\text{C}_i \times \text{S}_i) / \Sigma \text{C}_i$$

where S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester.

19.3 The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

20. ILLUSTRATION OF COMPUTATION OF SGPA AND CGPA AND FORMAT FOR TRANSCRIPTS

20.1 Computation of SGPA and CGPA

20.1.1 Illustration 1 for calculation of SGPA

The illustration is for a student who has taken six courses of given credits in a semester and performance is given in grade letter which carry certain grade point.

Course	Credit	Grade letter	Grade point	Credit Point Credit x Grade
Course 1	3	A	08	3x08 = 24
Course 2	4	B+	07	4x07 = 28
Course 3	3	B	06	3x06 = 18
Course 4	3	O	10	3x10 = 30
Course 5	3	C	05	3x05 = 15
Course 6	4	B	06	4x06 = 24
	20			139

$$\text{SGPA} = 139/20 = 6.95$$

20.1.2 Illustration 2 for calculation of SGPA

A student registered for 6 (six) courses in a semester. At the end of the semester the student got A grade in a 4 credit course , A grade in 2 credit course B+ in a 3 credit course another B+ in a 3 credit course, B in a 3 credit course and F grade in a 3 credit course. Calculation of SGPA of this student is:

$$\text{SGPA} = (8 \times 4 + 8 \times 2 + 7 \times 3 + 7 \times 3 + 6 \times 3 + 0 \times 3) / (4 + 2 + 3 + 3 + 3 + 3) = (32 + 16 + 21 + 21 + 18 + 0) / 18 = 108 / 18 = 6.00 \text{ Out of } 10.00.$$

SGPA of the student is 6.00.

20.2 Illustration for calculation of CGPA (Example)

The illustration is for calculation of CGPA of a student who studied six semesters in a UG program.

Semester	Credits	SGPA
Semester 1	20	6.95
Semester 2	22	7.80
Semester 3	18	5.65
Semester 4	21	6.04
Semester 5	19	7.21
Semester 6	20	7.85
	Total = 120	

CGPA =

$(20 \times 6.95 + 22 \times 7.80 + 18 \times 5.65 + 21 \times 6.04 + 19 \times 7.21 + 20 \times 7.85)$ divided by 120	$= 139.00 + 171.60 + 101.70 + 126.84 + 136.99 + 157.00 = 833.13/120 = 6.94275$ Rounded off to 6.94
--	--

CGPA = 6.94. The student has passed in the program and is placed in 2nd Class.

20.3 **Transcript:** the University shall issue a transcript for each semester as given in 14.7 and a consolidated transcript indicating the performance in all semesters.

2017-2018 ONWARDS SYLLABUS PROPOSED FOR

B.Sc. BIOTECHNOLOGY

UNDER CBCS AND CFSD FRAMEWORK

PONDICHERRY UNIVERSITY

2017

SCHEME FOR CHOICE BASED CREDIT SYSTEM IN B.A./B.Sc./B.Com/BBA PROGRAMME

To be implemented from 2017-18 onwards

COURSE	SUBJECT CODE	TITLE OF THE PAPER	CREDITS ALLOTTED		Hours Per Week	
			Lecture	Tutorial/Lab	Lecture	Tutorial/Lab
SEMESTER – I		23 Credits				
MIL- 1	LARA/ LBEN/ LHIN/ LMAL/ LSAN/ LTAM/ LTEL 111	Bengali/ Hindi/ Malayalam/ Sanskrit/ Tamil/ Telugu	03		05	
ENGLISH-1	ENGL 112	English – I	03		05	
DSC - 1A	UBIOT 111	Cell biology	04		04	
DSC- 2A	UBIOT 112	Biomolecules	04		04	
DSC- 3A	UBIOT 113	Chemistry I	04		04	
AECC-1	PADM 113	Public administration	02		02	
Practical	UBOT 111(P)*	Cell biology		01		02
	UBIOT 112 (P)	Biomolecules		01		02
	UBIOT 113 (P)	Chemistry I		01		02
SEMESTER – II		23 Credits				
MIL-2	LARA/ LBEN/ LHIN/ LMAL/ LSAN/ LTAM/ LTEL 121	Bengali/ Hindi/ Malayalam/ Sanskrit/ Tamil/ Telugu	03		05	
ENGLISH-2	ENGL 122	English – II	03		05	
DSC-1B	UBIOT 121	Fundamentals of Microbiology	04		04	
DSC-2B	UBIOT 122	Intermediary Metabolism	04		04	
DSC-3B	UBIOT 123	Chemistry II	04		04	
AECC-2	ENVS 123	Environmental science	02		02	
Practical	UBOT 121 (P)	Fundamentals of Microbiology		01		02
	UBIOT 122 (P)	Intermediary Metabolism		01		02
	UBIOT 123 (P)	Chemistry II		01		02

SEMESTER – III		23 Credits		
MIL 3	LARA/ LBEN/ LHIN/ LMAL/ LSAN/ LTAM/ LTEL 231	Bengali/ Hindi/ Malayalam/ Sanskrit/ Tamil/ Telugu	03	05
ENGLISH 3	ENGL 232	English – III	03	05
DSC- 1C	UBIOT 231	Molecular Biology	04	04
DSC - 2C	UBIOT 232	Analytical techniques in biology	04	04
DSC- 3C	UBIOT 233	Allied General Biology	04	04
SEC-1	UBIOT 234	Parasitology and Entomology	02	02
Practical	UBOT 231(P)	Molecular Biology	01	02
	UBIOT 232 (P)	Analytical techniques in biology	01	02
	UBIOT 233 (P)	General Biology	01	02
SEMESTER – IV		23 Credits		
MIL-4	LARA/ LBEN/ LHIN/ LMAL/ LSAN/ LTAM/ LTEL 241	Bengali/ Hindi/ Malayalam/ Sanskrit/ Tamil/ Telugu	03	05
ENGLISH -4	ENGL 242	English – IV	03	05
DSC-1D	UBIOT 241	Genetic Engineering	04	04
DSC-2D	UBIOT 242	Immunology	04	04
DSC-3D	UBIOT 243	Allied Evolution and Genetics	04	04
SEC-2	UBIOT 244	Genomics and Proteomics	02	02
Practical	UBOT 241(P)	Genetic Engineering	01	02
	UBIOT 242 (P)	Immunology	01	02
	UBIOT 244 (P)	Evolution and Genetics	01	02

SEMESTER – V		20 Credits		
SEC-3*	UBIOT 351	Seminar and Field Visit	02	02
	UBIOT 352	Fish processing technology	02	02
DSE-1A* DSE-2A* DSE-3A*	UBIOT 353	Bioprocess Technology & Downstream processing	04	06
	UBIOT 354	Animal Biotechnology	04	06
	UBIOT 355	Marine Biotechnology	04	06
	UBIOT 356	Environmental Biotechnology	04	06
	UBIOT 357	Enzyme Technology	04	06
GE-1	UBIOT 358	Developmental Biology	03	04
Practical	UBOT 353 (P)	Bioprocess Technology & Downstream processing	01	02
	UBIOT 354 (P)	Animal Biotechnology	01	02
	UBIOT 355 (P)	Marine Biotechnology	01	02
	UBIOT 356 (P)	Environmental Biotechnology	01	02
	UBIOT 357 (P)	Enzyme Technology	01	02
SEMESTER – VI		20 Credits		
SEC-4*	UBIOT 361	Molecular diagnostics	02	02
	UBIOT 362	Entrepreneurial Development, Biosafety, Bio-ethics and IPRs	02	02
DSE-1B* DSE-2B* DSE-3B*	UBIOT 363	Pharmaceutical Biotechnology	04	06
	UBIOT 364	Bioinformatics	04	06
	UBIOT 365	Plant Biotechnology	04	06
	UBIOT 366	Microbial Biotechnology	04	06
	UBIOT 367	Medical Biotechnology	04	06
GE-2	UBIOT 368	Project	03	04
Practical	UBOT 363 (P)	Pharmaceutical Biotechnology	01	02
	UBIOT 364 (P)	Bioinformatics	01	02
	UBIOT 365 (P)	Plant Biotechnology	01	02
	UBIOT 366 (P)	Microbial Biotechnology	01	02
	UBIOT 367 (P)	Medical Biotechnology	01	02

DSE* - Any 3 in semester V & VI

SEC* - Any 1 in semester V & VI

Total Number of Credits 132

Course code ending with (P) denotes practical paper.

Number of Courses:

B.Sc. Biotechnology	Course with Credit							
	Semester	MIL	ENG	DSC	DSE	SEC	AECC	GE
I	01	01	03			-	01	-
II	01	01	03			-	01	-
III	01	01	03			01	-	-
IV	01	01	03			01	-	-
V	-	-	-	03	01	-	-	01
VI	-	-	-	03	01	-	-	01
Total	04	04	12	06	04	04	02	02
Total No. of Papers = 34								

DETAILS OF COURSES FOR B.Sc. BIOTECHNOLOGY

I. DSC 1 - DISCIPLINE SPECIFIC CORE – (for Biotechnology main) (COMPULSORY)

(Four papers)

1. Cell biology
2. Fundamentals of Microbiology
3. Molecular Biology
4. Genetic Engineering

DSC 2- DISCIPLINE SPECIFIC CORE- (for Biotechnology main) (COMPULSORY)

(Four papers)

1. Biomolecules
2. Intermediary Metabolism
3. Analytical techniques in biology
4. Immunology

DSC 3- DISCIPLINE SPECIFIC CORE- (for Biotechnology main) (COMPULSORY)

(Four papers)

1. Chemistry I
2. Chemistry II
3. General Biology
4. Evolution and Genetics

II. SEC- SKILL ENHANCEMENT COURSES (also for Non-Biotechnology main)

(Four papers)

1. Parasitology and Entomology
2. Genomics and Proteomics
3. Seminar and Field Visit / Fish processing technology
4. Molecular diagnostics / Entrepreneurial Development, Biosafety, Bio-ethics and IPRs

III. DSE - DISCIPLINE SPECIFIC ELECTIVES

DSE-1A, 2A & 3A

(Three papers)

1. Bioprocess Technology & Downstream processing
2. Animal Biotechnology
3. Marine Biotechnology
4. Environmental Biotechnology
5. Enzyme Technology

DSE-1B, 2B & 3B

(Three papers)

1. Pharmaceutical Biotechnology
2. Bioinformatics
3. Plant Biotechnology
4. Microbial Biotechnology
5. Medical Biotechnology

IV. GE - GENERIC ELECTIVE (also for Non-Biotechnology main)

GE - 1

1. Developmental Biology

GE - 2

1. Project

V. MIL - MODERN INDIAN LANGUAGES

Bengali/ Hindi/ Malayalam/ Sanskrit/ Tamil/ Telugu

VI. ENGLISH

VII. AECC- ABILITY ENHANCEMENT COURSES- (COMPULSORY)

1. Public Administration
2. Environmental Studies

**DISCIPLINE SPECIFIC CORE COURSES
(COMPULSORY)**

Discipline Specific Core (DSC) – 1A
CELL BIOLOGY
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 111

Lectures: 60
Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT – I (10 hours)

History of cell Biology, cell as basic unit of life, Cell theory, Protoplasm theory, Organismal theory, Classification & characterization of cell types – Prokaryotes & Eukaryotes, Organization, Ultrastructure of plant cell, animal cell, bacterial cell and viruses.

UNIT – II (10 hours)

Structure and function of cell wall - Bacterial and Plant. Ultra structure of plasma membrane – fluid mosaic model, membrane fluidity, Transport across membranes - Symport, antiport, uniport, active and passive transport, Intra cellular communication, Differentiation of cell surface: Basement membrane, tight junction, gap junctions, Desmosomes, hemidesmosomes. Cytoskeletal structures – microtubules, microfilaments (actin, myosin), Intermediate filament.

UNIT –III (10 hours)

Structure & Functions of cell organelles: Endoplasmic Reticulum (SER & RER), golgi apparatus, lysosomes, microbodies (peroxysomes and glyoxysomes), ribosomes and its types, centrioles, basal bodies. Structure and functions of mitochondria, chloroplast, organization of respiratory chain in mitochondria, photophosphorylation in chloroplast.

UNIT – IV (15 hours)

Structure and organization of nucleus , nuclear membrane, organization of chromosomes - structural organization of chromatids, centromere, chromatin, telomere, nucleosomes, euchromatin and heterochromatin, specialized structures- polytene and lambrush chromosomes

UNIT – V (15 hours)

Cell division - Cell cycle, mitosis and meiosis, regulations of cell cycle and check points and enzymes involved in cell cycle check points. Basics in cell signaling- signaling molecules and receptors, G protein coupled receptors, receptor protein tyrosin kinases, apoptosis and necrosis.

CELL BIOLOGY PRACTICALS (1 Credit)

Practicals:

1. Microscopic techniques- light microscopy.
2. Observation of permanent slides
3. Measurement of cell using ocular micrometer and stage micrometer
4. Cell types- Microbial, animal and plant cells
5. Cell counting method- animal cell: Haemocytometer
6. Cell counting method- plant cells-stomatal density
7. Mitosis in onion root tip.
8. Meiosis in Pollen mother cells of plants

Text Books:

- E.D. P. De Robertis and E.M.F. De Robertis, Jr. 2012 Cell and Molecular Biology (Eighth edition). B.I. Waverly Pvt.Ltd. New Delhi.
- Harvey Lodish, Arnold Berk, S. Lawrence Zipursky, Paul Matsudaira, David Baltimore and James Dernell, 2009. Molecular Cell Biology (Fourth Edition). Media Connected – W.H.Freeman and Company.
- P.S. Verma and V.K. Agarwal, 2012, Concepts of Cell Biology. S.Chand & Company Ltd., New Delhi;

Further Reading:

- D.E Sadava, 1993. Cell Biology - Organelle Structure and Function. Jones and Bartlett Publishers
- B Alberts, 2009 Essential Cell Biology (Third Edition), Garland Science; publishers
- Alberts Bruce, 2008 Molecular Biology of the Cell (Fifth Edition), Garland Science; publishers

Discipline Specific Core (DSC) – 2A
BIOMOLECULES
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 112

Lectures: 60
Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT-I (10 hours)

Carbohydrates: Classification of carbohydrates, Occurrence and structure of mono, di and polysaccharides (homo and heteropolysaccharides), asymmetry, stereo-isomerism and optical isomerism of sugars, anomeric form and mutarotation. Biological importance of carbohydrates (starch, cellulose, chitin)

UNIT-II (15 hours)

Amino acids & Proteins: Classification, structure and Properties of amino acids, Essential and non-essential amino acids, peptide bond and chemical bonds involved in protein structure - Protein classification based on solubility, shape, composition and function, Structure of proteins (Primary, secondary tertiary and quaternary), Biologically important peptides (insulin, glutathione, vasopressin).

UNIT-III (15 hours)

Enzymes: Definition, Classification & nomenclature of enzymes - Specificity of enzyme action - Fischer's Lock and Key Hypothesis & Koshland's Induced Fit Hypothesis - Active site – coenzyme - Enzyme kinetics, Michaelis-Menten equation and Lineweaver-burk plot) - significance of K_m and V_{max} – enzyme inhibitors (reversible, irreversible and feedback inhibitions), Modes of enzyme inhibition, Regulatory enzymes (Allosteric & covalently modulated enzymes). Biological importance of enzymes (ribonuclease and chymotrypsin)

UNIT-IV (10 hours)

Lipids: Classification, nomenclatures, structure and functions of Simple, Compound and Derived lipids, Structure and functions of fatty acids (Essential Fatty Acids), Triacyl glycerol, phospholipids, sphingolipids, Glycolipids and Gangliosides. Biological importance of lipids (PUFA)

UNIT-V (10 hours)

Nucleic acid: Structure, Properties and types of nucleic acid, Composition of DNA and RNA -Watson and Crick model of DNA, Structure of purines and pyrimidines, Structure of Nucleosides and Nucleotides. Structural forms of DNA, Biological importance of Nucleic acids

BIOMOLECULES PRACTICALS **(1 Credit)**

Practicals:

1. Qualitative Analysis of Proteins
2. Qualitative Analysis of Aromatic amino acids
3. Qualitative Analysis of Sulphur containing amino acids
4. Qualitative Analysis of Carbohydrates
5. Qualitative Analysis of Fats
6. Extraction of Starch from Potatoes
7. Extraction of Ovalbumin from Egg
8. Extraction of Lactalbumin from Milk
9. Acid – Base Titration Curve

Text Books:

- Nelson and Cox, Lehninger. Principles of Biochemistry (7th Edition), W.H Freeman Publishers (2010).
- Roy Tasker, Carl Rhodes. Stryer's Biochemistry (7th Edition) W. H. Freeman publishers(2012).
- Voet D. Biochemistry (4th Edition), Academic Press (2012).

Further Readings:

- Zubey G. Principles of Biochemistry, Oscar Publication (2000).
- Devlin T. M. Text Book of Biochemistry with Clinical Correlations (4th Edition) Wiley & Sons Publication (2005).

Discipline Specific Core (DSC) – 3A
CHEMISTRY- I
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 113

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT-I (10 hours)

Atomic Structure and Chemical Bonding: Atoms, elements, compounds and molecules. Electronic configuration of atom, Quantum mechanical model. Chemical bonding: classification, ionic bonding, covalent bonding, co-ordinate – covalent bonding, VSEPR, bond theory, shape of molecules, atomic orbital's, σ , π bonds, hybridization, resonance, bond properties, molecular orbital theory, metallic bonding, Intermolecular forces. Hydrogen bonds, Van der Waals forces.

UNIT-II (15 hours)

Chemical Thermodynamics, Energetics & Kinetics: Basic concepts of thermodynamics, I law of thermodynamics, heat capacity & specific heat capacity, Enthalpy changes, bond enthalpies, Entropy and II law of thermodynamics, Entropy changes, Gibbs energy & its changes. Rate of chemical reaction, rate constant & order of reaction – zero order, 1st order, pseudo 1st order, determination of order of reaction, theories of chemical kinetics, mechanism of reaction.

UNIT-III (10 hours)

Chemical Equilibrium and Redox Reactions: Equilibrium in chemical and physical processes, dynamic equilibrium & equilibrium constant homogeneous & heterogeneous, equilibria, Equilibrium constant units & application, factors affecting equilibrium. Redox reactions: rate of electrons in redox reactions, oxidation number balancing chemical equation, stoichiometry of redox reactions.

UNIT-IV (15 hours)

Solutions- I: Types of solutions, concentration of solutions, colligative properties, acids & bases, Bronsted-Lowry concept of acid and bases, ionization, acid-base titration, strong and weak electrolytes, degree of dissociation, hydrolysis, pH, pH scale, pH electrode, ionic strength. Equivalent & molecular mass, mole concepts, expressing concentration of solutions – mole fraction, molarity, molality, normality, molar volume, mass of substance, Mass – mole conversion, percent compositions, empirical & molecular formula, chemical stoichiometry.

UNIT-V (10 hours)

Solutions- II: Solvation energy, Polar and non-polar solvents, properties of water, Polarity of solvents, factors affecting solubility, dielectric constant of solvents, classification of solvents, dilution factor, serial dilution, solvent – solvent interaction, solute – solvent interaction in solutions. Colloids – types, properties, emulsions, coagulation. Distillation and its application.

CHEMISTRY- I PRACTICALS
(1 Credit)

Practical:

1. Calibration of fractional weights, pipettes and burettes, Preparation of standards, Solutions of different molarity and normality, Dilution – 0.1 M to 0.001 M solutions.
2. Measurement of pH of Solutions
3. Acid-Base Titration and Comparison of Strengths of Acids and Bases,
4. Determination of Order of a reaction.
5. Preparation of standard solution of oxalic acid and standardization of (a) NaOH solution and (b) KMnO₄ solution.
6. Analysis of Dissolved Oxygen.
7. Preparation and Purification of Colloidal Sols by dialysis.
8. To determine the density of the liquid.

Text Books:

1. B.R Puri., L.R Sharma and K. C Kalia. 31st edition *Advanced Inorganic Chemistry*. Delhi:Shoban Lal Nagin Chand and Sons, 2011.
2. B.R Puri., L.R Sharma and Pathania. 46th edition *Principles of Physical Chemistry*. Vishal Publishing Company, 2012.
3. Chang Raymond *Chemistry*. 6th ed.2008.

Further reading:s

1. R. M. Verma *Analytical Chemistry- Theory and Practice*, 3rd edition CBS Publishers and Distributors Pvt. Ltd., 2007
2. Skoog, West, Holler and Crouch, *Fundamentals of analytical chemistry*, 8th edition, Thomson Asia Pvt. Ltd, 2004.

Discipline Specific Core (DSC) – 1B
FUNDAMENTALS OF MICROBIOLOGY
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 121

Lectures: 60
Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT - I (10 hours)

Microbial Diversity: Basics of microbiology, History and Scope of microbiology, General features and Classification of Archaea, Bacteria, Fungi, Algae, Protozoa, Viruses and Prions. Differences between prokaryotic and eukaryotic organisms.

UNIT- II (15 hours)

Ultrastructure of Bacteria: Sub-cellular structures - Cell wall of bacteria and its biosynthesis, Cell envelope - capsule and slime layer, Cellular appendages - pili, flagella and fimbriae, Cell membrane, inclusion bodies, Plasmid DNA and chromosomal DNA. **Bacterial genetics** - conjugation, transduction (generalized and specialized), and transformation.

UNIT - III (15 hours)

Microscopy: Staining - Principles and types of staining (simple and differential)
Microscopy -Instrumentation, principles and applications of light microscopes (bright field, dark field, phase contrast, fluorescent microscopes) and electron microscopes (transmission and scanning electron microscopes)

UNIT - IV – (10 hours)

Microbial Nutrition: Classification of microorganisms based on their nutritional types, Preparation of media, types of media, culturing of microbes, Microbial growth curve, viral replication: lytic and lysogenic cycles, Isolation, preservation and maintenance of microorganisms, Aerobic and Anaerobic culturing of bacteria, Effect of biotic and abiotic factors on the growth of organisms.

UNIT - V (10 hours)

Microbial Control: Sterilization, disinfection, antiseptics, fumigation. Physical control: Temperature (moist heat, autoclave, dry heat, hot air oven and incinerators), desiccation, osmotic pressure, radiation, UV-light, electricity, ultrasonic sound waves, filtration. Chemical control: Antiseptics and disinfectants (halogens, alcohol, gaseous sterilization)

FUNDAMENTALS OF MICROBIOLOGY PRACTICALS (1 Credit)

Practicals:

1. Microscopic examination of Bacteria, Yeasts & Fungi
2. Motility of bacteria.
3. Simple staining of bacteria
4. Gram staining.
5. Preparation of media – solid, liquid media and semi-solid.
6. Methods of inoculation.
7. Isolation and maintenance of pure cultures.
8. Enrichment culture techniques.
9. Growth curve of microbes

Text Books:

- M.J. Pelczar Jr. E.C.S. Chan and N.R. Kreig , Microbiology (5th edition), Tata MaCraw-Hill, New Delhi;
- R. Ananthanarayanan. and C.K.Jayaram Panickar, Text book of Microbiology (9th edition), Orient Longman Publications, New Delhi
- Lansing M. Prescott, John. P. Harley, Donald A. Klein, 1999. Microbiology (9th edition) WCB MaCraw-Hill, New York;

Further reading:

- Sundararajan S (2003). College Microbiology, revised edition, Vardhana publications, Bangalore.
- R.C. Dubey, D.K.Maheswari, A Text book of Microbiology (2005), S.Chand & Company Ltd. New Delhi;

Discipline Specific Core (DSC) – 2B
INTERMEDIARY METABOLISM
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 122

Lectures: 60
Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT-I – (10 hours)

Bioenergetics: Enzyme & its forms, laws of thermodynamics, free energy change, enthalpy, entropy, equilibrium constant, flow of electrons, electron carriers, redox potential, redox coupling & ATP bioenergetics, High energy compounds.

UNIT-II – (15 hours)

Carbohydrate Metabolism: Glycolysis, Fermentation, Citric acid cycle, Oxidative Phosphorylation & Electron transport chain, Gluconeogenesis, Pentose phosphate pathway, Glyoxylate shunt, Glycogen metabolism (glycogenesis and glycogenolysis)

UNIT-III – (15 hours)

Amino Acids Metabolism: General aspects of amino acid metabolism, Transamination, Transamidation, Deamination, Uric acid biosynthesis, Nitrogen excretion - Urea cycle, Amino acid catabolism, Amino acid biosynthesis - Fixation of ammonia into amino acid, biosynthesis of amino acids (Tryptophan and Methionine), Regulation of amino acid biosynthesis.

UNIT-IV – (10 hours)

Lipid Metabolism: Biosynthesis of fatty acids - long chain, unsaturated, Triacylglycerols, phospholipids, comparison of fatty acid synthesis and degradation; Oxidation of fatty acids – even chain saturated fatty acids, Unsaturated fatty acids, odd chain fatty acids (α , β , ω), ketone bodies, cholesterol metabolism, dietary absorption of lipids, Transport forms (VLDL, LDL, HDL, chylomicron).

UNIT-V – (10 hours)

Nucleic Acid Metabolism: Biosynthesis of purines and pyrimidines, feedback inhibition of purine & pyrimidine biosynthesis, NMP conversion to NTP, Nucleotide degradation, salvage pathways, degradation of purine and pyrimidines to uric acid & urea, nucleotides as regulatory molecules, non-enzymatic transformation of nucleotides & nucleic acids.

INTERMEDIARY METABOLISM PRACTICALS **(1 Credit)**

Practicals:

1. Estimation of carbohydrates by Anthrone method
2. Estimation of proteins by Lowry method
3. Estimation of protein by Bradford method
4. Estimation of reducing sugars by DNS method
5. Estimation of total and HDL Cholesterol
6. Estimation of free amino acids by Ninhydrin method
7. Estimation of DNA by DPA method
8. Estimation of RNA by Orcinol method

Text Books:

- Voet. D. Biochemistry (4th Edition), Academic Press 2012.
- Zubey.G - Principles of Biochemistry (4th edition) Oscar Publication 2000.
- Wilson and Walker Principles and Techniques of Practical Biochemistry, (7th edition), Cambridge University Press 2010.

Further reading:

- Nelson and Cox, Lehninger. Principles of Biochemistry (7th Edition), W.H Freeman Publishers 2010
- Roy Tasker, Carl Rhodes. Stryer's Biochemistry (7th Edition). W. H. Freeman publishers 2012.

Discipline Specific Core (DSC) – 3B
CHEMISTRY- II
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 123

Lectures: 60
Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT-I (10 hours)

Introduction to Organic Chemistry: Nomenclature, tetravalency of carbon, structure, isomerism, steric hindrance, resonance structure, functional groups – alcohols, phenols, esters, aldehydes, ketones, acids, hydrocarbons – aliphatic & aromatic hydrocarbons, electrophiles and nucleophiles.

UNIT-II (10 hours)

Stereo Chemistry: Isomerism: types, structures, configurational, isomers, concepts of asymmetric carbon atoms, enantiomers, diastereoisomers, optical isomerism, optical activity, elements of symmetry, chirality, meso compounds, racemic modifications, absolute configuration: R/S and D/L configuration, chirality of organic compounds with special reference to amino acids and sugars.

UNIT-III (15 hours)

Nuclear Chemistry: Atomic nucleus, nature of radiation, measurement of radioactivity stability of atomic nucleus, neutron/proton ratio, neutron, electron, positron, α , β , γ rays, stability of radioactive decay, radioactive rate of decay, half-life, traces, liquid scintillation counting – solid state counting, Geiger counter, radiocarbon dating, medicinal use of isotopes, radiation & hazards. Differences between ionizing and non-ionizing radiation.

UNIT-IV (15 hours)

Chemical Analysis: Gravimetric analysis: Principles and methods of analyses, Application of gravimetry and precipitation in biology. Volumetric analysis: primary and secondary standards of substances (solutions), principles of acids and bases. Acid-base titration, redox and metal ion indicators. Analysis of real samples, sampling techniques, methods of dissolutions of solid samples for chemical analysis, salting in and salting out. Accuracy and precision in quantitative analyses, errors, standard deviations.

UNIT-V (10 hours)

Bio-Inorganic Chemistry: Essential & trace elements in biological processes, metalloporphyrins & with special reference to haemoglobin and myoglobin, biological role of alkali and alkali earth metals with special reference to Ca⁺.

CHEMISTRY- II PRACTICALS
(1 Credit)

Practical

1. Qualitative analysis of Alcohol
2. Qualitative analysis of Aldehydes
3. Qualitative analysis of Nitro Compounds
4. Qualitative analysis of Carboxyl group
5. Separation of organic compounds from mixtures: Benzoic acid and Sucrose.
6. Gravimetric analysis of biological samples,
7. Determination of Hardness of water.
8. Volumetric Analysis:
 - (a) Determination of acetic acid in commercial vinegar using NaOH.
 - (b) Determination of alkali content – antacid tablet using HCl.
 - (c) Systematic semi-micro qualitative analysis of a mixture of two simple salts

Text Books:

1. Anil Kumar de and Arnab Kumar de. *Inorganic Chemistry and analysis*. 2nd ed. New age international publication: 2005.
2. B. S. Bahl and A Bahl *Advanced Organic Chemistry*. 20th ed. S. Chand & Co, 2011.
3. Finar I. L. *A Text Book of Organic Chemistry Vol I&II*. 6th ed. LBS & Longman group Ltd. Reprinted in 2008

Further reading:

1. S.M. Mukherji, S. P. Singh, and R. P. Kapoor. *Organic Chemistry*. 3rd, 12th Reprint, New Delhi: New Age International (P) Ltd. Publishers, 2009.
2. Ege, Seyhan N. *Organic Chemistry – Structure and Reactivity*. 5th ed. Delhi: AITBS publishers, 2003.
3. Y. Bruice, Paula *Organic Chemistry*. 6th ed. New Jersey: Prentice-Hall International Inc, 2010.

Discipline Specific Core (DSC) – 1C
MOLECULAR BIOLOGY
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 231

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT - I (10 hrs)

Introduction to Molecular Biology, Types of genetic materials- Experiments of Griffith, Avery, MacLeod and McCarty, Hershey and Chase, Lederberg and Tatum, Central dogma of life.

UNIT- II (10 hrs)

Replication of DNA, Models of DNA replication, Mechanism of DNA replication in prokaryotes (initiation, elongation, replication fork, replication machinery, termination), Enzymes and proteins involved in DNA replication (nucleases, DNA polymerases, DNA helicases, gyrases, SSCP, topoisomerase, primase).

UNIT - III (15 hrs)

Mechanism of transcription in prokaryotes and eukaryotes. Enzymes and proteins involved in transcription, post transcriptional modification. Inhibitors of transcription.

UNIT- IV (15 hrs)

Genetic code - characteristics and properties, Wobble hypothesis. Protein biosynthesis in prokaryotes and eukaryotes, post translational modification, protein degradation, Inhibitors of protein synthesis. Regulation of gene expression (*lac*, *trp* and *gal* operons).

UNIT- V (10 hrs)

Mutation and its types- spontaneous, induced, reverse, suppressor mutations; chemical mutagens- alkylating agent, nitrous acid, hydroxylamine; physical mutagen- radiation. DNA repair- mismatch repair, excision repair, direct repair and SOS repair.

MOLECULAR BIOLOGY PRACTICALS (1 Credit)

Practicals

1. DNA isolation from prokaryotes- *E.coli*
2. DNA isolation from eukaryotes- Yeast
3. Plasmid DNA isolation
4. Protein extraction from *E.coli*
5. Molecular weight determination of DNA
6. Physical mutation: UV irradiation
7. Chemical mutation: EMS
8. Quantification of DNA
9. Total RNA isolation from bacteria
10. Melting curve analysis of DNA

Text books

- Lodish. H, Berk. A, Lawrence, A, Matsudaira. A, Baltimore. D and Darnell. J. Molecular Cell Biology (Fourth Edition). Media Connected – W.H.Freeman and Company. 2009
- Cooper G M & Hausman E, The Cell - A Molecular Approach. (6th edition), Sinauer Associates 2013

Further readings

- P.S. Verma and V.K. Agarwal, 2012, Concepts of Cell Biology. S.Chand & Company Ltd., New Delhi. 2012
- Lewin. B , GENES X, (10th edition), Jones & Bartlett Learning, 2011

Discipline Specific Core (DSC) – 2C
ANALYTICAL TECHNIQUES IN BIOLOGY
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 232

Lectures: 60
Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT – I (10 hours)

Water: structure and interactions, water as solvent, interaction with charged solutions, entropy changes, hydrophobic interactions, Van der Waals, interactions, colligative properties: vapour pressure, melting point, boiling point, osmotic pressure, osmosis, plasmolysis, haemolysis, isotonic solution, role of osmosis in living systems. Buffer: Henderson-Hasselbalch equation, Biological buffer system (bicarbonate and phosphate buffers).

UNIT – II (10 hours)

Spectroscopy: colorimetry, basic principles, Beer-Lambert's law, instrumentation and applications of UV-Vis and IR spectroscopies, centrifugation – principle & types, sedimentation co-efficient, sedimentation velocity, ultra-centrifugation, separation of macromolecules, subcellular fractionation.

UNIT – III (15 hours)

Chromatography – basic principle & types – paper chromatography, thin layer chromatography, column chromatography: gel exclusion, adsorption, ion exchange, affinity. Applications of chromatographic techniques – separation of biomolecules. Electrophoresis – Principle, DNA and RNA gel electrophoresis, Protein gel electrophoresis – SDS PAGE, native-PAGE, documentation, 2D-electrophoresis, Isoelectric focusing.

UNIT – IV (10 hours)

Bio-Physical Techniques: Crystallography: basic concepts & laws, symmetry of elements in crystal X-ray crystallography/ diffraction, determination of crystal structure, fluorescence: concepts, emission, chemi-luminescence. Viscometry, EPR, NMR, 2D & 3D structure, prediction, microscopy (density-density- volume conversion). Nature of light, wavelength, spectra, prism, refraction, diffraction, interference, polarization.

UNIT – V (15 hours)

Analysis of biological data – Measures of central tendency: mean, median, mode, Binomial, Poisson and Normal distributions (applications and simple problems) – Statistical inference-hypothesis -simple hypothesis, concept of sampling distribution – test of significance based on t-test (one-sample, two-sample and paired t-test)- chi-square test (independence of attributes) – F-test. Analysis of Variants (ANOVA)

ANALYTICAL TECHNIQUES IN BIOLOGY PRACTICALS (1 Credit)

Practicals:

1. Operation of shakers, incubators, pH meters and centrifuges
2. Buffer preparation- Phosphate/Acetate/Citrate
3. Density gradient centrifugation
4. Agarose gel electrophoresis of DNA
5. Poly Acrylamide Gel Electrophoresis of Proteins
6. Staining of protein gel: Coomassie Brilliant Blue staining.
7. Molecular Weight determination of Protein.
8. Test of significance based on t-test.
9. Chi-square test for independence of attributes.

Text Books:

- Wilson, K. and Walker, J. Practical Biochemistry – Principles and techniques 7th edition, 2010, Cambridge University Press,
- Brawer, I M., Perce, A.M., Experimental techniques in Biochemistry. Prentice Hall Foundation, New York 2012.
- N. Gurumani, 2005, An introduction to Biostatistics. MJP Publishers, Chennai.
- W. W. Daniel, 2007, Biostatistics, John Wiley Sons, NewYork.
- P.S.S. Sundar Rao and J. Richard, An introduction to Biostatistics, 2006, Third edition, Christian Medical College, Vellore.

Further Readings:

- Joseph Sambrook and David. W. Russel, Molecular Cloning- A laboratory manual, 4th edition, 2012, Cold spring harbor press.
- R. C. Cambell , 7th edition, 2012, Statistics for Biologists, Cambridge University Press

Discipline Specific Core (DSC) –3C
GENERAL BIOLOGY
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 233

Lectures: 60
Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT- I (10 Hours)

General classification of Plants and Animals, Concept of Species, Overview of Kingdoms - Animalia and Plantae, General characteristics of each group up to class level with an example.

UNIT- II (10 Hours)

Structure and function of plant tissues: parenchyma, collenchyma, sclerenchyma. Different types of xylem and phloem.

Structure and functions of animal tissues: simple epithelial tissue, connective tissues, muscle tissues and nervous tissue (Neurons).

UNIT- III (15 Hours)

Autotrophic nutrition, Photosynthesis, micro- and macro-nutrients, overview of mineral element deficiencies in plants. Different types of heterotrophic nutrition.

UNIT - IV (15 Hours)

Brief account of plant-water relations, types of transpiration and stomatal mechanisms, ascent of water in xylem and translocation of organic solutes in phloem, Anaerobic and aerobic respirations, Nitrogen fixation, Vegetative and asexual propagation of plants, sexual reproduction in plants (algae to angiosperm), pollination, fertilization.

UNIT - V (10 Hours)

Digestion of food in various regions of the alimentary canal; General characteristics of blood vascular system, composition of blood, structure and functions of heart, blood clotting; Nervous system; General view of endocrine system.

GENERAL BIOLOGY PRACTICALS (1 Credit)

Practicals

1. Isolation of placoid scale from shark.
2. Determining the age of fishes using scales.
3. Isolation of body setae from earthworms.
4. Dissection of mouth parts of cockroach.
5. In vitro germination of pollen grains.
6. Transpiration – Ganong’s Potometer
7. Estimation of photosynthetic pigments in plants.
8. Estimation of ascorbic acid in plant tissues.
9. Study of stomatal frequency & leaf area index.
10. Study of transverse section of stem/ root
11. Study of transverse section of dicot leaf.
12. Study of morphological adaptations of Xerophytes and Hydrophytes.

Text Books

- D.J. Taylor, N.P.O. Green, G.W. Stout. Biological Science (3rd Edition) –Cambridge University Press. 2008.
- Taiz, L & Zeiger, E. Plant physiology (5th edition), Sinauer Associates, Inc. Sunderland. 2010.
- Knut Schmidt-Nielsen. Animal physiology (5th edition). Cambridge University Press. 1997.

Further Readings:

- Raven, P.H., Evert, R.F & Eichhorn, S.E. Biology of plants (7th edition). W.H. Freeman Company publishers, USA. 2005.
- Campbell, N.A & Reece, J.B. Biology (8th edition). Pearson Benjamin Cummings, San Francisco. 2008.

Discipline Specific Core (DSC) – 1D
GENETIC ENGINEERING
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 241

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT-I (10 hours)

History and basic steps involved in genetic engineering, Enzymes involved in genetic engineering (Nucleases, Restriction enzymes and their types, DNA ligases and ligation, Kinases, Phosphatases, Reverse transcriptase, Transferases, DNA polymerase), Restriction mapping.

UNIT -II (10 hours)

Basic design of cloning vectors - plasmid (pBR322 and pUC 18/19), cosmids, phage vectors (lambda and M13), phagemid, yeast vectors (YE_p, YR_p, YI_p), shuttle vectors, BAC and YAC

Expression of cloned genes - general features of an expression vector, expression of eukaryotic gene in prokaryotes - advantages and limitations.

UNIT - III (15 hours)

Gene transfer techniques - physical (microinjection and biolistic transformation), chemical (CaCl₂ mediated transformation and Lipofection), electroporation and transduction.

Selection of recombinants - blue and white screening and plus and minus screening.

UNIT –IV (15hours)

Construction of genomic and cDNA library, PCR- steps involved, Guidelines for PCR primer designing, variants of PCR (multiplex, nested, quantitative real time, RT-PCR), applications and limitations.

Blotting - southern, northern and western blotting ; Nucleic acid and immuno probes.

UNIT -V (10 hours)

Manipulation of gene sequences by random mutations and site directed mutagenesis, Applications of Genetic engineering in industry, medicine and agriculture. Bioethics and Biosafety.

GENETIC ENGINEERING PRACTICALS
(1 Credit)

Practicals:

1. Restriction digestion of pBR322
2. Ligation using pET vector
3. Southern hybridization.
4. Competent cell preparation.
5. Transformation & Selection of recombinants.
6. Isolation of total RNA from Bacteria.
7. Polymerase chain reaction.
8. Native PAGE of Bacterial Proteins

Text books

- Primrose Sandy B. and Richard Twyman, Principles of Gene Manipulation and Genomics (7th Edition), Wiley-Blackwell 2006.
- Brown T. A, Gene Cloning and DNA Analysis: An Introduction, (6th Edition) Wiley-Blackwell, 2010.
- Winnacker L Ernst, From genes to clones -Introduction to gene technology (4th edition), Panima Publishing Corporation, 2003.

Further readings:

- **Dubey R.C, Advanced Biotechnology (1st edition), Chand and Company, 2014.**
- Watson D James; et al Recombinant DNA: genes and genomes, (3rd edition), Basingstoke: Palgrave pacmillan, 2007.
- Sathyanarayanan U, Biotechnology (2013) Books and allied (P) ltd.

Discipline Specific Core (DSC) – 2D
IMMUNOLOGY
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 242

Lectures: 60
Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT - I (10 hours)

Immunology - History & Milestones, Microbial infections and host resistance. Immune response: Innate & Adaptive responses, Humoral and cell mediated Immune Responses. Structures, composition and functions of cells and organs of immune system.

UNIT- II: (10 hours)

Antigens & Immunogenicity. Antigens - Types, properties, Haptens, Adjuvants, Toxoids, Immunoglobulins- structure, types and properties, Theories of antibody formation, Structural and genetic basis of antibody formation.

UNIT - III (12 hours)

Antigen and antibody reactions, Immunodiagnostic methods - Agglutination, precipitations, complement fixation, RIA, ELISA and its types, Immunofluorescence, Production of Monoclonal Antibodies and Hybridoma technique.

UNIT - IV (13 hours)

Cytokines & Chemokines - Classification, types and its functions, Complement system: - structure, properties, functions of complement components and its pathways. Hypersensitivity reactions: Type I, II, III and IV.

UNIT - V (15 hours)

Immunity and tumors: Types of tumors, tumor antigens, immune response to tumors. Immunodeficiency and Auto immune diseases, MHC - Structure and function of class I and class II MHC molecules, Transplantation immunology - types and mechanisms involved.

IMMUNOLOGY PRACTICALS
(1 Credit)

Practicals:

1. Single Immunodiffusion analysis
2. Double Immunodiffusion analysis.
3. Rocket Immuno-electrophoresis.
4. Separation of PBMC from the blood sample.
5. Slide & Tube Agglutination Reaction
6. Extraction of antigens from microbes
7. Purification of Antibodies: Ig G.
8. Preparation of murine splenolymphocytes
9. Enzyme-Linked Immunosorbent Assay

Text Books

- Roit, I.M., Delves P.J., Essential Immunology (10th edition), Blackwell Science, Oxford 2001
- Immunology by Kuby, J. (7th edition) W.H. Freeman and Company, New York, 2013
- Kumar. M.S, Leela K Sai, Microbiology and Immunology (2nd edition) Jaypeebooks 2014

Further Reading:

- Male. D and Roth. D, Immunology (8 edition), Reed Elsevier India Pvt Limited 2013.
 - Khan. F.H. The Elements of Immunology, Pearson Education India, 2009
- Hay. F.C, Olwyn. M.R West wood, Practical Immunology (4th edition), Blackwell science 2002

Discipline Specific Core (DSC) – 3D
EVOLUTION AND GENETICS
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 243

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT- I (10 Hours)

Theories of the origin of life, evidence for the theory of evolution, paleontology, comparative anatomy, embryology and biochemistry. Adaptive radiation, modern views on evolution. Evolution of Human (*Homo sapiens*).

UNIT -II (15 Hours)

Mechanism of speciation, population genetics, gene pool, allele frequency, genotype frequency, genetic polymorphism, Hardy-Weinberg equation.

UNIT -III (10 Hours)

Mendelian genetics, monohybrid and dihybrid crosses, test cross, back cross, reciprocal cross, chromosomal basis of inheritance, allele, multiple alleles, pseudoalleles, Epistasis, Hypostasis, Co-dominance, Incomplete dominance.

UNIT- IV (15 Hours)

Linkage and crossing over, recombination, sex determination, sex linked Inheritance (autosomal and allosomal), blood groups, lethal genes, mutation and variations. Structural organization of chromosomes, packaging of DNA molecules into chromosomes, Giant chromosomes, polytene chromosomes, Chromosomal aberrations.

UNIT -V (10 Hours)

Epigenetics- DNA methylation and histone modification(Acetylation, Methylation and Phosphorylation). Non coding RNA and prion proteins.

EVOLUTION AND GENETICS PRACTICALS
(1 Credit)

Practicals:

1. Studying Barr body with the temporary mount of human cheek cells.
2. Mounting of salivary gland chromosomes in chironomous larvae.
3. Mitotic cell division in onion root tips by squash method.
4. Preparation of blood smear of man.
5. Identification of blood groups.
6. Enumeration of RBC and WBC using Hemocytometer.
7. Differential counts of WBC.
8. Estimation of hemoglobin using Hemometer.
9. Study of community structure by quadrat / line transect method.

Text Books:

- D.J. Taylor, N.P.O. Green, G.W. Stout, Edited by R. Soper. Biological Science (3rd edition) – Cambridge university press. 2008.
- Ridley, M. Evolution (3rd edition). Blackwell publishers. 2004.
- Chapman, J.L & Reiss, M. J. Ecology (3rd edition). Cambridge University Press. 2008.

Further Readings:

- Raven, Johnson, Mason, Losos & Singer. Biology (9th edition). Tata McGraw Hill Education, New Delhi. 2011.
- Brooker, R.J. Genetics: Analysis & Principles (4th edition). Tata McGraw Hill Education. 2011.
- Gardner EJ, Simmons MJ, Snustad DP. Principles of Genetics. 8th Ed. Wiley-India. 2008.
- Snustad DP, Simmons MJ. Principles of Genetics. 6th Ed. John Wiley and Sons Inc. 2011.
- Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. Introduction to Genetic analysis, 9th Ed. W.H. Freeman and Co., NewYork. 2007.

DISCIPLINE SPECIFIC ELECTIVES

Discipline Specific Elective (DSE)
BIOPROCESS TECHNOLOGY AND DOWNSTREAM PROCESSING
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 353

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT I (15 Hours)

Principles of Bioprocess technology – Introduction and history of traditional and modern bioprocess technology. General concepts of fermentation technology – Outline of an integrated bioprocess and various unit operations. Industrially important microbes: Isolation, Screening & Preservation techniques – Slant culture, spore culture, overlaying culture with mineral oil, Lyophilization, Cryopreservation – Strain improvement – mutation, protoplast fusion & rDNA techniques for strain development – Maintenance of Industrially important microbes.

UNIT II (10 Hours)

Introduction to fermentation - Types of fermentation processes (Submerged & solid static) - Media formulation - Synthetic and complete media, Sterilization (batch & continuous) – Air, Filter and Media sterilization – Operation: Inoculum preparation and sampling. Fermenters: Design of a fermenter – Types: Stirred tank, Fluidized bed, Immobilized bed bioreactors, Photo bioreactors, Air lift bioreactors and its other types.

UNIT III (10 Hours)

Microbial growth and death kinetics - Bioprocess control & monitoring of various factors, temperature, agitation, pressure, pH, dissolved oxygen and foam sensing – online measurements, Control systems – Manual control, Automatic control - on/off control & PID control, Computer applications in fermentation technology - Scale up & Scale down of microbial reactions.

UNIT IV (10 Hours)

Down- stream processing: Removal of microbial cells and solid matter – Precipitation, Filtration, Centrifugation, Liquid – Liquid extraction, Chromatography and membrane processes, BOD and COD measurements, Disposal of industrial wastes.

UNIT V (15 Hours)

Industrial waste water treatment and disposal: Physical treatment, chemical treatment and biological treatments. Aerobic processes - trickling filter, towers, biologically aerated filters, rotating drums, fluidized bed systems, activated sludge process. Anaerobic treatment - anaerobic digestion, anaerobic filters, up-flow anaerobic sludge blankets. Disposal - seas and rivers, lagoons, spray irrigation, well-disposal, landfilling, incineration, disposal of effluents to sewers.

**BIOPROCESS TECHNOLOGY AND DOWNSTREAM PROCESSING
PRACTICALS
(1 Credit)**

Practical:

1. Fermenter design and structure.
2. Inoculum preparation and sterilization
3. Preparation of Wine
4. Isolation of lactic acid bacteria from curd
5. Isolation of amylase producing microorganisms
6. Isolation of antibiotic producing microorganisms from soil
7. Estimation of COD.
8. Estimation of BOD.
9. Immobilization of bacterial cells.

Text Books:

- Stanbury P.F., Whitaker. A & Hall. S. J. Principles of fermentation technology (2nd edition), Aditya Books Private Ltd., 2000.
- Crueger, W. and Crueger, A, Biotechnology: A Textbook of Industrial Microbiology. (2nd Ed.), Panima Publishing Corporation, New Delhi. 2000.
- Waites M.J., Morgan N.L., Rockey J.S., Industrial Microbiology. 2nd edition, Blackwell Science, 2002.

Further Reading:

- Demain L. & Davies E. Manual of Industrial Microbiology and Biotechnology (2nd edition), ASM Press, Washington, 2004.
- Emt El Mansi, Bryce, CFA, Demain, AL (Eds). Fermentation Microbiology and Biotechnology (2nd Edition), CRC Press. 2006.

Discipline Specific Elective (DSE)
ANIMAL BIOTECHNOLOGY
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 354

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT - I (10 hours)

Introduction, history, basic concepts of animal cell culture, primary cell culture and established cell lines, maintenance of cultures, requirements of animal cell culture, media - natural (clots, biological fluids and tissue extracts) and synthetic (serum containing media, serum free media, chemically defined media, protein free media).

UNIT – II (15 hours)

Basic techniques of mammalian cell culture, disaggregation of animal tissues - mechanical, enzymatic and EDTA, evolution of cell line, monolayer culture, suspension culture, immobilized culture, organ culture - plasma clot, raft method, agar gel, grid method, embryo culture, maintenance of cell culture.

UNIT – III (15 hours)

Artificial insemination, Super ovulation, In vitro fertilization and embryo transfer, applications and limitation, Transgenic animals (avian, rodent & ruminants), Transfusion methods, Embryonic Stem cell transfer, Targeted Gene Transfer, Detection of transgenic animals, Production of useful proteins in transgenic animals, Sericulture basics and production of useful proteins through sericulture.

UNIT – IV (10 hours)

Role of Animal models in Experimentation. Molecular markers - RFLP, RAPD, VNTR, AFLP. Somatic and Reproductive cloning - Definition, history and types. Somatic cell nuclear transfer, story of dolly, Therapeutic cloning and its significance.

UNIT – V (10 hours)

Animal diseases (cattle) -Mad cow, Anthrax, Foot and Mouth, Lumpy skin, Bluetongue; (Poultry)- Newcastle; Bird flu, Avian Influenza, Marek's disease – Vaccines; Bioethics and biosafety in animal handling.

ANIMAL BIOTECHNOLOGY PRACTICALS
(1 Credit)

Practicals:

1. Isolation of High Mol. Wt. DNA from mammalian cells
2. DNA finger printing
3. Western blotting
4. Silver staining
5. Isolation of DNA from blood
6. Estimation of fibroin protein from silk worm.
7. Lymphocyte proliferation assay
8. Staining of lymphocytes - Typhan blue
9. Molecular diagnosis of animal diseases

Text Books:

- Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten, Molecular Biotechnology: Principles and Applications of Recombinant DNA (4th edition), ASM publisher(2009).
- Michael wink, An Introduction to Molecular Biotechnology: Fundamentals, methods and applications, (2nd edition) , John Wiley and sons 2013.
- Ganga. G & Slochanachetty, An Introduction to Sericulture, (2nd edition), Oxford and IBH publishers Pvt.Ltd.Delhi (2012).
- Old R.W, Primrose S.B, Twyman R. M, Principles of Gene manipulation (6th edition), Blackwell Sciences, (2001)

Further Reading:

- Tom Strachan & Andrew P. Read, Human Molecular Genetics, 2nd edition. Garland Science, (2004).
- Maule J.P, The Semen of Animals and Artificial Insemination, Commonwealth Agricultural Bureaux, 1962
- John R.W. Masters, Animal Cell Culture, 3rd edition, OUP Oxford, (2000).

Discipline Specific Elective (DSE)
MARINE BIOTECHNOLOGY
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 355

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT - I (10 hours)

The marine ecosystem and its functioning: intertidal, estuarine, salt marsh, mangrove, coral reef, coastal & deep sea ecosystems. Hydrothermal vents - biodiversity of organisms. Marine microbes - unculturable bacteria, occurrence, characteristics and exploitation,

Barophilic organisms and their potential gene application for Marine Biotechnology Industry

UNIT - II (15 hours)

Bioactive compounds from marine organisms, GFP, RFP characteristics and their applications, Green mussel adhesive protein, Marine hydrocolloids - Agar, Agarose, Chitosan, Chitin, Alginate, Carrageen and its applications, Marine enzymes and their applications in food processing, Marine Pharmaceuticals – Zinconotide, Dolostain, Bryostain.

UNIT - III (15 hours)

Aquaculture - Culturing of shrimp, edible mollusks, oysters, pearl oysters, sea cucumbers. Culture of live feed organisms - brine shrimp, rotifers, marine algae. Techniques for identification of bacterial & viral pathogens in aquaculture Methods of diagnosis of SEMBV, MBV and Vibrio diagnosis, Probiotic bacteria and their importance in aquaculture; Vaccines in aquaculture: Fish, shrimps & prawns

UNIT - IV (10 hours)

Chromosome manipulation in aquaculture – hybridization; Ploidy induction; Gynogenesis, Androgenesis and sex reversal in commercially important fishes; Cryopreservation of fish gametes and embryo; Transgenic fishes - Antifreeze and metallothionine gene.

UNIT - V (10 hours)

Biofouling, biofilms, corrosion and antifouling treatment. Ballast water: consequences & management. Red tides: causative organisms and control. Control of oil spills and bioremediation.

**MARINE BIOTECHNOLOGY PRACTICAL
(1 Credit)**

Practicals

1. Biochemical tests for identification of Marine bacteria.
2. Measurement of growth of microorganisms.
3. Plankton analysis.
4. Isolation, characterization and antagonistic effects of probiotic bacteria against fish pathogens.
5. Identification of Shrimp/Oysters/Sea cucumber (Spotters)
6. Estimation of Ammonia from shrimp pond
7. Disease identification in shrimps and fishes.
8. Isolation of chitin and chitosan from shrimp waste.

Text Books:

- Milton Fingerman, Nagabhushanam. R, Recent Advances in Marine Biotechnology, Vol. 8: January 1, Science Publisher, (2003).
- Kim, Se-Kwon, Springer Handbook of Marine Biotechnology, Springer Handbooks, (2014) Pillay T V R; Kutty M N, Aquaculture: Principles and practices, 2nd edition, Blackwell Pub., (2005).

Further readings:

- Ronald M. Atlas , Richard Bartha, Microbial Ecology: Fundamentals and Applications (4th edition), Benjamin Cummings, (1997).
- Marco Saroglia, Zhanjiang Liu, Functional Genomics in Aquaculture, Wiley-Blackwell, (2012).
- Laboratory manual on methodologies for assessing Biodiversity in estuaries, mangroves and coastal waters – Annamalai University.

Discipline Specific Elective (DSE)
ENVIRONMENTAL BIOTECHNOLOGY
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 356

Lectures: 60
Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT - I (10 hours)

Introduction to environmental biotechnology, Renewable resources - coal, petroleum, and natural gas. Non-renewable resources - solar, wind, tidal, biomass, nuclear, geothermal and hydroelectric resources. Current status and environmental impact of renewable and non-renewable resources

UNIT- II (10 hours)

Methanogenic bacteria and biogas, microbial hydrogen production, conversion of sugars to alcohols, plant-based petroleum industry, cellulose as the source of energy, Environmental impact of modern fuels.

UNIT - III (10 hours)

Principles of waste management, types, sources and effects of solid waste, Physical and biological treatment methods, Concept of composting and vermicomposting, Waste to energy conversion, Disposal of wastes.

UNIT- IV (15 hours)

Basics and types of bioremediation, Bioremediation of oil, heavy metals, pesticides contaminated soil and water, Phytoremediation and its types, Biochemical and genetic basis of biodegradation, Xenobiotic compounds and recalcitrance, Biodegradation of pesticides and petroleum products, Biotransformation of heavy metals, Biopolymers and Biodegradable plastics.

UNIT - V (15 hours)

Biomonitoring - Bioassays, Biosensors, Biochips, Biological indicators and Biomarkers, Bioremediation of waste land, Bioleaching – microbes involved, Role of Biotechnology in pollution abatement.

ENVIRONMENTAL BIOTECHNOLOGY PRACTICALS
(1 Credit)

Practicals:

1. Biodiesel production from vegetable oil (Lipase-Catalysis method)
2. Bioethanol production from organic waste.
3. Enumeration of microorganisms from sewage samples.
4. Isolation of cellulolytic organisms from soil.
5. Isolation of phage from sewage.
6. Preparation of phage stock.
7. Estimation of total hardness in water.
8. Estimation of nitrite in water sample.
9. Estimation of salinity in water samples.
10. A Visit to Waste water treatment (Sewage and Industrial effluents treatment)

Text Books:

- Scragg A. H, Environmental Biotechnology, (2nd revised edition), Oxford University Press 2005
- Jogdand S. N, Environmental Biotechnology (3rd edition), Himalaya publishing house pvt.ltd 2012.
- Thakur. I. S, Environmental Biotechnology: Basic Concepts and Applications, (2nd revised edition), I K International Publishing House Pvt. Ltd, 2011.

Further readings:

- Varnam A. H - Environmental Microbiology (1st Edition), ASM Press 2001
- Wang, L.K., Ivanov, V., Tay, J.H., Hung, Y.T, Environmental Biotechnology (Volume 10), Humana Press 2010

Discipline Specific Elective (DSE)
ENZYME TECHNOLOGY
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 357

Lectures: 60
Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT I (15 hours)

Introduction to enzymes. Types of enzyme – Constitutive and Induced type - Intracellular and extracellular enzyme. Two substrate reactions (Random, ordered and ping-pong mechanism). Enzyme-substrate interactions, Protein ligand binding, Hill and Scatchard plots. Structure and functional relationships of enzymes. Structural motifs and enzyme evolution. Techniques for studying mechanisms of action, chemical modification of active site groups, specific examples: Carboxypeptidases and alcohol dehydrogenases by computational biology.

UNIT II (10 hours)

Methods of Enzyme isolation- cell disruption methods, salting in and salting out, crystallization and purification of enzymes- dialysis and chromatographic methods. Nature of extraction medium, criteria for purity, Determination of Molecular weight of enzymes. Process optimization and scale-up of industrial enzymes production.

UNIT III (15 hours)

Instrumental methods of analysis - Manometric and substrate assays, Spectrophotometric methods, Spectrofluorimetric methods, Electrochemical methods, Enthalpimetry and Radiochemical methods. Enzyme units and specific activity. Automation in enzymatic analysis - Fixed time methods, Methods involving continuous monitoring.

UNIT IV (10 hours)

Thermal stability and catalytic efficiency of enzymes, Site-directed mutagenesis and enzyme engineering - selected examples, Delivery system for protein pharmaceuticals, Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes. Protein folding in vivo & in vitro.

UNIT V (10 hours)

Enzymes of economic importance (proteases, amylases, cellulases). Application of enzymes - Therapeutic applications (therapeutic agents, clinical diagnosis). Industrial application (food and beverages, textile and detergents, pulp and paper industries, animal feed, agriculture). Immobilization of enzymes: Immobilized enzymes, Methods for immobilization of enzymes, applications of immobilized enzymes.

ENZYME TECHNOLOGY PRACTICALS
(1 Credit)

Practicals:

1. Screening of microorganisms for enzyme production.
2. Effect of pH on enzyme activity.
3. Effect of temperature on enzyme activity.
4. Ammonium sulphate precipitation of enzymes
5. Partial purification of enzymes by dialysis.
6. Colorimetric assay for enzyme activity
7. Determination of K_m and V_{max} of the enzymes.
8. Electrophoretic separation of isoenzymes.

Text Book:

1. Nelson.D.L, Cox. M. M. Lehninger's Principle of Biochemistry. 4th ed. Freeman, 2004
2. Berg.J.M, Tymoczko.J.L, Stryer, L. Biochemistry. 6th ed. Freeman, 2006.

Suggested Reading:

1. Dixon & Webb. Enzymes. 3rd ed. Longmans, 1979.
2. Murray. R.K, Granner.D.K, Mayes. P. A, Rodwell. V. W.Harper's Biochemistry. 27th ed.
McGraw Hill, 2006.

Discipline Specific Elective (DSE)
PHARMACEUTICAL BIOTECHNOLOGY
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 363

Lectures: 60
Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT- I (10 hours)

Definition and scope of Pharmaceutical Biotechnology, sources of drugs, classification of pharmacological agents (based on chemistry, mode of action, dosage forms), route of administration, absorption and bioavailability of drugs, distribution and liver detoxification metabolism and drug excretion.

UNIT- II (10hours)

General classes and properties of phytopharmaceuticals, Extraction of phytochemicals, Phytochemical screening of medicinal plants. Bioassay guided fractionation methods- TLC, HPTLC, GLC, and HPLC, Role of NMR and Mass spectrometry in drug discovery and Identification of impurities.

UNIT- III (15 hours)

Antimicrobial agents, Antibiotics - source, classification, mode of action, Antimicrobial resistance, and Antimicrobial activity studies (antibacterial, antiviral, antifungal and antiparasitic activity).

Pharmacological Assays - In-vitro assays - chemical (anti-oxidant), Biological (anti-cancerous and assay system based on enzymes and cells), and immunological (RIA and ELISA) - In vivo assays (Anti-inflammatory and Anti-analgesic).

UNIT- IV (15 hours)

Process of drug discovery and development- Target identification and validation, Assay development, lead optimization, pre-clinical testing, clinical trials involved in drug discovery and development, regulatory approvals and phase IV trials, High throughput screening, ICMR guidelines for the conduct of clinical trials.

UNIT- V (10 hours)

Vaccines: concept, production and types - Inactivated, Attenuated, toxoid, Recombinant vaccines, Peptide and DNA vaccines, Edible vaccines.

Recombinant proteins, approved rDNA drugs in market, Probiotics, Nutraceuticals, Economic and legal considerations in Pharmaceutical Biotechnology

PHARMACEUTICAL BIOTECHNOLOGY PRACTICALS
(1 Credit)

Practicals:

1. Preparation of different methods of medicinal plant extracts.
2. Antibacterial activity.
3. Antifungal activity.
4. Total antioxidant activity.
5. Phytochemical screening of Primary metabolites.
6. Phytochemical screening of Secondary metabolites.
7. Separation of medicinal plant extracts by chromatography.
8. Estimation of ascorbic acid in multivitamin formulations.

TEXT BOOKS

- Satoskar R.S, Nirmala N. Rege, and Bhandarkar S. D, Pharmacology and Pharmacotherapeutics (Revised 23rd Edition), Popular Prakashan, Mumbai.
- Tripathy K. D, *Essentials of Medical Pharmacology (6th edition)*, Jaypee publishers
- Shoba rani R Hiremath, Text book of industrial pharmacy, orient longman Pvt ltd 2008.
- Crommelin Daan J. A., Sindelar D. Robert (3rd edition) Pharmaceutical Biotechnology: Fundamentals and Applications, CRC Press, 2007.

FURTHER READINGS

- Trease, G.E.and Evans, W.C., 2011, *Pharmacognosy (12th edition)*, Bailliere Tindall Eastbourne, U.K
- Mukherje P.K., *Quality Control Herbal Drugs—An approach to evaluation of botanicals*. Business Horizons Pharmaceutical Publishers, 2005
- Sambamurthy K., Pharmaceutical Biotechnology (1st edition) New Age International

Discipline Specific Elective (DSE)
BIOINFORMATICS
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 364

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT-I (10 hours)

Bioinformatics: an overview - Introduction to Computational Biology and Bioinformatics; some of the biological problems that require computational methods for their solutions; Role of internet and www in bioinformatics. Biological Databases Acquisition –Primary and Secondary databases, Nucleotide sequence databases. Types of DNA sequences – genomic DNA, cDNA, recombinant DNA, Expressed sequence tags (ESTs), Genomic survey sequences (GSSs); RNA sequencing methods.

UNIT-II (15 hours)

Sequence Analysis – Methods of sequence alignment: Dot plots; Scoring matrices – identify matrix, genetic code matrices (GCM); Substitution matrices, Percentage accepted Mutation (PAM). Block Substitution Matrices (BLOSUM), dynamic programming algorithms; Needleman-Wunch and Smith Waterman; alignment scores and gap penalties; Database searching (BLAST and FASTA). Multiple Sequence alignment (MSA) – significance. Softwares : ClustalW and Meme.

UNIT-III (15 hours)

Phylogenetic analysis – Phylogenetics, cladistics and ontology; Phylogenetic representations – graphs, trees and cladograms; Classification and ontologies; Steps in phylogenetic analysis; Methods of phylogenetic analysis – similarity and distance tables, distance matrix method; Method of calculation of distance matrix (UPGMA, WPGMA); The Neighbor Joining Method; The Fitch/Margoliash method; Steps in constructing alignments and phylogenies; Phylogenetic softwares –PHYLIP

UNIT-IV (10 hours)

Anatomy of proteins; Ramachandran Plot; secondary structures; motifs; domains; tertiary and quaternary structures. Anatomy of DNA; A, B, Z-DNA, DNA bending. Methods for prediction of secondary and tertiary structures of proteins – knowledge-based structure prediction; fold recognition; *ab initio* methods for structure prediction, Comparative protein modeling.

UNIT-V (10 hours)

Applications of bioinformatics in Drug discovery: Finding new drug targets to treat diseases – Pharmacophore identification - Structure based drug design. Mining of sequence data: Mining data from Yeasts. Microarray and genome wide expression analysis: transcriptomes, proteome: Genomics in medicine, disease monitoring, profile for therapeutic molecular targeting.

BIOINFORMATICS PRACTICALS
(1 Credit)

Practicals:

1. Open access bibliographic resources and literature databases: PubMed, BioMed Central
2. Nucleic acid sequence databases: GenBank, EMBL, DDBJ;
3. Protein sequence databases: Uniprot-KB: SWISS-PROT, TrEMBL
4. Genome Databases at NCBI, EBI, TIGR, SANGER
5. Sequence file formats: GenBank, FASTA, GCG, MSF.
6. Pairwise sequence alignment: BLAST
7. Multiple sequence alignment: ClustalW, MEGA
8. Protein structure database: PDB, Rasmol.
9. Sequence editing and manipulation: Bioedit and Sequence manipulation suite.

Text books:

- Mount, D. *Bioinformatics: Sequence and Genome Analysis*; Cold Spring Harbor Laboratory Press, New York. 2004
- Baxevanis, A.D. and Ouellette. B.F. *Bioinformatics – a practical guide to the analysis of Genes and Proteins*; John Wiley and Sons, New Jersey, USA. 1998
- Lesk, A.M. *Introduction to Bioinformatics*, First edition, Oxford University Press, UK. 2002
- Rastogi, S.C, Mendiratta. N and Rastogi. R. *Bioinformatics: Concepts, Skills and Applications*, CBS Publishers, New Delhi, India. 2006

Further reading:

- Pevzner, P.A. *Computational Molecular Biology*; Prentice Hall of India Ltd, New Delhi. 2004
- Sensen, C.W. *Essentials of Genomics and Bioinformatics*. Wiley-VCH Publishers, USA. 2002
- Andrew R. Leach *Molecular Modeling – Principles and Applications* Second Edition, Prentice Hall, USA. 2001
- Creighton, T.E. *Proteins: structure and molecular properties* Second edition, W.H. Freeman and Company, New York, USA. 1993

Discipline Specific Elective (DSE)
PLANT BIOTECHNOLOGY
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 365

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT – I (10 hours)

Introduction to plant biotechnology, Relevance of plant biotechnology to sustainable agriculture, food security and environment, Plant biotechnology in India- Achievements. Environmental impacts of genetically modified plants.

UNIT –II (15hours)

Basics of Plant tissue culture, Sterilization – Surface and Dry, Components (inorganic, organic and plant hormones) and types of nutrient media, Callus and Suspension cultures, Micropropagation, Somatic embryogenesis and Germplasm conservation. Embryo culture, Rapid clonal propagation, somaclonal variations and synthetic or artificial seeds, embryo rescue, production of haploid plants (microspores and ovules). Applications and limitations of haploid plants. Secondary metabolites from plants.

UNIT- III (10hours)

Introduction and Principles of Somatic Hybridization – Protoplast Isolation, Protoplast fusion, Selection of hybrid cell, Regeneration of hybrid plants, Somatic hybrids and cybrids – cytoplasm transfer, Genetic transformation, Advantages and Limitations, Molecular markers – RFLP, RAPD, DNA fingerprinting.

UNIT – IV (15hours)

Genetic engineering of plants - Gene constructs, Vectors- Plasmid vectors and plant viral vectors (CaMV, Gemini virus, Tobacco Mosaic virus), cloning vectors for higher plants - Genetic manipulation using *Agrobacterium tumefaciens*. Gene transfer in plants - Electroporation, Particle Gun Method, Microinjection, Polyethylene glycol mediated transformation, Chloroplast transformation, terminator seed technology.

UNIT –V (10hours)

Biocontrol and biofertilizers, Applications of transgenic plants- Pest resistance, Herbicide resistance, virus resistance, Fungal and bacterial resistance, Delay of fruit ripening, Salt & drought tolerance, improvement of crop yield and Quality, Improved nutrition.

PLANT BIOTECHNOLOGY PRACTICALS
(1 Credit)

Practicals:

1. Isolation of total genomic DNA from leaves by CTAB method
2. Extraction of total protein from leaves and PAGE analysis.
3. Amplification of a plant gene by polymerase chain reaction
4. Isolation of PCR product from agarose gels
5. Plant Tissue culture technique - Preparation of Media
6. Callus Induction and shoot regeneration.
7. Shoot multiplication
8. Somatic Embryogenesis
9. Embryo rescue
10. Anther culture

Text Books:

- Trivedi P.C. **Plant Biotechnology: Perspectives and Prospects**, Pointer Publishers (2007).
- Slater. A, Scott. N, Fowler. M., Plant Biotechnology: The genetic manipulation of plants, Oxford University Press (2008).
- Hans-Walter Heldt, Plant Biochemistry (4th ed.), Academic Press. (2010).

Further reading:

- Old R.W, Primrose S.B, Twyman R. M, Principles of Gene manipulation (6thed.), Wiley-Blackwell, 2002.
- **Bailey. L.H**, Plant-Breeding , Read Books, (2009).
- Buchanan. B, Grussem. W, Jones.W, Plant Biochemistry and Molecular Biology (2nd edition) ,Wiley-Blackwell, (2002).

Discipline Specific Elective (DSE)
MICROBIAL BIOTECHNOLOGY
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 366

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT – I (10 hours)

General concepts of microbial biotechnology. Genetic engineering of microbes for the production of antibiotics, enzymes, insulin, growth hormone and monoclonal antibodies. Synthetic bacteria. Microorganisms as factories for the production of novel compounds.

UNIT – II (10 hours)

Biofertilisers and their importance in crop productivity. Bacterial, algal and fungal biofertilisers - their significance and practice. Biopesticides - Bacterial, fungal and viral pesticides. Production of biofertilisers and biopesticides for large scale applications.

UNIT – III (15 hours)

Industrial production of alcohol, acetic acid, antibiotics (Penicillin and streptomycin), enzymes (Amylases and Proteases), amino acids (lysine and glutamic acid), vitamin B12. Microbial biomass production - algal (SCP), fungal (mushroom), yeast (baker's yeast).

UNIT – IV (10 hours)

Role of microorganisms in fermented products - organisms used for fermented food products. Microbial production of yoghurt, cheese, beer and wine. Microbial fermentation of tea, coffee and cacao. Health aspects of fermented foods.

UNIT – V (15 hours)

Microbial leaching of ores, Bioweapons and Bioshields, Microbial biocatalyst and microbial fuel cells. Microbial fuels (biohydrogen, bioethanol and biomethane), Nutraceuticals from algae, Algal Pigments and Genetics of secondary metabolite production.

MICROBIAL BIOTECHNOLOGY PRACTICALS
(1 Credit)

Practical:

1. Measurement of Microbial growth kinetics
2. Effect of pH and Temperature on microbial growth.
3. Microbial spoilage of Milk/fruits/foods.
4. Screening for auxotrophic mutants in bacteria
5. Microbial production of Wine.
6. Mushroom cultivation
7. Screening for secondary metabolite production by microbes
8. Bacteriological testing of water.

Reference Books:

1. Microbial biotechnology (1995) Alexander N. Glazer Hiroshi Nikaido W.H. Freeman & Company
2. Fungal ecology and biotechnology (1993) Rastogi Publications, Meerut

Discipline Specific Elective (DSE)
MEDICAL BIOTECHNOLOGY
(Credits: Theory-4, Practicals-1)
THEORY

Course Code: UBIOT 367

Lectures: 60

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT – I (10 hours)

Introduction – Origin, significance & worldwide market of Medical Biotechnology. Revolution in clinical diagnosis, Antibody and Nucleic Acid Hybridization techniques, Imaging techniques (Nanodiagnosis).

UNIT – II (15 hours)

Genetic & Metabolic Disorders – Introduction, Classification, Impact of genetic diseases on human health - Chromosome errors - Down syndrome, Klinefelter's and Turner's syndrome. Metabolic disorders – Phenylketonuria, Homocystinuria, Mucopolysaccharidosis, Gangliosidosis, Gaucher's disease, Diabetes, Hemophilia and sickle cell anemia. Treatment of Genetic diseases - prenatal diagnosis, Genetic Counseling - Ethical, Legal and Social Issues.

UNIT – III (10 hours)

Revolution in treatment – Recombinant DNA technology for human insulin, Hepatitis B vaccine. Therapeutic proteins and peptides – Erythropoietin, Tissue plasminogen activator, clotting factor VIII. Antibody Engineering and Therapeutic Antibodies. Phage therapy.

UNIT – IV (15 hours)

Cancer - Molecular, cellular and genetic basis of cancer, tumor virus and oncogenes, tumor suppressor genes and mechanism of action of p53 proteins. Stem Cells - Sources and types of stem cells, Stem cell transplant and its types, Potential targets for stem cell treatment, Therapeutic applications of stem cells, Regenerative medicine and Stem cell ethics.

UNIT – V (10 hours)

Gene therapy- basic approaches and types of gene therapy, vectors used in gene therapy, application of gene therapy in medicine. Nanobiotechnology - Introduction, types and structures of nanoparticles, biosynthesis of nanoparticles, application of nanoparticles in treatment.

MEDICAL BIOTECHNOLOGY PRACTICALS
(1 Credit)

Practicals:

1. Biochemical test for identification of bacteria
2. Extraction and separation of Antigen proteins from Bacteria & protozoa
3. Estimation of blood glucose.
4. Estimation of cholesterol in blood.
5. Estimation of iron in blood.
6. Biological synthesis of nanoparticles
7. Detection of plasmodium pathogen using peripheral smear
8. Widal test.

Text Books:

- Glick B.R. and Pasurank..Molecular biotechnology – Principle and Applications of Recombinant DNA- J.I.(4th edition), ASM Press. 2010.
- Anthony D. Ho, Hoffman. R, and Esmail D. Zanjani, Stem Cell Transplantation (4th edition), Wiley – liss publishers, 2006.
- Hornyak. G.L , Moore. J.J. Tibbals H.F., Dutta. J. Fundamentals of Nanotechnology (1st edition), CRC press, 2008.

Further Reading:

- Jogdand. S. N. Medical Biotechnology –, (4th edition), Himalayan publishing house, 2004.
- Freshney.I, Stacey. G. N, Auerbach.J.M, Culture of Human Stem Cells (1st edition) , Wiley – Liss publishers, 2007.

SKILL ENHANCEMENT COURSES (SEC)

Skill Enhancement Course (SEC)
PARASITOLOGY AND ENTOMOLOGY
(Credits: Theory- 2)
THEORY

Course code: UBIOT 234

Lectures: 40

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT I (10 hours)

General Consideration: Taxonomy, Transmission of parasites, Pathogenesis and pathology, Host immunity in parasitic infections, Clinical manifestations of parasitic infections, Laboratory diagnosis of parasitic infections, Prevention and control of parasitic infections.

UNIT II (5 hours)

Protozoa: *Plasmodium falciparum*- Habitat, Morphology, Pathogenesis and pathology, Host immunity in parasitic infections, Clinical manifestation and laboratory diagnosis of *P. falciparum*, its prevention and control.

UNIT III (5 hours)

Platyhelminthes: *Fasciola hepatica*- Habitat, Morphology, Pathogenesis and pathology, Host immunity in parasitic infections, Clinical manifestation and laboratory diagnosis of *F. hepatica*, its prevention and control.

UNIT IV (5 hours)

Nematodes: *Wuchereria bancrofti*- Habitat, Morphology, Pathogenesis and pathology, Host immunity in parasitic infections, Clinical manifestation and laboratory diagnosis of *W. bancrofti*, its prevention and control.

UNIT V (5 hours)

Entomology and disease transmission: Life cycles of arthropod vectors - ticks, mites, fleas, mosquitoes and flies. Vector transmitted diseases in India and control measures.

Text Books:

Parija SC, Text Book of Medical Parasitology, Protozoology & Helminthology (3rd edition), All India Publishers & Distributors (2008).

- Arora. D.R. and Arora, B, Medical Parasitology, (1st edition), CBS Publishers & Distributors, New Delhi (2002).
- Easwari Nayar, Hand Book on Medical Entomology, Kalpana Printing House, Delhi (1994).

Further Readings:

- Garcia LS, Bruckner DA. Diagnostic Medical Parasitology. American Society for Parasitology, Washington DC, (2004).
- Colle Jc, Duguid JP, Fraser AC and Marimon BP, Mackie and McCartney's Practical Medical Microbiology, 14th edition, Churchill Livingstone (2004).

Skill Enhancement Course (SEC)
GENOMICS AND PROTEOMICS
(Credits: Theory- 2)
THEORY

Course code: UBIOT 244

Lectures: 40

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT I (10 hours)

Definition: Genome organizations, Principles of gene expression, C-value paradox, Genome mapping – Physical mapping and Genetic mapping, Chromosome walking, Linkage analysis

UNIT II (5 hours)

Comparative genomics - genome annotation and analysis, Genome-based search for mutations.

UNIT III (8 hours)

Functional genomics: protein-nucleic acid interactions, RNA interference, Microarrays, Sequencing – Maxam Gilbert and Sanger's methods, Next Generation Sequencing technologies, whole genome sequencing.

UNIT IV (8 hours)

Proteomics – Introduction, Protein detection & Methods of Analysis of Proteins, Protein purification and Separation techniques, Two dimensional PAGE for proteome analysis; Image analysis of 2D gels

UNIT V (5 hours)

Protein characterization – MALDI-TOF and Peptide mass finger printing, Protein sequencing, Protein-protein interactions (Two hybrid interaction screening), Protein arrays, Applications of proteome analysis to drug development.

Text Books:

- Terence A. Brown, Genomes 2, (2nd edition) – Garland Science publishing, 2002.
- Old R.W & Primrose S. B, Principles of gene manipulation – An introduction to genetic Engineering, Black well publishers, (5th Edition), 2000.
- Helen Kreuzer and Adrienne Massey, Recombinant DNA and Biotechnology (2nd edition), ASM Press, 2001

Further Readings:

- Primrose S.B. & Twyman R.M. Principles of Genome Analysis and Genomics (3rd edition) Blackwell publishing. 2003.
- Mike Bailey and Keith Hirst, Advanced Molecular Biology, Haeper Collins Publisher Limited,(2nd edition) 2000.

Skill Enhancement Course (SEC)
SEMINAR AND FIELD VISIT
(Credits: 2)

Course code: UBIOT 351

Lectures: 40

Max. Marks =100

(ICA = 25 + Presentation = 60+Report=15)

Identifying suitable topic in Biotechnology and Literature survey. Preparation of report for the seminar presentation and Presentation of the seminar in PPT format. Discussion on the topic and evaluation.

A field Visit to any Industry/ research institutes and preparation of report based on the visit.

Skill Enhancement Course (SEC)
FISH PROCESSING TECHNOLOGY
(Credits: Theory- 2)
THEORY

Course code: UBIOT 352

Lectures: 40

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT-I (5 hours)

General Introduction and food source from fishes: Status of fish production in India – export of marine fish and fish products from India. Types of Indian fisheries: marine, estuarine and fresh water. Biology and structure of fish and shellfish in Indian coast – Fish harvesting methods – Application of fish in human diet: Proximate analysis of fish – protein, carbohydrate, lipid, vitamins.

UNIT-II (5 hours)

Fish spoilage: Different types of food spoilage in fish and fishery products – chemical, physical and biological spoilage – post mortem changes – Fish as an excellent medium for growth of microorganisms – Microflora of fish and shellfish - Intrinsic and extrinsic factors affecting spoilage – spoilage in thermal processed products and dry fish products.

UNIT-III (10 hours)

Quality assessment: Quality assurance, total quality management: GMP/; GLP, GAP; Sanitary and hygienic practices; HACCP; Quality manuals, documentation and audits; Indian and international quality systems and standards like ISO and food codex; Export and import policy, export documentation; Laboratory quality procedures and assessment of laboratory performance; Applications in different food industries; food adulteration and food safety. IPR and patent.

Unit IV (10 hours)

Fish processing methods: Scope of food processing; historical developments; principles of food processing and preservation. Principles of fish preservation - precautions taken in handling fish in the fishing vessel - landing center and processing plant – Importance of hygiene and sanitation in fish handling – quality of water and ice – common equipment and tools used in the processing plant: rafter, ovens, dryers. Principles, process and applications in fish processing technologies: Drying, salt curing, marinating, freeze drying, canning and irradiating methods.

Unit V (10 hours)

Fishery products (Production and preservation methods): Fishery products – chitin, chitosan, shark fin and fin rays, fishmeal, fish oil, shark liver oil, fish maws and icing glass, fish skin leather, fish extract, shrimp extract, fish glue, fish fertilizer, fish silage, fish sausage, F.P.C. laminated Bombay duck, fish soup powder, fish wafer, fish cutlet, fish ball, fish fingers and fish cake.

Text Books

- Balachandran KK. 2001. Post-harvest Technology of Fish and Fish Products. Daya Publ. House.
- Gopakumar K. 2002. Text Book of Fish Processing Technology. ICAR. Hall GM. (Ed). 1992. Fish Processing Technology. Blackie.

Reference Books

- Rahman MS. 2007. Handbook of Food Preservation. 2nd Ed. CRC Press. Sen DP. 2005.

- Advances in Fish Processing Technology. Allied Publ. Wheaton FW & Lawson TB. 1985. Processing Aquatic Food Products. John Wiley & Sons.
- Windsor M & Barlow. 1981. Introduction to Fishery Byproducts. Fishing News (Books)

Skill Enhancement Course (SEC)
MOLECULAR DIAGNOSTICS
(Credits: Theory- 2)
THEORY

Course code: UBIOT 361

Lectures: 40

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT-I (8 hours)

Genetics and diagnostics: General features of Chromosomes, chromosome banding patterns, banding techniques and their correlates, karyotyping, DNA profiling hybridization arrays. Early detection of diseases.

UNIT-II (10 hours)

Molecular methods: Nucleic acid extraction: principles and methods. Assessing purity and concentration of nucleic acids, PCR- basic and applied - Alu-PCR, Hot start PCR, PCR-ELISA, Arbitrarily primed PCR, *in situ* PCR.

UNIT-III (10 hours)

Nuclear hybridization methods, Single nucleotide polymorphisms and plasmid finger printing in infections, PFGE, DGGE. Detection of mutation using ARMS-PCR and microsatellite markers.

UNIT-IV (8 hours)

Allele susceptibility test for multifactorial disorders (Neural tube defect, cleft-lip and palate, cardiovascular disorder, male infertility)

UNIT-V (4 hours)

Cell sorting- Flow cytometry and FACS. Neonatal and prenatal diagnosis. Sex identification in forensics.

Text Books:

- Wilson, K. and Walker, J. Practical Biochemistry – Principles and techniques 7th edition, 2010, Cambridge University Press,
 - Primrose Sandy B. and Richard Twyman, Principles of Gene Manipulation and Genomics (7th Edition), Wiley-Blackwell 2006.
- Brown T. A, Gene Cloning and DNA Analysis: An Introduction, (6th Edition) Wiley-Blackwell, 2010.

Further Reading:

- Terence A. Brown, Genomes 2, (2nd edition) – Garland Science publishing, 2002.
- Old R.W, Primrose S.B, Twyman R. M, Principles of Gene manipulation (6thed.), Wiley-Blackwell, 2002.

Skill Enhancement Course (SEC)
ENTREPRENEURIAL DEVELOPMENT, BIOSAFETY, BIOETHICS AND IPRs
(Credits: Theory- 2)
THEORY

Course code: UBIOT 362

Lectures: 40

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT- I (5 hours)

Introduction– Demand survey of a product – Identifying a product line – Design and Developing the process – Economics of scale – Essentials of a project report in business.

UNIT- II (10 hours)

Resources – Choice of location – Energy requirement – skilled manpower government interface / laws, excise duty, sales tax – Labour, Factories / industries; Department compliance – Licenses – Permissions – rules and regulations of export – import.

UNIT- III (7 hours)

Concept of GLP and GMP. Bioethics – social and legal issues. Biosafety and its types, environmental fallout. Principles and practices – containment facilities, Disposal of biowates.

UNIT- IV (8 hours)

IPRs convention on Biological Diversity (DBD), Geographical Indicators, procedures. Biodiversity Protection Act 2003 (GOI).

UNIT- V (10 hours)

Indian Patenting Act 2003, Patent Registration procedure. Information and services. Patent Application US /EU patent procedures, WIPO, copy rights, conflict of interest and trademarks.

Text Books:

- Hisrich R D and Peters M P, “Entrepreneurship”, (5th ed), Tata Mc Graw-Hill, 2002.
- Narayanaswamy S., Youth development in the new millennium, (1sted), Discovery publishing house, 2003.
- Satheesh. M. K. Biosafety and Bioethics, (1st edition), I.K. International publishing house pvt. ltd., 2008

Further Reading:

- Anand Saena, Sharma R. A, Entrepreneurship motivation performance rewards, (2nd ed) Deep and Deep publications, 2005.
- Verma S.B, Entrepreneurship and employment - Strategies for human recourse development, (2nd ed) Deep and deep publications, 2005.
- Ignacimuthu. S, Bioethics, (1st edition), Alpha Science International, 2009

GENERIC ELECTIVES (GE)

Generic Elective (GE)
DEVELOPMENTAL BIOLOGY
(Credits: Theory- 3)
THEORY

Course code: UBIOT 358

Lectures: 40

Max. Marks =100 (ICA = 25 + ESE = 75)

UNIT I - (5 hours)

Basic concepts of development biology - Cell fate and commitment; Mechanisms of development commitment, mosaic and regulative development, maintenance of differentiation, pattern formation and compartments, morphogenesis

UNIT II - (10 hours)

Vegetative and Reproductive anatomy of Plants: Root apical meristem – Root cap, Root hairs, Root architecture; Shoot apical meristem- vascular tissue, Shoot architecture; Leaf-structure and types ; Flower- structure, sepal and petal, stamans, carpels, nector; Pollen and ovules- structure of pollen, embryo sac, pollination and fertilization; seed- definition, seed coat, endosperm, embryo; fruit- fruit structure, indehiscent fruits, seed dispersal.

UNIT III - (10 hours)

Plant Embryology: Anther structure and development, anther wall, tapetum- types and function, Microsporogenesis - Successive division, dehiscence of anther; microsporangium-structure of pollen grain, development, nemec phenomenon. Megasoprangium - structure of ovule, types and development of ovule. Megasoprogenesis - female gamete structure and development; Double fertilization- process, porogamy, chalozogamy, mesogamy.

UNIT IV - (10 hours)

Animal development - Gametogenesis – Spermatogenesis: formation of spermatids - multiplication phase, growth phase, maturation phase, spermiogenesis, formation of head of spermatozoan, changes in nucleus, acrosome formation, tail formation and other events, structure of sperm cell. **Oogenesis** – multiplication phase, growth phase – perivitellogenesis, Growth of nuclear substance, gene amplification, vitellogenesis, cortical differentiation, maturation of egg, menstrual cycle, structure of ovum.

UNIT V - (5 hours)

Fertilization: Acrosome reaction, fertilization, fertilization membrane formation, post fertilization changes, zygote. **Cleavage and gastrulation:** Cleavage, blastula, morula, gastrulation, formation of three germ layers – ectoderm, endoderm and mesoderm.

Text Books:

- Scott. F. Gilbert, Developmental Biology;(6th ed.) Sinauer Associates, INC., Publishers, Sunderland, Massachusetts. (2000).
- Inderbir Singh, Human Embryology (6th ed.), Macmillan India Limited (1996).

- Bilgrami K.S., Srivastava L.M., Shreemali S.L., Fundamentals of Botany, (2nd ed.) VIKAS Publishing House PVT LTD (1979).

Further Readings:

- Jonathan Slack. Essential Developmental Biology. (1st ed.) Blackwell Science (2001).
A.J.Lack and D.E. Evans, Instant notes in Plant Biology, (1st ed.) Bios Scientific Publishers Limited (2001)

Generic Elective GE -2
Project Work
(Credits: 3)

Course Code: UBIOT 368

Lectures: 60

Max. Marks =100

(ICA = 20 + Dissertation = 70+Viva voce=10)

With a view to develop creative thinking, team spirit and skill, a project work at preliminary level will be assigned to students, in groups. The project period is spread over about 4 months (i.e. from January to April) with a weekly work load of four hours. Project will be of a long assignment paper type, combined with field and lab work. Topics for project will be chosen from classical and applied fields.

It carries a maximum of 100 marks which include 20 marks for ICA, 70 marks for project report (valued by both External examiner and Internal Examiner- average mark will be calculated) and 10 marks for viva voce (valued by both External examiner and Internal Examiner- average mark will be calculated). The project report in the form of dissertation is prepared and submitted by the students will be evaluated by the External Examiner who attends to practical examination work, relating to semester VI. Head of the Department will chair the evaluation panel and proceedings of viva.