

# **PONDICHERRY UNIVERSITY PUDUCHERRY**

## **B.Sc. / B.Sc (Honors) Biotechnology**

**(NEP compliance - CBCS Pattern)**

**Effective for the Academic Year 2023 - 2024**



**Syllabus & Regulations**

**2023-2024 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 in biotechnology as NEP.

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

NEP Framework has specified the minimum number of credits that a Bachelor student has to earn in 3 or 4 year period. Table I specifies the number of credits and number of courses that a 3 year UG student is expected to complete in 3 duration.

**TABLE I**  
**BREAKUP OF CREDITS AND COURSES**

Sl.No.	Component	3+1 Year Degree
1.	Major Disciplinary Courses	84 Credits (21 Courses of 4 credits each)
2.	Minor Discipline Courses	35 Credits (9 Courses of 4 or 3 Credits each)
3.	Multi-Disciplinary Courses	9 Credits (3 courses of 3 credits each)
4.	Ability Enhancement Courses	8 Credits (4 courses of 2 credits each)

5.	Skill Enhancement Course	13 Credits (4 courses of 4 or 3 credits each)
6.	NEP Common Value added courses	8 Credits (4 course of 2 credits each)
7.	Winter Internship Community Engagement	3 Credits (1 field based course)
8.	Total ( 3 +1 year) credits required	160 Credits

Every Undergraduate (UG) programme offered by a College shall conform to the Structure specified by the UGC's Framework, 2023. A student of 3 year UG programme is mandated to complete a of 120-132 credits and 4 year programme is mandated to complete a 160-172 credits. An UG student shall complete the following courses under different heads as listed below:

1. Major Disciplinary Courses
2. Minor Disciplinary Courses
3. Multi Disciplinary Courses
4. Ability Enhancement Courses
5. Skill Enhancement Courses
6. Value added/Common Courses
7. Internships and Community Service based projects

### **NEP Classification of Courses:**

#### **i) Major Disciplinary courses (MJD): (60/80 credits)**

Major disciplinary courses are subject specific compulsory subjects that a student has to complete to obtain the UG/UG (Hons) Degree in the given discipline. Major disciplinary courses shall constitute 50% of the total credits.

All discipline specific major courses shall be designed for 4 credits each with one/two additional hours or guidance of teaching at Tutorials/Practicals.

UG programmes may be offered in a single major discipline or in Multiple Major disciplines giving equal weightage in credits. For example a B.Sc. course may be in a single discipline like B.Sc. (Biotechnology) or with multiple major disciplines like B.Sc. (Biotechnology, Biochemistry & Bioinformatics).

**ii) Minor Disciplinary Course (MID): (24/32 credits)**

Minor disciplinary courses refer to those subjects which are Allied/Specialisation/Elective subjects to the Major discipline. These allied courses are expected to provide additional understanding of the subject in a specific focused area. For example a B.A. (Political Science) student shall study allied subjects like Public Administration, Sociology as these subjects have inter linkages with the Major Disciplinary subjects.

**iii) Multi-Disciplinary courses (MLD): (9 Credits)**

All undergraduate students are mandated to pursue 9 credits worth of courses in such Multi-disciplinary areas/Courses out of 9/10 NEP defined subjects. Colleges may identify any 3 multiple disciplinary streams listed below based on availability of resources and manpower.

- a) Natural Sciences
- b) Physical Sciences
- c) Mathematics & Statistics
- d) Computer Science/Applications
- e) Data Analysis
- f) Social Sciences
- g) Humanities
- h) Commerce & Management
- i) Library Science
- j) Media Sciences, etc.

Students are expected to learn basic/introductory courses designed by other departments for this purpose. Colleges may list any 3 introductory courses (one each in natural Sciences, Physical Sciences, Humanities) for uniform adoption of all UG students.

**iv) Ability Enhancement (AEC) courses: (8 Credits)**

All Undergraduate (UG) students are mandated to complete at least 8 Credits worth of Courses which focus on Communication and Linguistic skills, Critical reading, and writing skills. These courses are expected to enhance the ability in articulation and presentation of their thoughts at workplace. Colleges may design these ability enhancement courses tuned to the requirements of given major discipline. Eg. A course in Business Communication is more appropriate in place of literature/prose/poetry.

a) English Language

Ability Enhancement Course	
I. English Language a) English Language & Literature – 1 and 2 b) Functional English – 1 and 2 c) Communicative English – 1 and 2	II. Indian Language (two courses) a) Indian language & Literature – 1 and 2 b) Functional language – 2 c) Communicative language – 1 and 2

v) Skill Enhancement Course: (9 Credits)

These courses focus at imparting practical skills with hands-on Training. In order to enhance the employability of students, Colleges are expected to design such courses that they deem fit for their students for better employment/entrepreneurship/career development, e t c . Colleges may also outsource the Skill Enhancement Courses to AICTE approved agencies for conducting short term Training Workshops, Skill India initiatives of GOI and approved Trades by Skill development of corporation are to be considered. Short term courses.

vi) Value Added Common courses (VAC): (8 credits)

Under NEP, the UGC has proposed for 6 to 8 credits worth of common courses which are likely to add value to overall knowledge base of the students. These courses include:

- a) Understanding India
- b) Environmental Sciences/Education
- c) Digital and Technological solutions
- d) Health, Wellness, Yoga Education, Sports & Fitness

The course structure and coverage of topics are suggested by UGC in its draft documents, colleges/UG Boards of Studies may design the methodology for conducting these value added courses.

vii) Summer Internship (2 to 4 Credits)

As per the UGC guidelines all UG students should be exposed to 4 to 6 week Summer Internship in an industrial organisations /Training Centres/Research Institution, etc. Such Summer Internship is to be conducted in between 4<sup>th</sup> Semester and 5<sup>th</sup> semester. A review of report and award of grade based on Work based learning by students is to be recorded during the 5<sup>th</sup> Semester.

a) Community Engagement and Service (CES) (2 credits)

All UG students are also mandated to participate in a 15 days community engagement activity during their winter vacation between 5<sup>th</sup> and 6<sup>th</sup> Semesters. This Community engagement activity is expected to expose the students to social problems of neighbourhood village students may prepare a report on the activities carried out for an award of 2 credits.

**7.3.1 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 (Major, Minor, Multi-Disciplinary, Skill Enhancement, Value Added 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:

**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 consists 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.

## 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.
- 12.3** 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.
- 13.4** Faculty to Students Ratio: The Faculty to Student Ratio in all the practical/ laboratory classes shall be maintained at 1:25
- 13.5** End-semester examination shall be conducted for all courses offered. The duration of the end-semester examination shall be 3 hours.
- 13.6** Every student has to pay examination fee per Credit basis as fixed by the University.
- 13.7** A schedule of end-semester examinations will be prepared and displayed by the University much in advance.
- 13.8** 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.
- 13.9** 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.
- 13.10** 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.

### SCHEME OF EXAMINATION

Total Marks: 100

Internal: 25 & External: 75 for theory courses,

Internal: 50 & External: 50 for practical courses,

Internal: 25 & External: 75 for field work/ internship/project

### 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 Assessment Guidelines for Practical Courses: 100 marks**

**a. Internal Assessment: 50 marks**

- Practical Performance (Laboratory): 20 marks
  - observation notes : 15 marks
- Attendance: 15 marks
  - 95% - 100% (15 marks)
  - 90% - 94% (12 marks)
  - 85% - 89% (9 marks)
  - 80% - 84% (6 marks)
  - 75% - 79% (3 mark)

**b. External Assessment: 50 marks**

- Major Experiment: 20 marks
- Spotters: 15 marks
- Practical Record Note: 15 marks

**14.4 Internal Assessment Guidelines for Field Work / Project Work / summer winter internship: 100 marks**

**a. Internal Assessment: 25 marks**

- Attendance- 15 marks
- Observation Notebook- 10 marks

**b. External Assessment: 75 marks**

- Final Thesis / report – 50 marks
- Viva voice / presentation – 25 marks

**14.5** 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. 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% attendance 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** According to NEP 2020, undergraduate programs provide the flexibility to exit at different stages. Students will receive the following certifications upon completion of specific years:
- 14.11** Students choosing to exit after the first year will be conferred the UG Certificate in Biotechnology, granted they have accumulated a minimum of 40 credits. Additionally, they must complete a work-based vocational course or internship worth 4 credits during the summer break of the first year.
- 14.12** Those opting to exit after the second year will be granted the UG Diploma in Biotechnology upon earning a minimum of 80 credits. Similar to the first-year exit, they must undertake a work-based vocational course or internship of 4 credits during the summer break of the second year.
- 14.13** Students choosing to exit after three years will be awarded the UG degree in B.Sc. Biotechnology, provided they have earned a minimum of 120 credits.
- 14.14** Those completing the full four-year program will be conferred the UG degree as B.S. Honors in Biotechnology after accumulating a minimum of 160 credits.
- 14.15** Result Passing Board for each Programme of Study shall be constituted by the Pondicherry University from time to time.
- 14.16** 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.

<b>Question Paper Pattern</b>	
<b>SECTION – A: (10 x 2 = 20 Marks)</b>	<ul style="list-style-type: none"> <li>• It is of short answer type. Each question carries 2 marks.</li> <li>• 10 questions to be given by setting 2 questions from each unit.</li> <li>• Candidate should Answer all the questions.</li> </ul>
<b>SECTION – B: (5 x 5 = 25 Marks)</b>	<ul style="list-style-type: none"> <li>• It is of short answer type. Each question carries 5 marks.</li> <li>• 5 questions to be given on internal choice of two (either or type). Two questions of internal choice must be from the same unit.</li> <li>• Candidate should answer ALL questions.</li> </ul>
<b>SECTION – C: (3 x 10 = 30 Marks)</b>	<ul style="list-style-type: none"> <li>• It is of essay answer type. Each question carries 10 Marks.</li> <li>• 5 questions to be given by setting 1 question from each unit</li> <li>• Candidate should Answer 3 questions out of 5 questions.</li> </ul>

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

- Title of the course taken by the student Number of credits allotted to the course
- The grades secured by the student in each course
- Total number of credits earned by the student in that semester
- SGPA of the student
- Total number of credits earned by the student till that semester
- 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.,

$$\text{SGPA (Si)} = \Sigma (C_i \times G_i) / \Sigma C_i$$

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

$$\text{CGPA} = \Sigma (C_i \times S_i) / \Sigma C_i$$

where  $S_i$  is the SGPA of the  $i^{\text{th}}$  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 transcript.

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

## 20.1 Computation of SGPA and CGPA

### 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

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

### 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:

$$\text{SGPA} = (8 \times 4 + 8 \times 2 + 7 \times 3 + 7 \times 3 + 6 \times 3 + 0 \times 3) / (4 + 2 + 3 + 3 + 3 + 3) = (32 + 16 + 21 + 21 + 18 + 00) / 18 = 108 / 18 = 6.00 \text{ Out of } 10.00.$$

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 =

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



**COURSE STRUCTURE CREDITS AND WORK HOURS ON A SEMESTER BASIS IN ACCORDANCE WITH THE NATIONAL EDUCATION POLICY (NEP) FOR ACADEMIC**

<b>SEMESTER I</b>				
<b>Code No</b>	<b>Nature of Course</b>	<b>Title of the Course</b>	<b>Credits</b>	<b>Teaching hrs</b>
MJD 01	Major Disciplinary courses	Cell biology	4 (T)	4
MID 01	Minor Disciplinary courses	Chemistry for Biology	4 (T)	4
MLD 01	Multi-Disciplinary courses	Microbiology	3 (T)	4
SEC 01	Skill Enhancement Course	Biotechnological laboratory technique -I	3 (P)	6
AEC 01	Ability Enhancement courses	English or Tamil / Hindi / French	2 (T)	4
VAC 01	NEP Value added common courses I	Understanding India	2 (T)	4
	NEP Value added common courses II	Environmental Studies	2 (T)	4
<b>Total Credits/ Total Hours of Work</b>			<b>20 Credit</b>	<b>30 Hours</b>
<b>SEMESTER II</b>				
<b>Code No</b>	<b>Nature of Course</b>	<b>Title of the Course</b>	<b>Credits</b>	<b>Teaching hrs</b>
MJD 02	Major Disciplinary courses	Introduction to Biotechnology	4 (T)	4
MID 02	Minor Disciplinary courses (choose any one)	Intermediary metabolism	4 (T)	4
MLD 02	Multi- Disciplinary courses	Application of Biotechnology	3 (T)	4
SEC 02	Skill Enhancement Course	Biotechnological laboratory technique –II	3 (P)	6
AEC 02	Ability Enhancement courses	English or Tamil / Hindi / French	2 (T)	4
VAC 02	NEP Value added common courses I	Health, Wealth, Yoga & Sports	2 (T)	4
	NEP Value added common courses II	Digital Technologies	2 (T)	4
<b>Total Credits/ Total Hours of Work</b>			<b>20 Credit</b>	<b>30 Hours</b>

**YEAR 2023-2024**

The Practical Paper is structured to be conducted in batches, with class divisions occurring if the student enrollment surpasses 25.

Students choosing to conclude their studies after the first year will receive a **Certificate in Biotechnology**, contingent upon achieving a **minimum of 42 credits**. Additionally, they must fulfill a work-based vocational course or internship, earning 4 credits, during the summer break of the first year.

SEMESTER III				
Code No	Nature of Course	Title of the Course	Credits	Teaching hrs
MJD 03	Major Disciplinary courses	Molecular biology & Genetics	4(T)	5
MJD 04	Major Disciplinary courses	Analytical techniques in Biology	4(T)	5
MID 03	Minor Disciplinary courses (choose any one)	Plant Science	3(T) +1(P)	6
MLD 03	Multi- Disciplinary courses	Parasitology and entomology	3 (T)	4
SEC 03	Skill Enhancement Course	Biotechnological laboratory technique -III	3 (T)	6
AEC 03	Ability Enhancement courses	English or Tamil / Hindi / French	2 (T)	4
<b>Total Credits/ Total Hours of Work</b>			<b>20 Credit</b>	<b>30 Hours</b>
SEMESTER IV				
Code No	Nature of Course	Title of the Course	Credits	Teaching hrs
MJD 05	Major Disciplinary courses	Immunology	4 (P)	6
MJD 06	Major Disciplinary courses	Genetic Engineering	3(T) +1(P)	6
MJD 07	Major Disciplinary courses	Animal Science	3(T) +1(P)	6
MID 04	Minor Disciplinary courses	Scientific writing & Presentation skills	3 (T)	4
AEC 04	Ability Enhancement courses	English or Tamil / Hindi / French	2 (T)	4
VAC 03	NEP Value added common courses I	Winter Training	3 (T)	4
<b>Total Credits/ Total Hours of Work</b>			<b>20 Credit</b>	<b>30 Hours</b>

The Practical Paper is structured to be conducted in batches, with class divisions occurring if the student enrollment surpasses 25.

Students choosing to conclude their studies after the second year will receive a **Diploma in Biotechnology** upon achieving a minimum of 84 credits. Additionally, they must undertake a work-based vocational course or internship worth 4 credits during the summer break of the second year

SEMESTER V				
Code No	Nature of Course	Title of the Course	Credits	Teaching hrs.
MJD 08	Major Disciplinary courses	Bioprocess technology	3(T) +1(P)	6
MJD 09	Major Disciplinary courses	Animal Biotechnology	3(T) +1(P)	6
MJD 10	Major Disciplinary courses	Environmental biotechnology	3(T) +1(P)	6
MID 05	Minor Disciplinary courses	Developmental Biology	4(T)	6
SEC 04	Skill Enhancement Course	Summer Internship	4(T)	6
<b>Total Credits/ Total Hours of Work</b>			<b>20 Credit</b>	<b>30 Hours</b>
SEMESTER VI				
Code No	Nature of Course	Title of the Course	Credits	Teaching hrs
MJD 11	Major Disciplinary courses	Plant biotechnology	3(T) +1(P)	6
MJD 12	Major Disciplinary courses	Bioinformatics	3(T) +1(P)	6
MJD 13	Major Disciplinary courses	Pharmaceutical biotechnology	3(T) +1(P)	6
MJD 14	Major Disciplinary courses	Marine Biotechnology	3(T) +1(P)	6
MID 06	Minor Disciplinary courses	Genomics & Proteomics	4(T)	6
<b>Total Credits/ Total Hours of Work</b>			<b>20 Credit</b>	<b>30 Hours</b>

The Practical Paper is structured to be conducted in batches, with class divisions occurring if the student enrollment surpasses 25.

Students who choose to withdraw will receive a Bachelor of Science (B.Sc.) degree in Biotechnology upon successfully completing three years, provided they have accumulated a minimum of 124 credits.

SEMESTER VII				
Code No	Nature of Course	Title of the Course	Credits	Teaching hrs.
MJD 15	Major Disciplinary courses	Medical biotechnology	3(T) +1(P)	5
MJD 16	Major Disciplinary courses	Industrial Biotechnology	3(T) +1(P)	5
MJD 17	Major Disciplinary courses	Agricultural Biotechnology	3(T) +1(P)	5
MID 08	Minor Disciplinary courses	Molecular Diagnostics & Forensic Science	4(T)	5
MID 09	Minor Disciplinary courses	Biophysics	4(T)	5
Total Credits/ Total Hours of Work			20 Credit	25 Hours
SEMESTER VIII				
Code No	Nature of Course	Title of the Course	Credits	Teaching hrs
MJD 18	Major Disciplinary courses	Nanotechnology	3(T) + 1(P)	5
MJD 19	Minor Disciplinary courses	Enzyme technology	3(T) + 1(P)	5
RP 01	Research Project (OR)  3 Major Disciplinary Course	Project	12 (OR)	15 (OR)
MJD 20		Biological Data Analysis	3(T) + 1(P)	5
MJD 21		Fermentation Technology	3(T) + 1(P)	5
MJD 22		Biotechnology Entrepreneurship & IPRs	4(T)	5
Total Credits/ Total Hours of Work			20 Credit	25 Hours

The Practical Paper is structured to be conducted in batches, with class divisions occurring if the student enrollment surpasses 25.

# SYLLABUS SEMESTER – I

## CELL BIOLOGY

(Credits: Theory-4)

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

### Course objectives:

The course is aimed to impart knowledge of structural and functional aspects of cells as unit of living systems.

To understand functions of various organelles and transport of information and matter across cell membrane and classical genetics comprising Mendelian laws of inheritance and their significance in genetic diseases.

### 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, 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 proteins involved in cell cycle check points. Basics in cell signaling- signaling molecules and receptors, G protein coupled receptors, Tyrosine kinase receptor, apoptosis and necrosis.

### Course Learning Outcomes (CLO)

1. acquire knowledge about the organizational and functional aspects of cell and cell organelles  
**Students** will be able to
2. learn about the interactions of the cells with outside environment through exchange of information and transport of molecules.
3. learn about the classical genetics and transmission of characters from one generation to the next which will make foundation for the advanced genetics.
4. develop innovative research ideas for curing genetic disorders in humans 1. Microscopic techniques- light microscopy.

**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 Darnell, 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

## CHEMISTRY FOR BIOLOGY

(Credits: Theory-4)

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

### Course objective:

The Students will know the basics of organic chemistry, how the collection of thousands inanimate molecules that constitute living organisms interact to maintain and perpetuate life governed solely by the physical and chemical laws as applicable to the nonliving thing.

To emphasize the role of biomolecules by providing basic information on metabolism.

### UNIT-I (10 hours)

**Bio Organic Chemistry:** Functional groups of Biomolecules, Geometry of C bonding, chirality and 3D structure- configuration, confirmations, steric hinderance. Setero isomers and geometric isomers. Stereo specific interactions, chemical bonding and intramolecular forces.

### UNIT-II (15 hours)

**Chemistry of Carbohydrates:** Definition, nomenclature and classification. Monosaccharides - Optical isomers and configurations (D&L), Fischer's, Haworth Projections and Conformations (chair and boat), Formation of Hemiacetyl / Hemiketyl linkage, Cyclic structures ( $\alpha$  &  $\beta$ ) and Mutarotation. Hexose derivatives. Disaccharides and glycosidic bonds. Polysaccharides - Starch, Bacterial Peptidoglycan and Extracellular matrix (Glycosaminoglycans). Glycoconjugates.

### UNIT-III (15 hours)

**Chemistry of Amino acids & Proteins:** Classification, Structure and Properties of amino acids, proteogenic and non proteogenic aminoacids, unusual aminoacids, amphoteric nature, Zwitter ion, isoelectric point and pK<sub>a</sub> Value, Ramachandran plot for amino acids. Peptide bond formation - Planar structure, stabilization & peptide conformation ( $\phi$  &  $\psi$ ). Peptide hormones (glucagon) and antimicrobial peptides. Structural classification of proteins, Forces stabilizing the 3D structure of proteins, Protein denaturation and folding. Molecular chaperons, Protein misfolding and genetic disorders. Oxygen binding proteins (Hemoglobin & Myoglobin) and Histones.

### UNIT-IV (10 hours)

**Chemistry of Lipids:** Nomenclature and Classification, Structure and function of storage lipids (Triacylglycerols), membrane lipids (Phospholipids, Glycolipids and Archeal ester lipids), Intracellular signals (Phosphatidyl inositol), Cofactors (Vitamins) and natural pigments ( $\beta$ -carotene). Biomembranes: Behavior of amphipathic lipids in water- formation of micelles, bilayers, vesicles, liposomes. Membrane composition and organization – Fluid mosaic model.

### UNIT-V (10 hours)

**Chemistry of Nucleic acids:** Occurrence, Composition & structure of DNA and RNA, Chargaff's rules, Nucleotides as energy carrier, cofactors & regulatory molecules (cyclic AMP). Unusual structures in DNA (Palindrome, mirror repeats, hairpins and cruciform), Structural polymorphism in DNA, DNA stability, DNA Denaturation (C<sub>ot</sub> value and T<sub>m</sub>), DNA hybridization, Molecular Concept of prokaryotic and eukaryotic genes: introns, exons, spacers. Chromosomes: chromatin, centromere & Telomere, Role of telomere and centromere, telomeric and centromeric repeat sequences, karyotyping. Central dogma of life.

**Course Learning Outcomes (CLO):**

Students will be able to

1. know the chemical constituents of cells, the basic units of living organisms.
2. explain various types of weak interactions between the biomolecules.
3. know how the simple precursors give rise to large biomolecules such as proteins, carbohydrates, lipids, nucleic acids.
4. correlate the structure-function relationship in various biomolecules
5. know the role of biomolecules for orderly structures of the cells/tissues. 1. Extraction and

**Text Books:**

- Nelson and Cox, Lehninger. Principles of Biochemistry (7<sup>th</sup> Edition), W.H Freeman Publishers (2010).
- Voet D. Biochemistry (4<sup>th</sup> Edition), Academic Press (2012).
- Dubey R.C, A Textbook of Biotechnology (6<sup>th</sup> Edition), S. Chand Publishing, reprint, 2014.

**Further Readings:**

- Zubey G. Principles of Biochemistry, Oscar Publication (2000).
- Devlin T. M. Text Book of Biochemistry with Clinical Correlations (4<sup>th</sup> Edition) Wiley & Sons Publication (2005).
- Roy Tasker, Carl Rhodes. Stryer's Biochemistry (7<sup>th</sup> Edition) W. H. Freeman publishers(2012).



## MICROBIOLOGY

(Credits: Theory-3)

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

### Course objective:

To understand the basics of microbiology and to know the role in environment.

To provide fundamental understanding of the microbial world, basic structure and functions of microbes, metabolism, nutrition, their diversity, physiology and relationship to environment and human health.

To impart practical skills of isolation and manipulating conditions for their propagation. To ensure the students to understand about the structure and function of microorganisms.

### 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, antisepsis, 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)

### Course Learning Outcomes (CLO):

Students will be able to

1. Define the science of microbiology, its development and importance in human welfare.
2. describe historical concept of spontaneous generation and the experiments performed to disprove.
3. describe some of the general methods used in the study of microorganisms.
4. recognize and compare structure and function of microbes and factors affecting microbial growth.
5. demonstrate aseptic microbiological techniques in the laboratory and check sources of microbial contamination and their control.

**Text Books:**

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

**Further reading:**

- Sundararajan S (2003). College Microbiology, revised edition, Vardhana publications, Banglore.
- R.C. Dubey, D.K.Maheswari, A Text book of Microbiology (2005), S.Chand & C7ompany Ltd. New Delhi

## SYLLABUS SEMESTER – II

### ANALYTICAL TECHNIQUES IN BIOLOGY

(Credits: Theory-4)

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

#### Course objective:

The objective of this course is to provide the students with the understanding of various analytical techniques used in biotechnology-based research and industry.

The course will acquaint the Students with the various instruments, their configuration and principle of working, operating procedures.

In this course, the students will be exposed to basic concepts related with techniques and instrumentation widely used in Biotechnology.

#### UNIT – I (12 hours)

**Solutions:** Water- Structure and interaction, water as solvent, pH, Bronsted- Lowry concept of acid and bases, ionization, Buffer: Henderson-Hasselbalch equation, Biological buffer system (bicarbonate, phosphate buffers and Tris buffers), Determination of molecular weight- molarity, molality, normality, equivalent weight.

#### UNIT – II (14 hours)

**Spectroscopy:** Colorimetry, Basic principles, Beer-Lamberts law, instrumentation and application of UV-Vis and IR spectroscopy, 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. Application of chromatographic technique – separation of biomolecules

#### UNIT – IV (14 hours)

**Electrophoresis** – Principle, DNA and RNA gel electrophoresis, Protein gel electrophoresis – SDS PAGE, native-PAGE, documentation, 2D-electrophoresis, Isoelectric focusing.

**Tracer techniques:** nature of radioactivity, isotopes, radioactive decay,  $\alpha$ ,  $\beta$  and  $\gamma$  radiation, Scintillation counter, application of radioisotopes in biological sample.

#### UNIT – V (18 hours)

**Bio-Physical Techniques:** Crystallography: basic concepts & laws, symmetry of elements in crystal X-ray crystallography, determination of crystal structure. Fluorescence: concepts, emission, chemi-luminescence, luminometry. NMR-2D & 3D structure prediction.

#### Course Learning Outcomes (CLO):

At the end of the course students will be able perform biochemical assays, electrochemical techniques, spectrophotometry and chromatography.

1. Apply basic principles of different analytical techniques in analytical work.
2. Use spectroscopy and radioactivity in biotechnological applications
3. Use microscopy, centrifugation and electrophoretic techniques.
4. Demonstrate principle and working of various instruments.
5. Use various techniques for solving industrial and research problems.

**Text Books:**

- Wilson, K. and Walker, J. Practical Biochemistry – Principles and techniques 7<sup>th</sup> edition, 2010, Cambridge University Press,
- Brawer, I M., Perce, A.M., Experimental techniques in Biochemistry. Prentice Hall Foundation, New York 2012.

**Further Readings:**

- Joseph Sambrook and David. W. Russel, Molecular Cloning- A laboratory manual, 4<sup>th</sup> edition, 2012, Cold spring harbor press.

## IMMUNOLOGY

(Credits: Theory-4)

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

### COURSE OBJECTIVES:

To introduce the science of immunology and detailed study of various types of immune systems and their classification, structure and mechanism of immune activation. And to get conceptual views about transplantation and its necessity.

### 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.

### UNIT - V (15 hours)

Immune disorders 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, Hypersensitivity reactions: Type I, II, III and IV Transplantation immunology - types and mechanisms involved.

### Course Learning Outcomes (CLO):

Students will be able to

1. Describe and explain the fundamental principles of modern immunology.
2. Understand and apply related immunological techniques in medical laboratory.
3. Relate and apply medical laboratory science knowledge to immunological changes in healthy and disease contexts.

### Text Books

- Roit, I.M., Delves P.J., Essential Immunology (10<sup>th</sup> edition), Blackwell Science, Oxford 2001
- Immunology by Kubly, J. (8<sup>th</sup> edition) W.H. Freeman and Company, New York, 2013
- Kumar. M.S, Leela K Sai, Microbiology and Immunology (2<sup>nd</sup> 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 (4<sup>th</sup> edition), Blackwell science 2002

## BIOCHEMISTRY

(Credits: Theory-3)

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

### Course objective:

The course aims to introduce the theories and concepts of biomolecules, provide an advanced understanding of the core principles and topics of biomolecule metabolism and their experimental basis and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of lecture series

### UNIT-I (10 hours)

**Bioenergetics:** 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 (10 hours)

**Introduction to Metabolism:** Anabolic, catabolic and amphibolic pathways. Enzymes in metabolism: Nature of enzymes - protein and non-protein (ribozyme). Cofactor and prosthetic group, active site, allosteric site, apoenzyme, holoenzyme, substrate inhibitor, modulator. IUBMB classification of enzymes, Fischer's and Koshland's hypothesis.

### UNIT-III (10 hours)

**Metabolism in mitochondria:** Biological oxidation - enzymes involved in oxidation and reduction, reactions catalyzed by dehydrogenases, oxidases, peroxidases and oxygenases; removing of H<sub>2</sub>O<sub>2</sub> from the biologic systems. Macroergic compounds. Respiratory chain, oxidative phosphorylation, inhibitors of the respiratory chain. The action of uncouplers; chemiosmotic theory. Glycolysis, Citric acid cycle, central role of Acetyl CoA, localization of TAC in the cell, Inborn errors: Type 1 Diabetes mellitus.

### UNIT-IV (15 hours)

**Metabolism of lipids:** Biosynthesis of fatty acids, membrane phospholipids, fatty acid synthase complex, regulation, Microsomal & Mitochondrial system of chain elongation & synthesis of unsaturated fatty acids.  $\beta$ -oxidation of fatty acids, role of carnitine, oxidation of unsaturated fatty acids & odd carbon fatty acids. Inborn errors: Disorders of Fatty acid oxidation metabolism—Medium chain acyl coenzyme A dehydrogenase deficiency.

### UNIT-V (15 hours)

**Metabolism of Nitrogenous Compounds:** Transamination (mechanism). Oxidative & Non-oxidative deamination. Urea cycle, linkage of urea & TCA cycle. Transmethylation & Decarboxylation, physiologically important products of decarboxylation. Synthesis and degradation of nucleotides (DNA). Disorders of Amino acid metabolism- Phenylketonuria, Disorders of Urea cycle— Carbamoyl phosphate synthetase I deficiency. Disorders of nucleotide metabolism – Lesch-Nyhan syndrome.

**Course Learning Outcomes (CLO):**

Students will be able to

1. Demonstrate broad knowledge of the biomolecules, machinery and information that flow within living cells and an appreciation of how these underpin all biological processes, in both normal and diseased states.
2. Demonstrate proficiency in core biochemical laboratory techniques, understanding both the principles and applications of these methods within the molecular biosciences.
3. Understand enzyme actions and kinetics

**Text Books:**

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

**Further reading:**

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