



FACULTY OF ENGINEERING & TECHNOLOGY

RAMA UNIVERSITY UTTAR PRADESH KANPUR

Rama City, G.T. Road, Mandhana, Kanpur-209217

Ref No: FET/DO/2025/037

Date: 20.08.2025

NOTICE

This is to inform all concerned that the **Board of Studies (BOS) meeting** of the Department of Biotechnology, FET will be held on **21st August 2025** at 10:00 a.m in Dean Office, FET.

All members of the Board of Studies (BOS) are requested to kindly make it convenient to attend the meeting.

Regards,

Dr. Indrajeet Gupta

Convenor

Board of Studies

Faculty of Engineering & Engineering

Rama University, Kanpur

Copy to:

1. All members of the BOS through E-Mail
2. Vice Chancellor, Rama University Uttar Pradesh, Kanpur
3. Director, Rama University Uttar Pradesh, Kanpur
4. Registrar, Rama University Uttar Pradesh. Kanpur
5. Dean Academic & Planning



HOD BIO <hodbio.fet@ramauniversity.ac.in>

Revised-Regarding your valuable suggestions/input in upcoming Board of Studies (BoS) Biotechnology Meeting on 19th August 2025

3 messages

HOD BIO <hodbio.fet@ramauniversity.ac.in>

Thu, Aug 14, 2025 at 11:09 PM

To: "lkumar@hbtu.ac.in" <lkumar@hbtu.ac.in>

Cc: Dean Engineering Rama University <deanengineering@ramauniversity.ac.in>, "Dr. Neeraj"

<dmeeraj.fet@ramauniversity.ac.in>, Ajay Kumar <drajay.fet@ramauniversity.ac.in>, Aman Pratap Singh

<amanpratapsingh.fet@ramauniversity.ac.in>, "Dr. Shraddha Sahu" <drshraddha.fet@ramauniversity.ac.in>, "Dr. Samakshi

Verma" <samakshiverma.fet@ramauniversity.ac.in>, "Dr. Renu Verma" <renuverma.fet@ramauniversity.ac.in>, "Dr. Deeksha

Ranjan" <drdeeksha.fet@ramauniversity.ac.in>, "Dr. Vivek Srivastava FET" <drviveksrivastava.fet@ramauniversity.ac.in>

Dear Sir,

Greetings from the Department of Biotechnology, FET, Rama University!

It gives us great honor to invite you to serve as an esteemed member of the Board of Studies (BoS-Biotechnology) for upcoming meeting scheduled on 19th August 2025 (Tuesday) at 10:00 A.M, to be held at Dean Office, FET, Rama University.

The agenda for the meeting includes review and discussion of the following academic programs:

B.Tech (AICTE 2020): Curriculum restructuring in alignment with the latest AICTE Model Curriculum (2020) for Biotechnology. The syllabus and evaluation scheme of biotechnology core courses are attached for your reference. Your expertise in this updated framework will be useful in ensuring academic excellence and relevance and their open elective subject syllabus are under process, we will update you as early.

B.Sc. (NEP 2020): Newly designed Board of Studies (BoS) implemented from the academic year 2024-25. Revisions are limited to modifications in evaluation and assessment criteria as per NEP 2020 guidelines. Your validated assessment for quality assurance is required and the documents related are attached.

M.Sc. and M.Tech in Biotechnology: BoS implemented from the academic year 2023-24 academic year. Discussion will focus on minor updates and suggestions to further strengthen academic rigor, research integration in order to align programs more closely with industry trends and research advancement. PG Suggestions file is attached for your concern.

Your insights and domain expertise will play a crucial role in enhancing the quality and competitiveness of our academic programs.

We request you to kindly provide us with your recommendations for obtaining a refined and up to date curriculum that meet regulatory requirements, incorporate emerging trends, and enhance academic quality.

Looking forward to your kind acceptance and advantageous contributions.

With Regards

Vivek Srivastava

On Thu, Aug 14, 2025 at 5:03 PM HOD BIO <hodbio.fet@ramauniversity.ac.in> wrote:

Dear Sir,

Greetings from Department of Biotechnology, FET, Rama University!

It gives us great honor to invite you to serve as an esteemed member of the Board of Studies (BoS-Biotechnology) for our upcoming meeting scheduled on 19th August 2025 (Monday) at 10:00 A.M, to be held at Dean Office, FET, Rama University.

The agenda for the meeting includes review and discussion of the following academic programs:

B.Tech (AICTE 2020): Curriculum restructuring in alignment with the latest AICTE Model Curriculum (2020) for Biotechnology. The syllabus and evaluation scheme of biotechnology core courses are attached for your reference. Your expertise in this updated framework will be useful in ensuring academic excellence and relevance and their open elective subject syllabus are under process, we will update you as early.

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We request you to kindly provide us with your recommendations for obtaining a refined and up to date curriculum that meet regulatory requirements, incorporate emerging trends, and enhance academic quality.

Looking forward to your kind acceptance and advantageous contributions.

4 attachments

-  **B. Tech BT Evaluation Scheme RR25 BOS.xlsx**
29K
-  **PG Suggestions.docx**
15K
-  **SYLLABUS NEW B. Tech 2025-26.docx**
159K
-  **B.Sc Biotechnology_Evaluation Scheme 2024-25(1).doc**
365K

Lalit Kumar <lkumar@hbtu.ac.in>

Tue, Aug 19, 2025 at 7:43 AM

To: HOD BIO <hodbio.fet@ramauniversity.ac.in>

Cc: Dean Engineering Rama University <deanengineering@ramauniversity.ac.in>, "Dr. Neeraj"

<drneeraj.fet@ramauniversity.ac.in>, Ajay Kumar <drajay.fet@ramauniversity.ac.in>, Aman Pratap Singh

<amanpratapsingh.fet@ramauniversity.ac.in>, "Dr. Shraddha Sahu" <drshraddha.fet@ramauniversity.ac.in>, "Dr. Samakshi Verma" <samakshiverma.fet@ramauniversity.ac.in>, "Dr. Renu Verma" <renuverma.fet@ramauniversity.ac.in>, "Dr. Deeksha Ranjan" <drdeeksha.fet@ramauniversity.ac.in>, "Dr. Vivek Srivastava FET" <drviveksrivastava.fet@ramauniversity.ac.in>

Dear Sir,

This is to inform you that the Orientation program of newly admitted students is scheduled today i.e. on 19th August 2025 in our University. As Dean Academic Affairs, I have to be there in the program, therefore not able to join the BoS meeting today. It is requested to please reschedule it after a few days.

Hope you understand the situation.
Thanks and regards

Prof. Lalit Kumar Singh
HoD, Biochemical Engineering &
Dean of Academic Affairs
HBTU Kanpur-208002

[Quoted text hidden]

HOD BIO <hodbio.fet@ramauniversity.ac.in>

Wed, Aug 20, 2025 at 5:13 PM

To: Lalit Kumar <lkumar@hbtu.ac.in>

Cc: Dean Engineering Rama University <deanengineering@ramauniversity.ac.in>, "Dr. Neeraj" <drneeraj.fet@ramauniversity.ac.in>, Ajay Kumar <drajay.fet@ramauniversity.ac.in>, Aman Pratap Singh <amanpratapsingh.fet@ramauniversity.ac.in>, "Dr. Shraddha Sahu" <drshraddha.fet@ramauniversity.ac.in>, "Dr. Samakshi Verma" <samakshiverma.fet@ramauniversity.ac.in>, "Dr. Renu Verma" <renuverma.fet@ramauniversity.ac.in>, "Dr. Deeksha Ranjan" <drdeeksha.fet@ramauniversity.ac.in>, "Dr. Vivek Srivastava FET" <drviveksrivastava.fet@ramauniversity.ac.in>

Dear Sir,

As per our telephonic discussion, this is to formally invite you to attend the Board of Studies (BOS) meeting scheduled of Department of Biotechnology on 21st August 2025 (Thursday) at 10:00 AM.

Your valuable presence and expert inputs will greatly contribute to the discussions and academic deliberations.

Meeting details:

Date: 21st August 2025

Time: 10:00 AM

Venue: Dean Office, FET, Rama University

We look forward to your participation in the meeting.

Best regards,
Dr. Vivek Srivastava

[Quoted text hidden]

**Office of the
Dean-Academic Affairs**



RAMA UNIVERSITY UTTAR PRADESH, KANPUR

(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))
Rama City, G.T. Road (Near Mandhana Railway Station)
Mandhana, Kanpur

Ref.No.: RU/DA/2025/025

DATE: 25.08.2025

NOTICE

To,

The Dean's

Faculty of Engineering & Technology.

Faculty of Agricultural Sciences & Allied Industries.

Faculty of Commerce & Management.

Faculty of Juridical Sciences.

Faculty of Pharmaceutical Sciences.

Faculty of Professional Studies.

Subject: Marks Distribution Criteria Based on Attendance.

This notice is to inform you that if attendance is selected as an assessment component for any course, the following rubrics will be applied:

Attendance Percentage	Marks
96%-100%	100% of attendance marks
91%-95%	80% of attendance marks
86%-90%	60% of attendance marks
81%-85%	40% of attendance marks
75%-80%	20% of attendance marks
Below 70%	0 Marks

It is requested to you kindly disseminate this information to all faculty members and implement the same from the current academic session.

Prof. (Dr.) Indrajeet Gupta
Dean- Academic Affairs

Dean- Academic Affairs
Rama University Uttar Pradesh
Kanpur

A

RAMA UNIVERSITY

Faculty of Engineering & Technology



B.Sc. (C

2020

ORDINANCE

For

PROGRAMME

B.Sc. (Biotechnology)/B. Sc. (Honors) in Biotechnology / B. Sc. (Honors with Research) in Biotechnology

2025-26

1. Program Name & Code

- **Program Name:** Bachelor of Science in Biotechnology (B. Sc. Biotechnology/ B. Sc. Biotechnology Honors/ B. Sc. Biotechnology Honors with Research)
- **Program Code:**1002

2. Eligibility Criteria

A candidate who has passed 10+2 Examination conducted by UP or CBSE or equivalent examinations by any Other State or any other recognized Board / Department shall be eligible for admission to First Semester U.G. Programme.

For B.Sc. Programme, a candidate who has passed 10+2 with science.

- i. A candidate opting life science subjects like Chemistry, Botany, Zoology, Biochemistry, Clinical Biochemistry, Bioinformatics, Biotechnology, Genetics, Microbiology, Home Science, etc., as Discipline Specific Core Courses (DSCC) in the B.Sc. Programme must have studied Physics, Chemistry and Biology as pre-requisite subjects at the qualifying examination.
- ii. A candidate opting subjects like Physics, Chemistry and Mathematics as DSCC must have studied Physics, Chemistry and Mathematics as pre-requisite subjects at the qualifying examination.
- iii. For other B.Sc. degree programmes such conditions shall not apply.

Eligibility for admission to Bachelor of Science (Honors)/Bachelor of Science (Honors with Research): A candidate seeking admission to a Bachelor of Science (Honors) in a Biotechnology shall have passed the relevant three-year Bachelor of Science Degree. However, for a Bachelor of Science (Honors with Research) in a Biotechnology, a minimum CGPA of 7.5 shall be the basic eligibility of three-year Bachelor of Science Degree.

3. Admission Procedure

1. Admission shall be made **strictly on the basis of merit** in the qualifying examination/entrance test conducted by Rama University (RUET) or as per guidelines of statutory bodies.
2. Reservation policy as per Government of Uttar Pradesh/University norms will be followed.
3. Final selection will be subject to verification of original documents and fulfillment of eligibility criteria.

4. Duration of Program

The duration of the B. Sc. programme is 4 years or 8 semesters. Students who desire to undergo a 3-year B. Sc. Programme will be allowed to exit after completion of the 3rd year. If a student wants to leave after the completion of the first or second year, the student will be given a B. Sc. Certificate or B. Sc. Diploma, respectively, provided they secure the prescribed number of credits. Students who exit with a B. Sc. certificate or B. Sc. diploma are permitted to re-enter within three years and complete the degree programme.

The B. Sc. programme governed by this Ordinance shall be of four (3+1) years duration with multiple Entry-Exit options during the program with appropriate certifications namely,

- (a) A Certificate in a '**Cell Biology Techniques in Biotechnology**' upon successful completion of the First Year (Two Semesters);
- (b) A '**Diploma in a Biotechnology**' upon successful completion of the Second Year (Four Semesters);
- (c) A '**Bachelor of Science in Biotechnology**' at the successful completion of the Third Year (Six Semesters);
- (d) A '**Bachelor of Science (Honors)/Bachelor of Science (Honors with Research)**' in Biotechnology at the successful completion of the Four Year (Eight Semesters).

This Ordinance shall be applicable to the students taking admission to the B. Sc. Biotechnology programme from the Academic Session 2024-25 onwards.

The curriculum for the 4-year B. Sc. programme shall be based on the LOCF-CBCS system (Learning Outcomes-based Curriculum Framework under the Choice Based Credit System) of the UGC with Value Addition Courses (VAC) as envisaged in the NEP-2020.

5. Maximum Duration

- i. The duration of the B. Sc programme is 4 years or 8 semesters. Students who desire to undergo a 3-year B. Sc Programme will be allowed to exit after completion of the 3rd year. If a student wants to leave after the completion of the first or second year, the student will be given a B. Sc Certificate or B. Sc Diploma, respectively, provided they secure the prescribed number of credits. Students who exit with a B. Sc certificate or B. Sc diploma are permitted to re-enter within three years and complete the degree programme.
- ii. Students may be permitted to take a break from the study during the period of study but the total duration for completing the programme shall not exceed 7 years.

6. Medium of Instruction

1. The medium of instruction and examination shall be English.
2. Technical terms in Hindi may be used wherever necessary to enhance comprehension.

7. Structure of the Program

Each programme shall have the components, *Viz.*,

- i) Discipline Specific Core Courses (DSCC)
- ii) Discipline Specific Elective Courses (DSEC)
- iii) Generic Elective Courses (GEC)

-

Sem.	DSCCs	DSECs	GECs	AECCs	SECs	VACs	Cr
I	CC-01 (4+ 1)	DSEC-1(4)	GEC-1(4)	AECC-1 (2+ 1)	SEC-1 (2)	VAC-1 (2)	24
	CC-02 (4)						
II	CC-03 (4+ 1)		GEC-2 (4)	AECC-2 (2)	SEC-2 (2)	VAC-2 (2)	24
	CC 04 (4+ 1)						
	CC-05 (4)						

Students on exit shall be awarded Certificate in “Cell Biology Techniques in Biotechnology” after securing the requisite 48 credits in Semester I & II

III	CC-06 (4 + 1)	DSEC-2 (4+1)	GEC-3 (4)	AECC-3 (2)		VAC-3 (2)	23
	CC-07 (4 + 1)						
IV	CC-08 (4 + 1)		GEC-4 (4)		SEC-3 (2)	VAC-4 (2)	23
	CC-09 (4 + 1)						
	CC-10 (4 + 1)						
Students on exit shall be awarded <i>“Diploma in Biotechnology”</i> after securing the requisite 94 credits on completion of Semester IV							
V	CC-11 (4)	DSEC-3 (4)		AECC-4 (2)	SEC-4 (3)		23
	CC-12 (4 + 1)						
	CC-13 (4 + 1)						
VI	CC-14 (4 + 1)	DSEC-4 (4 + 1)	GEC-5 (4)				23
	CC-15 (4)						
	CC-16 (4 + 1)						
Students on exit shall be awarded <i>“Bachelor of Science in Biotechnology”</i> after securing the requisite 142 credits on completion of Semester VI							
VII	CC-17 (4)	DSEC-5 (4)				Dissertation/ Major Project DST- 2 (6)	23
	CC-18 (4 + 1)	DSEC-6 (4)					
VIII	CC-19 (4)	DSEC-7 (4)				Dissertation/ Major Project DST-2 (6)	22
		DSEC-8 (4)					
		DSEC-9 (4)					
Students on exit shall be awarded <i>“Bachelor of Science (Honors with Research) in Biotechnology”</i> after securing the requisite 185 credits on completion of Semester VIII							
VII	CC-17 (4)	DSEC-5 (4)			SEC-5 (2)		23
	CC-18 (4 + 1)	DSEC-6(4)					
		DSEC-10(4)					
VIII	CC-19 (4+ 1)	DSEC-7 (4)					22
		DSEC-8(4)					

	DSEC-9(4)				
	DSEC-11 (4 + 1)				
Students on exit shall be awarded " <i>Bachelor of Science (Honors) in Biotechnology</i> " after securing the requisite 185 credits on completion of Semester VIII.					

8. Marks/Credits Distribution

a) Marks Distribution

Total marks for each course shall be based on internal assessment/Continuous Assessment (CA) (25%) and end term semester examination (75%). The Continuous Assessment of 25% shall be distributed as under:

- (a) MTE/PUT: 15%
- (b) CA/Quiz/Assignment/Seminar/ProjectWork/Internship/Attendance: 10%;
- (c) ETE: 75%

b) Credit Calculation

Credit defines the quantum of work-load for a course. Generally, one hour of theory or one hour of tutorial or two hours of laboratory work, per week for a duration of a semester result in the award of one credit. Credits for internship shall be one credit per one week of internship, subject to a maximum of six credits. The following mechanism shall be adopted for computation of work-load:

- (a) 1Credit = 1Theory period of one-hour duration/week/semester;
- (b) 1Credit= 1Tutorial period of one-hour duration/week/semester;
- (c) 1Credit= 1Practical period of two hours' duration/week/semester;
- (d) 1Credit= Internship of 1week/semester

The minimum credit requirements for these qualification types shall be as under:

Levels (as per UGC NEP-2020)	Qualification Title	Minimum Credit Requirements
Level-5	Certificate in Cell Biology Techniques in	48

	Biotechnology	
Level-6	Diploma in Biotechnology	94
Level-7	Bachelor of Science in Biotechnology	142
Level-8	Bachelor of Science (Honors) in Biotechnology/Bachelor of Science (Honors with Research) in Biotechnology	185

c) 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.

d) Grade Point (GP): It is a numerical weight allotted to each letter grade on a 10-point scale.

9. Evaluation Procedure

- a. **Sessional:** The laboratory course sessional evaluations shall be performed continuously based on practical performed by a student. Such evaluation may involve periodic assessment of documentation of the practical exercise/experiment, precision of experiment etc. In the case of Project /Dissertation the Internal Assessment may be based on periodical progress report.
- b. **Semester Examination:** The Semester Examination shall commence during the first week of December/May for the Odd semester/Even semester courses, respectively.
- c. **Appointment of Examiners:** Head of the department shall normally appoint the examiners for different courses, selecting at least two other than the concerned teachers, randomly for theory courses in each of the semesters. In case of Lab/Projects/Viva-Voce examinations there shall be one internal and one external examiner. A sizable panel of external examiners shall be approved by the BOS on annual basis to facilitate the appointment of external examiners.

- d. **Moderation:** A committee duly constituted by BOS as follows, shall moderate the examination papers and shall have the right to improve / change the questions to a considerable extent:
- i. Dean
 - ii. Head of the department
 - iii. Three Faculty Members nominated by the Dean
- e. **Examination & Evaluation System:** All the evaluations shall be performed in terms of marks, adding finally for each course out of 100 marks. The marks obtained by each student in courses shall be converted to Grade-Points. Uniform Grading system to be followed with uniform CGPA requirements for award of degrees at all levels and uniform conversion formulae to be followed for declaration of I, II and III divisions, distinctions etc. Declaration of division in the degree certificate to be made compulsory.
- f. **Examination:** Paper to be set by external: HOD shall ensure the coverage of syllabus. If needed moderation can be done. Evaluation to be done internally by the faculty other than the Course Instructor. Syllabus of the concerned course shall be sent to the external examiner, who shall prepare the question papers. For practical, it is recommended that examination shall be conducted by course instructor(s) and one teacher nominated by HOD.
- g. **Evaluation:** The Semester Grade Point Average (SGPA) is computed from the grades as a measure of the student's performance in a given semester. The SGPA is based on the grades of the current term, while the Cumulative GPA (CGPA) is based on the grades in all courses taken after joining the programme of study. The HEIs may also mention marks obtained in each course and a weighted average of marks based on marks obtained in all the semesters taken together for the benefit of students.

(a) Letter Grade and Grade Point Allocation:

In every course, based on the combined performance in all assessments in a particular semester as per the curriculum/syllabus, the student is awarded a letter grade. These letter grades not only indicate a qualitative assessment of the learner's performance but also carry a quantitative (numeric) equivalent called the Grade Point. The letter grades and

their equivalent grade point applicable for B.Sc. programme are given below:

Letter Grade	Performance	Percentage of Marks Obtained	Grade Points
O	Outstanding	91-100	10
A ⁺	Excellent	81-90	9
A	Very Good	71-80	8
B ⁺	Good	61-70	7
B	Above average	51-60	6
C	Average	41-50	5
P	Pass	33-40	4
F	Fail	0-32	0
AB	Absent	Absent	0
Q	Qualified		
NQ	Not Qualified		

A learner who remains absent in any form of evaluation/examination, letter grade allocated to him/her should be AB and corresponding grade point is zero. She/he should reappear for the said evaluation/examination in due course. Letter Grade is used to signify the level of qualitative/quantitative academic achievement of a student in a Course, while the Grade Point is used to indicate the numerical weight of the Letter Grade on a 10-point scale. Letter Grades 'O' to 'P' indicate successful completion of a Course, while Letter Grades 'F' and 'Ab' indicate 'fail' and 'Absent' respectively. The 10-point grading system of the UGC, as described above, will be adopted for assessment and examination of the performance of students in B. Sc. programme.

(b) Evaluation and Passing Criteria (as per NEP-2020)

- a. For qualifying papers, a Q grade will be awarded for "Qualified" and an NQ grade for "Not Qualified." All theory and practical papers of main and minor subjects are credit courses, and the minimum pass marks for these shall be 33

percent of the total. Six co-curricular courses and small projects in the third year will be qualifying in nature, with a minimum passing requirement of 40 percent.

- b. Skill Development and Vocational courses will consist of four credit-based courses, with passing marks fixed at 40 percent. Each course will be evaluated out of 100 marks, of which 50 marks shall be assigned to internship, training, or practical work and 50 marks to theory-based work. The minimum pass requirement is 40 out of 100, with no separate minimum prescribed for theory and practical components.
- c. Each course (theory or practical) shall carry a maximum of 100 marks, with 25 marks allotted for internal assessment and 75 marks for the university (external) examination. To pass each main or minor subject course, a student must secure at least 25 marks (33 percent of 75) in the external examination and obtain a minimum of 33 percent overall, including internal and external marks. For co-curricular and minor research courses, the requirement shall be at least 30 marks (40 percent of 75) in the external examination and a minimum of 40 percent overall, including internal and external marks.
- d. There will be no minimum pass requirement for internal assessment. A student securing zero in internal assessment but obtaining the required marks in the external examination (33 percent in main/minor subjects or 40 percent in co-curricular/research subjects) shall be considered as having passed. No grace marks will be awarded in any course.

Transcripts (Format): Based on the above recommendations on Letter grades, grade points, SGPA and CGPA, the Higher Education Institutions may issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters.

h. MOOCs Courses:

As per the mandates of UGC, the students have to register in the MOOCs online Courses. By keeping in the mind, the credits of B.Sc Biotechnology Graduates, they have to complete at least 12/16 credits in three/four years in their entire degree program.

i. Division and Position:

Division shall be awarded in the following manner, to the candidates on the basis of their respective CGPA:

CGPA	Division
5.000 – 5.999	Pass
6.000 - 6.999	II Division
7.000 – 7.999	I Division
8.000 & above	I Division with distinction

j. Review and Re-evaluation:

Review and re-evaluation of the answer sheets shall be as per the university rules.

k. Grade Card:

At the end of each semester, a student will be given a 'Grade Card' which will contain Course Code, Title, Credits, Grades Awarded, Earned Credits and Earned Point secured by him/her in each course, together with his/her SGPA in that semester. On the completion of the programme, a Final Grade Card will be issued to the student, giving full semester-wise details about the absolute marks and grades obtained by him/her in each course together with his/her SGPA and also the CGPA and Division awarded to him/her.

l. Equivalence:

Semester Grade Point Average (SGPA)

SGPA is the weighted average of grade points obtained in all courses of a semester.

$$SGPA = \Sigma(C_i \times G_i) / \Sigma C_i$$

Where:

C_i = Credit of the i -th course

G_i = Grade point obtained in the i -th course

Cumulative Performance Index (CPI)

CPI (sometimes called CGPA) is the weighted average of SGPA across all semesters completed.

$$CPI = \frac{\sum(SGPA_j \times T_j)}{\sum T_j}$$

Where:

$SGPA_j$ = SGPA of j -th semester

T_j = Total credits of j -th semester

Conversion to Percentage

Percentage (%) equivalent to CGPA earned by a candidate may be calculated using the following formula:

$\text{Percentage of Marks} = CPI \times 9.5$

10. Rules for Backlogs / Supplementary Exams

1. A student failing in one or more courses may appear in the **supplementary examination** conducted by the University.
2. Supplementary exams will be held within the notified schedule and as per University rules.
3. Maximum permissible backlogs for promotion: As per University promotion rules.
4. Students failing to clear backlogs within the **maximum duration** will not be awarded the degree.

11. Special Academic Requirements

1. Internship is mandatory for degree award; absence or failure will require repetition in the next academic cycle.
2. Students must maintain **minimum 75%** attendance in each course to be eligible for appearing in examinations.

12. Other Specific Rules

1. Ragging in any form is strictly prohibited and punishable under University and State laws.
2. Students must adhere to the Code of Conduct prescribed by Rama University.
3. Wearing of prescribed Uniform during practical/field work is mandatory.
4. Use of unfair means in examination will lead to disciplinary action as per University Examination Ordinance.

13. Exit Options (in Line with NEP Guidelines)

- a. Students on exit shall be awarded Certificate in "*Cell Biology Techniques in Biotechnology*" after securing the requisite 48 credits in Semester I & II
- b. Students on exit shall be awarded "*Diploma in Biotechnology*" after securing the requisite 94 credits on completion of Semester IV
- c. Students on exit shall be awarded "*Bachelor of Science in Biotechnology*" after securing the requisite 142 credits on completion of Semester VI
- d. Students on exit shall be awarded "*Bachelor of Science (Honors) in Biotechnology*" after securing the requisite 185 credits on completion of Semester VIII.
- e. Students on exit shall be awarded "*Bachelor of Science (Honors with Research) in Biotechnology*" after securing the requisite 185 credits on completion of Semester VIII

Minutes of Meeting

Board of Study

Bachelor of Science

(Biotechnology) [NEP 2020]

[Applicable w.e.f. Academic Session 2025-2026 till Revised]



FACULTY OF ENGINEERING & TECHNOLOGY
RAMA UNIVERSITY, UTTAR PRADESH, KANPUR

Website: www.ramauniversity.ac.in

Ref: RU/FET/BT/BOS/2025/003

Dated: 21.08.2025

Faculty of Engineering & Technology
Department of Biotechnology
Minutes of Meeting
Boards of Studies

The Board of Studies meetings of B. Sc. Biotechnology (H) syllabus for coming session 2025-26 as per NEP regulation were held in the Dean's Office on 21.08.2025 at 10:00 a.m. The following members were present:

1. Dr. Indrajeet Gupta
2. Dr. Vivek Srivastava
3. Dr. Neeraj
4. Dr. Ajay Kumar
5. Dr. Deeksha Ranjan
6. Dr. Shraddha Sahu
7. Dr. Samakshi Verma
8. Dr. Renu Verma
9. Mr. Aman Pratap Singh

- Convenor
- Chairperson
- Member
- Member
- Member
- Member
- Member
- Member
- Member
- External Member

(Handwritten signatures and dates for the members listed above, including "21/08/25" and "21/08/25")

The following members agreed to review the minutes.

1. Dr. Lalit Kumar Singh

Agenda:

Agenda Items

1. **Proposed Change in Syllabi**
Examination and approval of revisions in existing syllabi to meet emerging technological trends.
2. **Incorporation of MOOCs in Syllabus**
Integration of Massive Open Online Courses (MOOCs) into the curriculum to enhance learning outcomes.
3. **Incorporation of Flipped Classroom Approach**
Adoption of flipped classroom methodology to improve student engagement and practical learning.
4. **Revision of External Examiner Panel**

Review and update of the panel of external examiners for various courses and programs.

The BOS committee confirmed the minutes of the BOS meeting held on 21-Aug-2025

1. Action Taken Report (ATR) on Minutes of Previous Meeting.

The BOS committee reviewed and confirmed the minutes of the BOS meeting held on 27/06/2024.

The BOS Committee discussed on Action Taken Report on the basis of result analysis of session 2024-25 (Odd).

2. To Review existing evaluation scheme and syllabus of existing programme.

S. No.	Item No.	Existing	Recommendation /Action Taken
1	RU/FET/BT/BOS/2025/BSC/001	To consider and approve the changes in Syllabus B.Sc. (Hons.) Biotechnology with Research according to the New Education policy (NEP-2020) as it was newly implemented in 2024-25 session, on the basis of feedback taken from faculty and students to be implement for the students to be admitted in the Academic Session 2025-2026.	The Board of Studies (BOS) recommended continuing the same syllabus and evaluation scheme possess 25:75 (25 marks Internal Assessment and 75 marks End Semester Examination) for Academic Session 2025-2026, with the following modifications across all semesters: In the Semester I- For BBT 115 (Biotechnological Skills and Analytical Techniques), Expand Skill Enhancement with molecular biology demos (DNA isolation, gel electrophoresis) and industry SOP case studies. In the Semester II- In BBT 212 (Plant Physiology), add plant stress physiology modules (drought, salinity) with stress-marker assays in practicals. In BBT 215 (Application of Biotechnology in Agriculture), add case studies on Golden Rice, Bt Cotton, drought-tolerant maize and bioinformatics for marker-assisted breeding. In VBT 211 (Ecology & Environmental Science), integrate biotechnology solutions



			for climate change (biochar, phytoremediation, algal CO ₂ capture).
2	RU/FET/BT/BOS/2025/BSC/002 (In reference with Circular No: RU/DA/2025/020 Dated: 28 July 2025)	Incorporation of MOOCs in Syllabus Faculty and students requested flexibility to pursue online courses (SWAYAM, NPTEL, Coursera) for skill enhancement.	The committee took the decision to incorporate MOOCs in the curriculum, allowing credit transfer (up to 20%) as per AICTE norms.
3	RU/FET/BT/BOS/2025/BSC/003	Incorporation of Flipped Classroom Approach Students preferred interactive and practice-oriented sessions; faculty supported blended learning to increase participation.	The committee took the decision to formally introduce the flipped classroom pedagogy and circulate guidelines to faculty for effective implementation as per requirement.

3. Revision of External Examiner Panel: Faculty recommended updating the panel to include experts from both academia and industry. The committee took the decision to revise the external examiner panel, including industry experts and academicians from reputed institutions.

4. Question Paper Format: The question paper format, as per NAAC/NBA requirements, includes a dedicated column for CO (Course Outcome) mapping against each question. This ensures clear alignment of assessment items with defined learning outcomes, facilitates transparent evaluation, and supports accreditation compliance through measurable and outcome-based education practices.

5. Result Analysis: Summary of Result Analysis of the students performance in the semester examination 2024-25 was presented and it was suggested that the course instructors should conduct remedial classes for the students whose performance was not found satisfactory and the subjects where results are below standards. (**Annexure -1**).

6. Feedback Analysis: Analysis was performed based on summary of already collected feedback from students and the course instructors have been instructed for improvement in teaching pedagogy for better understanding of students in the cases where the feedback is below average.

7. Short term course: In upcoming session 2025-26, we have proposed short term course on “**Applied Microbiology and Molecular Biology**” which was approved previously will be continued in the upcoming session.

8. Any other issue with the permission of the Chair: No
The meeting concluded with a vote of thanks to the chair.

Date of the Next Meeting: to be decided and conveyed later

Convenor

Signature:

Name: Dr. Indrajeet Gupta

Chairperson

Signature:

Name: Dr. Vivek Srivastava



Signature: 1.....

Name: Dr. Neeraj

Signature: 4.....

Name: Dr. Shraddha Sahu

Signature: 7.... **ABSENT (21/8/25)**

Name: Mr. Aman Pratap Singh

External Members

Signature: 1.....

Name: Dr. Lalit Kumar Singh

Date: **21/8/25**

Encl.: Recommended Curricula attached for consideration and approval.

CC:

1. Dean

2. Registrar Office

Internal Members

Signature: 2.....

Name: Dr. Ajay Kumar

Signature: 5.....

Name: Dr. Samakshi Verma

Signature: 3.....

Name: Dr. Deeksha Ranjan

Signature: 6.....

Name: Dr. Renu Verma

Office of the
Dean Academic



RAMA UNIVERSITY UTTAR PRADESH, KANPUR
(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC Uis 2(i))
Rama City, G.T. Road (Near Mandhana Railway Station)
Mandhana, Kanpur

Ref.No.: RU/DA/2025/020

DATE: 28.07.2025

To,

1. All Deans/Except (Medical, Dental, Nursing, Paramedical and Pharma)
2. C.O.E.

Subject: MOOC Credit Exemption for Graduating Students in 2024-25 and Revised MOOC Integration

Following discussions with the Controller of Examinations (COE) in the Deans Meeting on July 23, 2025, and in relaxation of the conditions stated in notice Ref No. R.U./Reg./2021/10 dated January 6, 2021, it is decided that students who have completed their academic requirements for the AY 2024-25 are exempted from the mandatory MOOC course requirement. This exemption applies only to students graduating in the 2024-25 academic year.

All currently enrolled students are required to complete MOOC courses as per their year of study, proportional to the total program credits. The revised structure is as follows:

UG/PG Program Duration	Required/Desirable Credit Score*
2 Years	8
3 Years	12
4 Years	16
5 Years	20

*Concerned faculty/institutes (FET, FCM, FASAI, FPS) may decide to incorporate various learning modes, the AICTE Model Curriculum 2022 may be referred.

This decision has been taken with the approval of the Competent Authority.

Copy to: -

- 1- Secretary to Hon'ble Chancellor.
- 2- Secretary to Hon'ble Vice Chancellor
- 3- Hon'ble Director
- 4- Controller of Examination (COE)
- 5- Registrar for the necessary approval in AC & EC
- 6- Deputy Registrar/A.R./C.O.E.


Dr. Indrajeet Gupta
Dean Academic Affairs
Dean-Academic Affairs
Rama University Uttar Pradesh
Kanpur

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RAMA UNIVERSITY
DEPARTMENT OF BIOTECHNOLOGY
FACULTY OF ENGINEERING AND TECHNOLOGY

COURSE STRUCTURE

B. Sc/ B. Sc (Hons.) /B.Sc (Hons. with Research)

BIOTECHNOLOGY

(As per NEP-2020)

2024-25

National Education Policy 2020

Objectives: The proposed new structure for the undergraduate programs of the university aims to achieve the following key goals enunciated by the National Education Policy 2020 (NEP-2020):

- Multi-disciplinary and inter-disciplinary learning
- Holistic curriculum (including teaching of Indian and International languages, ethics and culture, social and emotional learning and co-curricular activities)
- Skill enhancement (including skills relating to information technology and data analysis)
- Research to be incorporated as a key component of the learning process
- Adoption of appropriate pedagogies to promote active student participation in the learning process so as to promote creativity and a spirit of exploration and adventure
- Capacity building for gaining as well as creating employment.
- Engagement with industry and society (including dissertations, projects and internships)
- Enhancing prospects for socially and economically disadvantaged and differently abled students.
- Provision for credit transfer in both national and international contexts

Bachelor of Science (Honors) in Biotechnology (Three Years / Four Years):

In the first three years of the new program, students shall study the following courses in addition to the courses that exist in the current B.Sc. Program:

Language and Literature -II: The current BSc Program includes only one language course (English/MIL) The new program structure would require students to study two 'Language and Literature' courses, of which at least one should be in an Indian Language (IL).

Social and Emotional Learning: An interdisciplinary course that promotes well-being and health.

Innovation and Entrepreneurship: An interdisciplinary course that helps students acquire skills relating to creative social and business entrepreneurship, and organizational skills.

Co-curricular: Co-scholastic activities such as music, art, gardening, sports.

Ethics and Culture: An interdisciplinary course that shall include experience of community service.

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Multidisciplinary and Research: In the fourth year (semesters VII and VIII), students can choose one discipline out of the three disciplines that they have pursued in the first three years of study, and study six courses in this discipline. (The discipline courses offered will aim to strengthen fundamental knowledge in the discipline). Students would also be required to complete a research dissertation on the Major discipline of study, and an interdisciplinary research dissertation on the Major and Minor disciplines of study

Introduction

The National Education Policy which was effective till now was formulated almost 34 years ago. A more felicitous vision was needed to meet the aspirations of the New India. The National Education Policy (NEP) 2020 is an ambitious and futuristic policy that strives to remove rigid boundaries and create new possibilities for students to choose and learn the subjects or courses of their choice.

The policy proposes a large number of changes that can transform higher education in India. One such change that has caught everyone's attention is changing the 3-year undergraduate course structure into a 4-year pattern with multiple entry and exit points to make higher education more suited to get jobs later. At present, students who leave the course in between are labelled as drop-outs and they get no qualification certificate or diploma for the credits earned during the period in the college.

NEP 2020 seeks to pave the way for flexible and lifelong learning and encourages students to choose their academic path leading to the award of certificate, diploma, and degree. Hence, Multiple Entry and Exit System (MEES) is the corner stone of the new National Education Policy in higher education. The system allows students to drop their course and resume it at a later stage as and when they desire or deem it worth pursuing. This arrangement will prove to be a boon for those students who cannot continue their studies due to financial, social

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or any other reason and desire to resume their studies when the conditions become favorable in due course of time.

How the system will function?

As per the draft of the NEP 2020 the undergraduate degree will be of either 3 or 4-year duration with multiple entry and exit options within this period, with appropriate certifications: a certificate after completing 1 year in a discipline or field including vocational and professional areas, a diploma after 2 years of study, or a Bachelor's degree after a 3-year programme. The 4-year programme may also lead to a degree 'with Research' if the student completes a rigorous research project in the major area(s) of study as specified by the higher education institution.

NEP 2020 states that innovative and flexible curricular structure under multiple entry and exit points will abolish the currently prevalent rigid, uniform and mechanical structure to create new possibilities for students to choose and learn the subjects of their choice as per their preference, convenience, or necessity.

Major benefits associated with the NEP system can be outlined as under: Benefits of Multiple Entry and Exit System (MEES)

- This is a kind of stress-buster move. It is likely to reduce the pressure of pursuing a course with an opportunity of zero-year loss in the academic journey. The move is likely to become a big boon for the students as they do not need to fear about losing a year or two if they have been studying one course for two years already when they plan to move into a different one.
- A large number of undergraduates quit the course after one or two year with zero benefit after paying huge fee and spending their valuable time. Awarding certificate or diploma after completing 1 or 2 years

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will have some worth in the long run.

- Students will have the greater flexibility and liberty to join a course or leave a course as they like, and they shall be also provided the opportunities to change the courses if they want to learn about a different sector as per their future career needs.
- Increasing Gross Enrolment Ratio at higher education is one of the objectives of NEP 2020. This move will reduce the drop-out rates of students especially for those who want to switch courses and desire to re-enter as and when they deem fit to resume their studies to earn full fledged college degree.
- The credits that the students obtain in their first and second year will be stored using the Academic Bank of Credits (ABC) system. So, at any point of time, if students want to take a break and continue their course within a fixed period, they can utilize these credits for further education.
- The system will allow students to take a sabbatical and then join back their studies without losing any credits. The move will allow students to build their own degrees. Students shall be granted more autonomy than before to decide what kind of major and minor courses they want to pursue.
- This is likely to revolutionize higher education system in India as only interested students will complete the degree through multiple entries and exit point system. Those who are not interested to pursue the course shall have no compulsion to complete the same by all means.
- This path breaking move will make our higher education system more like the global format with continuous reforms in this direction.

Effectiveness of Multiple Entry and Exit System (MEES)

In the light of above stated facts, multiple entry and exit system seems to be a very positive change. However, a more in-depth analysis of the concept raises few practical hitches as well. Hence, following

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concerns need to be addressed for the effective implementation of Multiple Entry and Exit System (MEES).

Concerns to be addressed.

- Students can exit after one year with a certificate, after two years with a diploma and a Bachelor's degree after three years and Bachelor's with research after 4 years. Curriculum construction is a big challenge in implementing this system. What type of proficiency will be attained by a student after one or two year of a degree course? Thus, curriculum needs to be reworked in order to incorporate the specialized competencies, knowledge and skills required in a particular subject area.
- In the absence of proper guidance, confusions and doubts can arise in the minds of the students leading to a state of chaos. Student support services need to be encouraged and developed at different levels for students who are more likely to drop out due to personal, social, emotional, cultural, and economic or any other reason.
- What type of opportunities will be available for the certificate and diploma holders in different sectors at the same time when degree holders are finding it hard to get jobs? Students may face difficulty to find employment on the basis of an early certificate or diploma unless it is technically specialized.
- Shall we be able to develop a pool of efficient entrepreneurs by awarding certificate and diploma after completing 1 or 2 years of a course through multiple entry and exit points? There is an apprehension of treating early exit certificates as a stamp of failure in the world of work.
- Educational institutions are required to develop a hassle-free mechanism of admissions while implementing this system. The situation is likely to become critical, suppose when the total intake of a degree course is fixed in a particular institution. How to tackle the situation when under this system suppose 15 students decide to exit in the second semester and about 25 students who left years ago are in queue for entry? Obviously, it will disturb the

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required teacher-pupil ratio and other infrastructural facilities available in the institution.

- Another concern that is bothering everybody is that a large population of the students who will leave the courses in between may not return back due to some trivial reasons. It is to be ensured that a large section of the students may not get deprived of higher education in the absence of strong motivation and proper guidance.
- The execution of this system in its true spirit needs to develop an impeccable mechanism of fees at the time of admission under multiple entry option. It is to be ensured that the system may not become a golden opportunity for private or other institutions to charge exorbitant fees from students who seek entry back to resume their studies.

Sem.	DSCCs	DSECs	GECs	AECCs	SECs	VACs	Cr
I	CC-01 (4 + 1)	DSEC-1(4)		AECC-1 (2+ 1)	SEC-1 (3)	VAC-1 (2)	21
	CC-02 (4)						
II	CC-03 (4+ 1)			AECC-2 (2)	SEC-2 (3)	VAC-2 (2)	21
	CC 04 (4+ 1)						
	CC-05 (4)						
Students exiting the programme after securing 40 credits will be awarded UG Certificate in the relevant Discipline /Subject provided they secure 4 credits in work based vocational courses offered during summer term or Internship / Apprenticeship in addition to 6 credits from skill-based courses earned during first and second semester.							
						VAC-3* (2)	2
						VAC-4* (2)	2
Students on exit shall be awarded Certificate in "Cell Biology Techniques in Biotechnology" after securing the requisite 42 credits in Semester I & II							
III	CC-06 (4 + 1)	DSEC-2 (4)		AECC-3 (2)	SEC-3 (4+1)	VAC-3 (2)	23
	CC-07 (4 + 1)						
IV	CC-08 (4 + 1)	DSEC-3 (4)			SEC-4 (6)	VAC-4 (2)	24
	CC-09 (4 + 1)						
	CC-10 (4 + 1)						
Students on exit shall be awarded "Diploma in Biotechnology" after securing the requisite 89 credits on completion of Semester IV							
Students exiting the programme after securing 80 credits will be awarded UG Diploma in the relevant Discipline /Subject provided they secure additional 4 credit in						VAC-5* (2)	2

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skill based vocational courses offered during first year or second year summer term							VAC- 6 th (2)	2
V	CC-11 (4)							
	CC-12 (4+1)							
	CC-13 (4+1)							
	CC-14 (4)							
VI	CC-15 (4)							
	CC-16 (4)							
	CC-17 (4+1)							
	CC-18 (4+1)							
Students on exit shall be awarded "Bachelor Degree of Science in Biotechnology" after securing the requisite 135 credits on completion of Semester VI								
VII	CC-20 (4)							
	CC-21 (4)							
	CC-22 (4+1)							
VIII	CC-23 (4)							
	CC-24 (4)							
	CC-25 (4)							
Students on exit shall be awarded "Bachelor of Biotechnology (Honours with Research)" after securing the requisite 180 credits on completion of Semester VIII								
VII	CC-17 (4)							
	CC-18 (4)							
	CC-19 (4+1)							
VIII	CC-20 (4)							
	CC-21 (4)							
	CC-22 (4+1)							
Students on exit shall be awarded "Bachelor of Biotechnology with Honours" after securing the requisite 180 credits on completion of Semester VIII.								

Abbreviations: DSCCs: Discipline Specific Core Courses (5Cr or 4+1Cr); DSECs: Discipline Specific Elective Courses (4Cr); GECs: Generic Elective Courses (4Cr); ALCs: Ability Enhancement Compulsory Courses (2Cr); SECs: Skill Enhancement Courses (2Cr); VACs: Value Addition Courses (2Cr); DST: Dissertations (6Cr); Cr: Credits

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Assessment Method: Weightage for Assessment

Type of Course	Internal Assessment/ Formative assessment	Summative Assessment (End-term Examination)
Theory	25	75
Practical	25	25
Projects	100	200
Internship	50	50

Progressive certificate, diploma, Bachelor's Degree Bachelor' Degree with Honours and Research and Bachelor' Degree with Honours, provided at the end of each year of exit of the four-years undergraduate programme

	Qualification Types, Exit Option and Credit Requirement	
	Exit Options	Credit Required
1.	"Certificate" upon the successful completion of the first year (two semesters) of multidisciplinary four-year undergraduate programme.	36-40
2.	"Diploma" upon the successful completion of the first two year (Four semesters) of multidisciplinary four-year undergraduate programme.	72-80
3.	"Bachelor's Degree" at the successful completion of the third year (Six semesters) of the multidisciplinary four-year undergraduate programme.	108-120
4.	"Bachelor' Degree with Honours and Research" in a Discipline at successful completion of Four years (Eight semesters).	144-160 (12 credit mandatory for Project /Research work)
5.	"Bachelor' Degree with Honours" in a Discipline at successful completion of Four years (Eight semesters).	144-160 (12 credit for discipline specific subjects)

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PEOs, POs & PSOs of B.Sc. Biotechnology Program

Program Educational Objectives (PEOs):

PEO1: To develop in our student competencies to pursue higher education and research in reputed institutes and industry at local and global level.

PEO2: To update, strengthen and deepen students' knowledge using a flexible, research-intensive program in concord to academia and industry requirements.

PEO3: To develop a working knowledge of biotechnology product and processes

PEO4: To enable critical thinking and full-fledged grasp of essential aspects of bioethics inculcating a value system among students.

Program Outcomes / Program Specific Outcomes are attributes i.e. what students are expected to know or will be able to do when they graduate from a program.

Program Outcomes (POs): The POs of BSc Biotechnology are as follows:

PO1: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO2: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO3: Understand the impact of the professional biotechnological solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO4: Apply ethical principles and commit to professional ethics and responsibilities and norms of the science practice.

PO5: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change

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Programme Specific Outcomes (PSOs):

- PSO1: Students will be equipped to understand three fundamental aspects in biological phenomenon: a) what to seek; b) how to seek c) why to seek?
- PSO2: Undergraduate students will be able to demonstrate and apply the principles of bioprocess engineering in the design, analysis, optimization and simulation of bioprocess operations.
- PSO3: Empower the students to acquire technological knowhow by connecting disciplinary and interdisciplinary aspects of biotechnology
- PSO4: Detailed experience would enable them to begin a career in industry that engages in genetic engineering as well as in research laboratories conducting fundamental research.
- PSO5: Recognize the importance of Bioethics, IPR, entrepreneurship, Communication and management skills so as to usher next generation of Indian industrialists
- PSO6: To impart in-depth practical oriented knowledge to students in various thrust areas of biotechnology, so as to meet the demands of industry and academia.

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1st Semester

S. No	Course Type	Course Code	Course Name	L	T	P	Cr	CA	MTE	ETE	Total
1	Major (Core) CC1	BBT111	Elementary Cell Biology	4	0	0	4	10	15	75	100
2	Major (Core) CC2	BBT112	Basics of Genetics	4	0	0	4	10	15	75	100
3	Multidisciplinary	BBT113	Chemistry for Biology	4	0	0	4	10	15	75	100
4	AEC1	BBT114	Computer and IT skill	2	0	0	2	10	15	75	100
5	SEC1	BBT115	Biotechnological Skills and Analytical Techniques	3	0	0	3	10	15	75	100
6	VAC1	VBT111	Indian Knowledge System	2	0	0	2	10	15	75	100
Practical											
7	Major (Core) CC1	BBT171	Elementary Cell Biology and Genetics Lab	0	0	2	1	15	10	25	50
8	AEC1	BBT172	Computer and IT skill Lab	0	0	2	1	15	10	25	50
				19	0	4	21	90	110	500	700
				Contact Hr.		23					
				Theory		6	Lab	2			

L-Lecture, T-Tutorial, P-Practical, CE-Continuous Evaluation, MTE-Mid Term Exam, ETE-End Term Exam

Abbreviations: CCs: Core Courses AECs: Ability Enhancement Compulsory Courses; SECs: Skill Enhancement Courses; VACs: Value Addition Courses
DST: Dissertations Cr: Credits

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2nd Semester

S. No	Course Type	Course Code	Course Name	L	T	P	Cr	CA	MTE	ETE	Total
1	Major (Core) CC3	BBT211	Biochemistry	4	0	0	4	10	15	75	100
2	Minor (Core) CC4	BBT212	Plant Physiology	4	0	0	4	10	15	75	100
3	Minor (Core) CC5	BBT213	Mammalian Physiology	4	0	0	4	10	15	75	100
4	AEC2	BBT214	Functional English -1	2	0	0	2	10	15	75	100
5	SEC2	BBT215	Application of Biotechnology in Agriculture	3	0	0	3	10	15	75	100
6	VAC2	VBT211	Ecology and Environmental Science	2	0	0	2	10	15	75	100
Practical											
7	Major (Core) CC3	BBT271	Biochemistry Lab	0	0	2	1	15	10	25	50
8	Minor (Core) CC4	BBT272	Physiology Lab	0	0	2	1	15	10	25	50
				19	0	4	21	90	110	500	700
				Contact Hr.		23					
				Theory		6	Lab		2		

L-Lecture, T-Tutorial, P-Practical, CE-Continuous Evaluation, MTE-Mid Term Exam, ETE-End Term Exam

Abbreviations: CCs: Core Courses AECs: Ability Enhancement Compulsory Courses; SECs: Skill Enhancement Courses; VACs: Value Addition Courses

DST: Dissertations Cr: Credits

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•Students on exit shall be awarded Certificate in “Cell Biology &Techniques in Biotechnology” after securing the requisite 42 credits in Semester I & II
Students exiting the programme after securing 40 credits will be awarded UG Certificate in the relevant Discipline /Subject provided they secure 4 credits in work based vocational courses offered during summer term or internship / Apprenticeship in addition to 6 credits from skill-based courses earned during first and second semester.

I	VAC (Summer)	VB T212	Plant Biotechnology and Genetic Improvement	2	0	0	2	10	15	75	100
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I	VAC (Summer)	VB T213	Genetic Engineering Techniques	2	0	0	2	10	15	75	100
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3rd Semester

S. No	Course Type	Course Code	Course Name	L	T	P	Cr	CA	MTE	ETE	Total
1	Major(Core) CC6	BBT311	General Microbiology	4	0	0	4	10	15	75	100
2	Major (Core) CC7	BBT312	Bioinstrumentation	4	0	0	4	10	15	75	100
3	SECs2	BBT313	Molecular Diagnostic Techniques	4	0	0	4	10	15	75	100
4	Multidisciplinary	BBT314	Developmental Biology	4	0	0	4	10	15	75	100
5	AEC3	BBT315	Communication Skill	2	0	0	2	10	15	75	100
6	VAC3	VBT311	Physical Education and Yoga	2	0	0	2	10	15	75	100
Practical											
7	Major(Core) CC6	BBT371	General Microbiology Lab	0	0	2	1	15	10	25	50
8	Major (Core) CC7	BBT372	Bioinstrumentation Lab	0	0	2	1	15	10	25	50
9	SECs2	BBT373	Molecular Diagnostic Techniques Lab	0	0	2	1	15	10	25	50
				20	0	6	23	105	120	525	750
				Contact Hr.		26					
				Theory		6	Lab	3			

Abbreviations: CCs: Core Courses AECs: Ability Enhancement Compulsory Courses; SECs: Skill Enhancement Courses; VACs: Value Addition Courses DST: Dissertations Cr: Credits
L-Lecture, T-Tutorial, P-Practical, CE-Continuous Evaluation, MTE-Mid Term Exam, ETE-End Term Exam

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4th Semester

S. No	Course Type	Course Code	Course Name	L	T	P	Cr	CA	MTE	ETE	Total
1	Major (Core) CC8	BBT411	Molecular Biology	4	0	0	4	10	15	75	100
2	Minor (Core)	BBT412	Enzymology	4	0	0	4	10	15	75	100
3	Major (Core) CC9	BBT413	Basic immunology	4	0	0	4	10	15	75	100
4	Multidisciplinary	BBT414	Role of Biotechnology in Forensic Science	4	0	0	4	10	15	75	100
5	SEC3	BBT415	Bio-safety and Ethics in Biological Sciences	3	0	0	3	10	15	75	100
6	VAC4	VB411	Innovation and Entrepreneurship	2	0	0	2	10	15	75	100
Practical											
7	Major (Core) CC8	BBT471	Molecular Biology and RDT Lab	0	0	2	1	15	10	25	50
8	Minor (Core)	BBT472	Enzymology Lab	0	0	2	1	15	10	25	50
9	Major (Core) CC9	BBT473	Basic immunology Lab	0	0	2	1	15	10	25	50
				21	0	6	24	105	120	525	750
				Contact Hr. 27							
				Theory 6		Lab 3					

Abbreviations: CCs: Core Courses AECCs: Ability Enhancement Compulsory Courses; SECS: Skill Enhancement Courses; VACs: Value Addition Courses DST: Dissertations
Cr: Credits L-Lecture, T-Tutorial, P-Practical, CE-Continuous Evaluation, MTE-Mid Term Exam, ETE-End Term Exam

*Students on exit shall be awarded "Diploma in Biotechnology" after securing the requisite 89 credits on completion of Semester III and IV

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Students exiting the programme after securing 80 credits will be awarded UG Diploma in the relevant Discipline /Subject provided they secure additional 4 credit in skill based vocational courses offered during first year or second year summer term.

II	VAC (Summer)	VB412	Applied Microbiology in Industry	2	0	0	2	10	15	75	100
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II	VAC (Summer)	VB413	Industrial Enzyme Technology	2	0	0	2	10	15	75	100
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5th Semester

S. No	Course Type	Course Code	Course Name	L	T	P	Cr	CA	MTE	ETE	Total
1	Major (Core) CC10	BBT511	Recombinant DNA Technology	4	0	0	4	10	15	75	100
2	Major (Core) CC11	BBT512	Fermentation Technology	4	0	0	4	10	15	75	100
3	Minor (Core)	BBT513	Bioinformatics	4	0	0	4	10	15	75	100
4	Major (Core)	BBT514	Animal Biotechnology	4	0	0	4	10	15	75	100
5	AEC4	BBT515	Biostatistics	2	0	0	2	10	15	75	100
Practical											
6	Major (Core) CC11	BBT571	Fermentation Technology Lab	0	0	2	1	15	10	25	50
7	Minor (Core)	BBT572	Bioinformatics Lab	0	0	2	1	15	10	25	50
8	SEC4	BBT573	Industrial Internship	0	0	6	3	30	20	50	100
				18	0	10	23	110	115	475	700
				Contact Hr.							
				28							
				Theory	5	Lab	3				

Abbreviations: CCs: Core Courses AECs: Ability Enhancement Compulsory Courses; SECs: Skill Enhancement Courses; VACs: Value Addition Courses
DST: Dissertations Cr: Credits

July

Sanakshi

AG

6th Semester

S. No	Course Type	Course Code	Course Name	L	T	P	Cr	CA	MTE	ETE	Total
1	Major (Core) CC12	BBT611	Bioprocess Technology	4	0	0	4	10	15	75	100
2	Minor (Core)	BBT612	Nanotechnology	4	0	0	4	10	15	75	100
3	Major (Core) CC13	BBT613	Environmental Biotechnology	4	0	0	4	10	15	75	100
4	Major (Core) CC14	BBT614	Plant Biotechnology	4	0	0	4	10	15	75	100
5	Major (Core) CC15	BBT615	Food Biotechnology	4	0	0	4	10	15	75	100
Practical											
7	Major (Core) CC13	BBT671	Environmental Biotechnology Lab	0	0	2	1	15	10	25	50
8	Major (Core) CC14	BBT672	Plant Biotechnology Lab	0	0	2	1	15	10	25	50
9	Major (Core) CC15	BBT673	Food Biotechnology Lab	0	0	2	1	15	10	25	50
				20	0	6	23	95	105	450	650
				Contact Hr.							
				26							
				Theory	5	Lab	3				

Abbreviations: CCs: Core Courses AECCs: Ability Enhancement Compulsory Courses; SECs: Skill Enhancement Courses; VACs: Value Addition Courses
DST: Dissertations Cr: Credits

*Students on exit shall be awarded Degree in "Bachelor Degree of Science in Biotechnology" after securing the requisite 135 credits on completion of Semester VI



 Prof. Banabala¹⁹



7th Semester

S. No	Course Type	Course Code	Course Name	L	T	P	Cr	CA	MTE	ETE	Total
1	Major (Core) CC16	BBT711	Stem Cell Engineering	4	0	0	4	10	15	75	100
2	Minor (Core)	BBT712	Medical Microbiology	4	0	0	4	10	15	75	100
3	Major (Core) CC17	BBT713	Genomics and Proteomics	4	0	0	4	10	15	75	100
4	SECS7	BBT714	Research Methodology	4	0	0	4	10	15	75	100
Practical											
5	DST1	BBT771	Major Project-I	0	0	12	6	50	50	200	300
6	Major (Core) CC17	BBT 772	Genomics and Proteomics Lab	0	0	2	1	15	10	25	50
				16	0	14	23	105	120	525	750
				Contact Hr.		30					
				Theory	4	Lab	2				

Abbreviations: CCs: Core Courses AECCs: Ability Enhancement Compulsory Courses; SECS: Skill Enhancement Courses; VACs: Value Addition Courses
DST: Dissertations Cr: Credits






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8th Semester

S. No	Course Type	Course Code	Course Name	L	T	P	Cr	CA	MTE	ETE	Total
1	Major (Core) CC18	BBT811	Advance Cell Biology	4	0	0	4	10	15	75	100
2	Major (Core) CC19	BBT812	Fundamental of Biomedical Sciences	4	0	0	4	10	15	75	100
3	Major (Core) CC20	BBT813	Scientific Writing	4	0	0	4	10	15	75	100
4	Major (Core) CC21	BBT814	Intractual property rights	4	0	0	4	10	15	75	100
Practical											
5	DST2	BBT871	Major Project-II	0	0	12	6	50	50	200	300
				16	0	12	22	90	110	500	700
				Contact Hr.		28					
				Theory		4	Lab	1			

Abbreviations: CCs: Core Courses AECs: Ability Enhancement Compulsory Courses; SECs: Skill Enhancement Courses; VACs: Value Addition Courses
DST: Dissertations Cr: Credits

*Students on exit shall be awarded "Bachelor of Biotechnology (Honours with Research)" after securing the requisite 180 credits on completion of Semester VIII.

July

Qanabati

W

AE

For Bachelor' Degree with Honours only

7th Semester

S. No	Course Type	Course Code	Course Name	L	T	P	Cr	CA	MTE	ETE	Total
1	Major (Core) CC22	BBT711	Stem Cell Engineering	4	0	0	4	10	15	75	100
2	Major (Core) CC23	BBT712	Medical Microbiology	4	0	0	4	10	15	75	100
3	DSEs 6	BBT713	Genomics and Proteomics	4	0	0	4	10	15	75	100
4	DSEs 7	BBT714	Research Methodology	4	0	0	4	10	15	75	100
5	SEC 5	BBT715	Application of Biosensor in Biotechnology	2	0	0	2	10	15	75	100
6	SECs 11	BBT716	Evolutionary Biology	4	0	0	4	10	15	75	100
Practical											
7	SECs 6	BBT 772	Genomics and Proteomics Lab	0	0	2	1	15	10	25	50
				22	0	2	23	75	100	475	650
				Contact Hr.	24						
				Theory	6	Lab	1				

Abbreviations: CCs: Core Courses AECCs: Ability Enhancement Compulsory Courses; SECs: Skill Enhancement Courses; VACs: Value Addition Courses
DST: Dissertations Cr: Credits

July

Qanabir

Wahid

Ali

8th Semester

S. No	Course Type	Course Code	Course Name	L	T	P	Cr	CA	MTE	ETE	Total
1	Major (Core) CC24	BBT811	Advance Cell Biology	4	0	0	4	10	15	75	100
2	SECs 8	BBT812	Fundamental of Biomedical Sciences	4	0	0	4	10	15	75	100
3	SECs 9	BBT813	Scientific Writing	4	0	0	4	10	15	75	100
4	SECs 10	BBT814	Intractual property rights	4	0	0	4	10	15	75	100
5	SECs 12	BBT815	Drug Design	4	0	0	4	10	15	75	100
Practical											
6	Major (Core) CC24	BBT872	Advance Cell Biology Lab	0	0	2	1	15	10	25	50
7	SECs 12	BBT873	Drug Design Lab	0	0	2	1	15	10	25	50
				20	0	4	22	80	95	425	600
				Contact Hr.		24					
				Theory		5	Lab	2			

Abbreviations: CCs: Core Courses AECs: Ability Enhancement Compulsory Courses; SECs: Skill Enhancement Courses; VACs: Value Addition Courses DST: Dissertations

Cr: Credits L-Lecture, T-Tutorial, P-Practical, CE-Continuous Evaluation, MTE-Mid Term Exam, ETE-End Term Exam

Students on exit shall be awarded "Bachelor of Biotechnology with Honours" after securing the requisite 180 credits on completion of Semester VIII

July

Sawab Ali

Vice-Chancellor

AG



SYLLABUS

B. Sc. (Hons. with Research)

BIOTECHNOLOGY

(As per NEP Regulation)

2025-26

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SEMESTER I

(CORE COURSE-1)

ELEMENTARY CELL BIOLOGY (BBT 111)

COURSE OBJECTIVES: Cell biology is the study of cell structure and function, and it revolves around the concept that the cell is the fundamental unit of life.

Credits: 04

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1	Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport; Symport, antiport, uniport, active and passive transport.	10
2	Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions.	10
3	Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes: Structures and function, Mitochondria: Structure and function, Chloroplasts: Structure and function, Nucleus: Structure and function, chromosomes and their structure.	10
4	Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. Cancer: Carcinogenesis, agents promoting carcinogenesis.	10
5	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.	10

Text Books:

Jeff Hardin, Gregory Bertoni, Lewis J. Kleinsmith, Wayne M. Becker. Becker's World of the Cell, 8th edition, Benajmin Cummings, 9780321689634. 0321689631, (2012).

EDP De Robertis and EMF De Robertis. Cell and Molecular Biology. 8th edition. Lippincott Williams and

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Wilkins, 9780781734936, 0781734932, (2006)

Reference Books:

Gerald Karp, Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc, 9780470483374, 0470483377 (2010)

G.M. Cooper, and R.E. Hausman. The Cell: A Molecular Approach. 5th Edition. ASM Press 780878931064, 0878931066 (2009)

Online links for study and reference materials:

<http://www.open2study.com/cellbiology>

<https://nptel.ac.in/courses/102103012/>

Cell Biology - Course (swayam2.ac.in)

COURSE OUTCOME: On completion of this course, the students will be able to:

1. Acquire knowledge about the ultra-structural information of cell besides the detailed views of the cell interior.
2. Understand the complex molecular mechanisms occurring in the cell and regulation of gene expression.
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

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	2	2	2	2
CO2	-	-	2	3	3
CO3	3	1	2	2	-
CO4	2	2	3	3	2

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(Signature)

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(CORE COURSE-1)

ELEMENTARY CELL BIOLOGY & GENETICS LAB (BBT 171)

COURSE OBJECTIVES: The course describes the tissue level organization and related functions of animal and plant cells, different staining techniques, etc.

Credits: 01

L-T-P: 0-0-2

Module No	Content	Teaching Hours
1	1. Organization and working of optical microscope: Dissecting and compound microscopes. 2. To examine the phenomenon of cell permeability using hypotonic, isotonic and hypertonic solutions. 3. Demonstration of dialysis. 4. To study the prokaryotic (bacterial) and eukaryotic cell structures with the help of microscope. 5. To observe the different stages of mitosis and meiosis using permanent slides. 6. To study the mitosis cell division in onion root tips. 7. Mendalian Genetics Problem	20

SUGGESTED TEXTBOOKS:

1. Rastogi, V.B. (2010). Fundamental of Molecular Biology. New Delhi: ANE Books.
2. Rastogi, V.B. (2016). Introductory Cytology –Knrn. Meerut: Kedar Nath Ram Nath Publishers.
3. Tamarin, R.H. (2004). Principles of Genetics (7th ed.). USA: McGraw- Hill Higher Education.

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Understand the structure of cells and its organelles with the help of permanent slides.
2. Gain hands-on training for operating microscope for cell analysis
3. Use relevant tools and techniques for the analysis of chromosomes, and cell size determination using micrometry.

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(CORE COURSE-2)**



BASICS Of GENETICS (BBT 112)

COURSE OBJECTIVES: The purpose of this course is to understand the genetic patterns of Mendelian inheritance and non-Mendelian inheritance.

Credits: 04

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1	Principles of Heredity and Variation: Mendel concept of genetics and his experiments, monohybrid crosses, dihybrid crosses, back cross and test cross. multiple alleles(blood group systems)	10
2	Gene Interaction: Concept of gene interaction, co-dominance and incomplete Dominance, Complementary factors, Supplementary factors, Inhibitory factors, Duplicate dominant factors, Lethal genes (dominant and recessive), Epistasis.	10
3	Genes and Chromosomes: General features of chromosomes. Chromosomal theory of inheritance, Sex determination. Sex-linked, Sex-limited and Sex-influenced inheritance. Variation in chromosome number and structure, Inherited disorders - Autosomal (Klinefelter syndrome and Turner's syndrome), Autosomal (Down syndrome and cri-du-chat syndrome)	10
4	Gene Linkage and Chromosome Mapping: Linkage and recombination of genes in a chromosome, Crossing over and genetic mapping, Gene mapping. Cytogenetic techniques. Penetrance and expressivity, Pleiotropy. Position effect and genomic imprinting	10
5	Population Genetics and Evolution: Allele frequencies and genotype frequencies, random mating and Hardy-Weinberg principle. Inbreeding. Genetics and evolution.	10

SUGGESTED TEXT BOOKS:

1. Boreman, A., Santos, F.R., & Bowen, D.E. (2003). Understanding Biotechnology (1st ed.). USA: Prentice Hall.
2. Brown, T. (2011). Introduction to Genetics –A molecular approach (1st ed.). USA: Garland Science.
3. Brown, T.A. (2010). Gene Cloning and DNA Analysis: An Introduction (6th ed.). USA: Wiley-Blackwell.
4. Gardner, E.J., Simmons, M.J., & Snustad, D.P. (2005). Principles of Genetics (8th ed.). New Jersey,

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USA: John Wiley & Sons Ltd.

5. Glick, B.R., & Patten, C.L. (2017). Molecular Biotechnology: Principles and Applications of Recombinant DNA (5th ed.). USA: American Society for Microbiology Press.

SUGGESTED REFERENCE BOOKS

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.

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Acquire knowledge of the structure and arrangement of the genome in living organisms.
2. Understand the biochemical nature of nucleic acids, their role in living systems.
3. Learn the basic genetic manipulation techniques and their application for human welfare.
4. Develop innovative research ideas for Plant Breeding and genetic disorders in humans to their own research.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	2	1	-	-	2
CO2	1	-	2	3	3
CO3	-	3	2	3	-
CO4	3	2	-	2	2

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(DISCIPLINE SPECIFIC ELECTIVE COURSE-1)
CHEMISTRY FOR BIOLOGY(BBT 113)**



OBJECTIVES: This course will enlighten students with basic knowledge of solutions, colloids and phase rules, chemical kinetics and electrochemistry. It will help students to understand about amino proteins and carbohydrates, basic nature and reactions of carboxylic acid and its derivatives, amine and diazonium salts and also about concept of coordination chemistry.

Credits: 04

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1	Solutions Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law–non-ideal solutions. Colloidal solution and suspension, types and properties of colloidal system, coagulation of colloidal solution, protective colloids. Phase Equilibrium Phases, components, and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule. Phase diagram (one component system).	9
2	Rate, order and molecularity of reaction, Integrated rate equation of zero order, first order and second order reactions, activation energy. Electrolysis, electrochemical cells, electrode potential, electrochemical series, Nernst equation.	9
3	Carbohydrate: Introduction, occurrence, classification, constitution of glucose, osazone formation. Reaction of glucose and fructose, Mutarotation, cyclic structure- pyranose and furanose form. Epimerisation, Chain lengthening and shortening in aldose. Disaccharides and glycosidic bonds. Polysaccharides - Starch, Bacterial Peptidoglycan and Extracellular matrix (Glycosaminoglycans). Glycoconjugates	9
4	Amino acids, Peptides and Proteins: Amino acids (Strecker synthesis using Gabriel's phthalimide synthesis, proteogenic and non proteogenic aminoacids, unusual aminoacids, amphoteric nature, Zwitter ion, isoelectric point and pKa Value, Ramachandran plot for amino acids. Peptides (The Peptide Linkage, Peptide Synthesis, Structure of Polypeptides); Proteins (General Characteristics, Classification, Structure). Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins).	9
5	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 (β - carotene).	9

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SUGGESTED TEXT BOOKS:

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

SUGGESTED REFERECE BOOKS:

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

COURSE OUTCOME:

On completion of this course, the 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.
4. Correlate the structure-function relationship in various biomolecules
5. Know the role of biomolecules for orderly structures of the cells/tissues.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	2	3	3	-
CO2	2	3	2	3	-
CO3	-	2	3	3	2
CO4	2	3	2	3	-
CO5	3	-	2	3	2

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(ABILITY ENHANCEMENT COMPULSORY COURSE-1)

COMPUTER & IT SKILL (BBT 114)

COURSE OBJECTIVES: The course is designed to aim at imparting a basic level appreciation program for biological science undergraduate students. After completing this course students are able to use the computer for basic purposes like making assignments, preparing projects, net surfing to retrieve the data related to their educational studies, reading books, preparing PPTs, etc. At the end of this course, students have basic knowledge about biological databases and their uses in their current course of study.

Credits: 02

L-T-P: 2-0-0

Module No	Content	Teaching Hours
1	Introduction of Computer: Fundamentals of Computer, Basic Applications of Computer; Components of Computer System, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Other input/output Devices, Computer Memory, Concepts of Hardware and Software; Concept of Computing, Data, and Information; Applications of IECT; Connecting keyboard, mouse, monitor and printer to CPU and checking power supply.	10
2	Operating Computer using GUI Based Operating System: What is an Operating System; Basics of Popular Operating Systems; The User Interface, Using Mouse; Using right Button of the Mouse and Moving Icons on the screen, Use of Common Icons, Status Bar, Using Menu and Menu-selection, Running an Application, Viewing of File, Folders and Directories, Creating and Renaming of files and folders, Opening and closing of different Windows; Using help; Creating Short cuts, Basics of O.S Setup; Common utilities	10
3	Introduction to Internet, WWW, and Web Browsers: Basic of Computer networks; LAN, WAN; Concept of the Internet; Applications of the Internet; Connecting to the Internet; What is ISP; Knowing the Internet; Basics of Internet connectivity related troubleshooting, World Wide Web; Web Browsing software, Search Engines; Understanding URL; Domain name; IP Address; Using e-governance website	10
4	Use of Microsoft Office: Word Processing Basics; Opening and Closing of documents; Text creation and Manipulation; Formatting of text; Table handling; Spell check, language setting and thesaurus; Printing of word document. Basics of presentation software; Creating Presentation; Preparation and Presentation of Slides; Slide Show; Taking printouts of presentation/handouts.	10
5	Biological databases and data search: Introduction to NCBI, Blast, Uniprot, SCOP, PDB, Sequence alignment online software. Scientific Literature data search. How to download biological data from databases and their preliminary use in biological research.	10

✓ (Signature)

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Text Books and Reading Materials:

Basic Computer Course by April 2022, Pawan Gupta

<https://www.computer-pdf.com/other/406-tutorial-basic-computer-course-book.html>

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Understand the basic concept of computer
2. Understand the detailed concept of Operating systems and the use of various software.
3. Understand the basic use of internet surfing for academic uses.
4. Students can able to prepare documents, PPTs, Assignment, and their reports.
5. Understand about various biological databases and their use for research purposes.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	2	3	3	-
CO2	2	3	2	3	-
CO3	-	2	3	3	2
CO4	2	3	2	3	-
CO5	3	-	2	3	2

✓

GD

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RAMA UNIVERSITY, KANPUR, U.P (INDIA)**
(ABILITY ENHANCEMENT COMPULSORY COURSE-1)



COMPUTER & IT SKILL LAB (BBT 172)

COURSE OBJECTIVES: To provide practical knowledge about the Basics of Computers hardware and software, internet, email, and to solve exercises using the application tools like Word processor, Spread sheet and Presentation

Credits: 01

L-T-P: 0-0-2

Module No	Content	Teaching Hours
1	1. Computer basics 2. Brief Introduction of MS-Word which includes formatting, editing of a document. 3. Brief Introduction of MS-Power point which includes animated presentation for a seminar/report. 4. Sending letters to multiple recipients using Mail Merge 5. Creating Table and calculation of sum, average, percentage in MS-Excel 6. Preparing charts or graphs in MS-Excel 7. Introduction of Python	20

SUGGESTED READINGS:

Computer Fundamentals Concepts, Systems, Application by D. P. Nagapal, S. Chand Publications, RP-2014, ISBN: 81-219-2388-3.

Fundamentals of Computers by V. Rajaraman and Neeharika Adabala, PHI Publications, 2015 Edition.

<http://www.tutorialsforopenoffice.org/>

<http://www.libreoffice.org/get-help/documentation/>

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Identify Computer hardware parts and connect peripherals.
2. Install Operating Systems and Utility software.
3. Install and configure Printer and LAN card.
4. Use internet to search, download, and access email account.
5. Create documents on Word processor, Spread sheet, and Presentation applications.

✓ (B)

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RAMA UNIVERSITY, KANPUR, U.P (INDIA)
(SKILL ENHANCEMENT COURSES-1)**



**BIOTECHNOLOGICAL SKILLS AND ANALYTICAL TECHNIQUES (BBT
115)**

COURSE OBJECTIVES: The course is designed to aim at skill enhancement as per National Occupational Standards (NOS) of “Lab Technician/ Assistant and knowledge about major activities of biotech industry, regulations, and compliance, environment, health, and safety. At the end of this course, students have skill about usage and maintenance of basic equipment of biotechnology lab and environmental lab.

Credits: 03

L-T-P: 3-0-0

Module No	Content	Teaching Hours
1	CIP and SIP Fundamentals, Safety, and Documentation: - Introduction to CIP and SIP: Industry standards and protocols for clean-in-place (CIP) and sterilize-in-place (SIP) procedures, Material Requirements for Cleaning: Guidelines for cleaning specific areas (lab benches, ventilation systems, equipment surfaces), selecting cleaning agents based on material properties (stainless steel, plastic, glass), Personal Protective Equipment (PPE) and Safety: Required PPE for handling cleaning and sterilization processes. Safety symbols, hazard signs, and proper usage, Methodology for Cleaning and Storage Areas: Cleaning protocols for various surfaces (metal, plastic, glass), best practices for material storage to avoid cross-contamination, Signage and Labeling: Do's and don'ts of labeling areas and equipment in the laboratory to ensure safety and compliance with standards, Documentation: Recording chemical and equipment usage. Maintaining cleaning records as per SOPs, logging cleaning/sterilization activities for traceability and audits.	10
2	Equipment Safety, Chemical Handling, and Hazard Management: Safety Protocols for Equipment and Chemicals: Handling and cleaning of critical lab equipment, focusing on safety protocols and maintenance procedures (e.g., autoclaves, incubators, pH meters, centrifuges), Chemical Safety: Proper storage, handling, and labeling of chemicals, including hazardous chemicals. Understanding Material Safety Data Sheets (MSDS) and safe disposal protocols, Inventory Management: Maintenance of chemical and equipment inventories. Procedures to maintain chemicals, stock updates, labeling and expiration tracking. Disposal of Hazardous Chemicals and Waste: Best practices for chemical disposal in compliance with environmental and safety regulations. Safe disposal of decontaminated media and materials, SOP Adherence: The importance of following Standard Operating Procedures (SOPs) in chemical handling, equipment cleaning, and labelling.	10
3	Instrument Handling and Practical Applications: Instrument Handling Practice: Understanding working principles, construction, and practical applications of laboratory equipment, including :Microscope, Weighing Scale, pH Meter, Autoclave, Hot Air Oven, BOD Incubator, Incubator Shaker, Centrifuge, Colony Counter, Water Bath, Double Distillation Unit, Hot Plate, Fermenter/Bioreactor, Microtome, Photoperiod Trolley (PTC Trolley), Dry Bath, Vortex Mixer, Calorimeter, Spectrophotometer, Gel Documentation, UV-Transilluminator, Semi-Dry Transblot System, Gel Electrophoresis, SDS-PAGE, PCR Analyzer, Operational Safety: Guidelines on equipment calibration, maintenance, and safety checks before and after use, Documentation of Instrument Use: Recordkeeping of instrument use and maintenance as per SOPs for research experiments and quality control.	10
4	Solution Preparation, Media Handling, and Laboratory Reporting: Preparation	10

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	of Solutions and Standards: Molarity, Molality, Normality: Calculations and preparation of solutions. Understanding %w/w, %v/v, ppm, ppb, Dilution Techniques: Methods for diluting concentrated solutions, preparation of standard and stock solutions, Handling Acids and Reagents: Safe preparation and usage of acids and reagents. Reading reagent bottle labels and precautionary measures, Water Quality Management: Maintenance and storage of purified water for media preparation (plant tissue culture, microbiological, and animal cell culture media), Media Preparation and Sterilization: Procedures for media preparation, sterilization, and making cotton plugs for long-term and short-term use, Molecular biology demonstrations: DNA isolation, agarose gel electrophoresis. Laboratory Record Writing: Method of Record Writing: Data collection, recording, and maintaining accurate research logs, Reporting and Analysis: Reporting of experimental results, discussion, summary writing, and creating effective PowerPoint presentations for research dissemination. Industry SOP-based case studies to link laboratory practices with real world compliance standards.	
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SUGGESTED TEXT BOOKS:

Principles of Instrumental Analysis" by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch.
Microbiology: Laboratory Theory & Application" by Michael J. Leboffe and Burton E. Pierce.

REFERENCE BOOKS:

Handbook of Good Laboratory Practice (GLP), Second Edition" by Peter D. Kunder and Ray H. Liu.
Basic Laboratory Methods for Biotechnology" by Lisa A. Seidman and Cynthia J. Moore.

Online links for study & reference materials:

<https://www.oecd.org/chemicalsafety/testing/good-laboratory-practiceglp.htm>
<https://practicalbiology.org/standard-techniques/aseptic-techniques>

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Understand CIP/SIP protocols and select appropriate cleaning agents for different materials.
2. Apply safety protocols using PPE and safety signage for equipment and chemical handling.
3. Perform and document cleaning and sterilization processes per SOPs.
4. Manage chemical and equipment inventories, ensuring compliance with safety regulations.
5. Operate, maintain, and document the use of laboratory instruments safely.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	2	3	3	-
CO2	2	3	2	3	-
CO3	-	2	3	3	2
CO4	2	3	2	3	-
CO5	3	-	2	3	2

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**(VALUE ADDITION COURSE-1)
INDIAN KNOWLEDGE SYSTEM (VBT 111)**

COURSE OBJECTIVES: This course introduces students to the rich and diverse Indian Knowledge Systems (IKS), covering key areas like ancient science, literature, philosophy, and environmental practices. The course aims to bridge the gap between traditional knowledge and modern education, highlighting India's contributions to various fields and their relevance in contemporary society.

Credits: 02

L-T-P: 2-0-0

Module No	Content	Teaching Hours
1	Introduction to Indian Knowledge Systems: Definition and scope of Indian Knowledge Systems, Historical development of IKS, Key sources of IKS: Vedas, Upanishads, Smritis, Puranas, Importance and relevance of IKS in modern education and science.	10
2	Indian Philosophical Traditions: Overview of Indian philosophical schools: Nyaya, Vaisheshika, Sankhya, Yoga, Mimamsa, Vedanta, Buddhist and Jain philosophies , , , The concept of knowledge (Pramana) in Indian philosophy, Indian approaches to logic, epistemology, and metaphysics.	10
3	Indian Contributions to Science and Mathematics: Development of mathematics in ancient India: concepts of zero, algebra, and calculus (Aryabhata, Brahmagupta, Bhaskara), Indian contributions to astronomy: Aryabhata, Varahamihira, and their works, Ayurveda and Siddha: indigenous systems of medicine, Metallurgy and chemistry in ancient India.	10
4	Indian Literature and Linguistics: Classical Sanskrit literature: Ramayana, Mahabharata, and the Puranas, Tamil Sangam literature and regional literary traditions, The development of linguistics in India: Panini's Ashtadhyayi, Impact of Indian literary works on modern thought and literature	10
5	Indian Environmental Knowledge and Sustainable Practices: Traditional environmental practices and ecological knowledge in ancient India, Sacred groves, water conservation, and sustainable agriculture, Traditional systems of animal care and biodiversity conservation, The relevance of ancient practices in modern environmental conservation.	10

SUGGESTED TEXT BOOKS:

1. "The Cultural Heritage of India" – The Ramakrishna Mission
2. "Ancient Indian Education" by Radha Kumud Mookerji
3. "Indian Philosophy" by S. Radhakrishnan
4. "A Concise History of Science in India" by D. M. Bose, S. N. Sen, and B. V. Subbarayappa
5. - "Ayurveda: Life, Health and Longevity" by Robert Svoboda
6. "The Ramayana" by Valmiki (Translation)
7. - "History of Indian Literature" by Maurice Winternitz
8. - "The Ashtadhyayi of Panini" by Panini

COURSE OUTCOME:

On completion of this course, the students will be able to:

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1. Understand the Philosophical Foundations of Indian Knowledge
2. Analyze Traditional Indian Contributions to Science and Mathematics
3. Evaluate the Interconnectedness of Indian Art, Literature, and Spirituality
4. Apply Indian Ethical and Environmental Wisdom to Contemporary Issue

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	2	2	2	2
CO2	-	-	2	3	3
CO3	3	1	2	2	-
CO4	2	2	3	3	2

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**SEMESTER-2
(CORE COURSE-3)**

BIOCHEMISTRY(BBT 211)

OBJECTIVES: To consolidate students' training in chemistry, biology and other aspects of disciplines, and combining both to generate a better understanding of the principle of biochemistry and metabolism of biomolecules.

Credits: 04

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1	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.	10
2	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.	10
3	Metabolism in mitochondria: Biological oxidation - enzymes involved in oxidation and reduction, reactions catalyzed by dehydrogenases, oxidases, peroxidases and oxygenases; removing of H ₂ O ₂ 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.	10
4	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. β -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.	10
5.	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.	10

SUGGESTED TEXTBOOKS & REFERENCES:

1. Berg, J.M., Stryer, L., Tymoczko, J.L. and Gatto, G.J. (2015). Biochemistry (8th ed.). New York, USA: WH Freeman.

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2. Conn, E.E., Stumpf, P.K., and Bruening, G. (2006). Outlines of Biochemistry (5th ed.). New Jersey: Wiley-Blackwell.
3. Copeland, R.A. (2008). Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis (2nd ed.). India: Wiley-VCH.
4. Gupta, S.N. (2015). Biochemistry (2nd ed.). Meerut: Rastogi Publication.
5. Jain, J.L., Jain, S., and Jain, N. (2016). Fundamentals of Biochemistry (7th ed.). New Delhi: S Chand

COURSE OUTCOME:

On completion of this course, the 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

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	-	-	2
CO2	3	2	2	-	3
CO3	3	-	3	-	2

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BIOCHEMISTRY LAB (BBT 271)

COURSE OBJECTIVES: This course will enable the students gain basic knowledge of biochemical methods and their application in biology. Better understand these theories, methods and its practical.

Credits: 01

L-T-P: 0-0-2

Module No	Content	Teaching Hours
1	1. Preparation of buffers. 2. Estimation of protein and to find out the λ_{max} of protein (BSA). 3. Qualitative analysis of carbohydrates, lipids and proteins 4. Determination of iodine number. 5. Determination of the acid value of lipid. 6. Demonstration of saponification value of fats and oil. 7. Preparation and precipitation of casein from buffalo milk.	20

SUGGESTED TEXTBOOKS & REFERENCES:

1. Berg, J.M., Stryer, L., Tymoczko, J.L. and Gatto, G.J. (2015). Biochemistry (8th ed.). New York, USA: WH Freeman.
2. Conn, E.E., Stumpf, P.K., and Bruening, G. (2006). Outlines of Biochemistry (5th ed.). New Jersey: Wiley-Blackwell.
3. Copeland, R.A. (2008). Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis (2nd ed.). India: Wiley-VCH.
4. Gupta, S.N. (2015). Biochemistry (2nd ed.). Meerut: Rastogi Publication.

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Apply various tools and techniques to understand different biochemical processes of experimentation and hypothesis testing.
2. Identify and distinguish the carbohydrates, proteins and lipids based on specific biochemical tests.
3. Apply the gained knowledge to develop entrepreneurship skills in both academics and industries.

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(CORE COURSE-4)**



PLANT PHYSIOLOGY (BBT 212)

COURSE OBJECTIVES: Plant physiology explains the various tissue systems of plants and the physiochemical processes taking part in the plants for transport of water, minerals and ions.

Credits: 04

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1	The shoot and root apical meristem and its histological organization, simple & complex permanent tissues, primary structure of shoot & root, secondary growth, growth rings, leaf anatomy (dorsi-ventral and isobilateral leaf).	10
2	Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing. Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport. Plant Stress Physiology: Responses to draught and salinity stress, Stress markers assays (proline estimation, antioxidant enzyme activity).	10
3	Photosynthesis- Photosynthesis pigments, concept of two photo systems, photophosphorylation, Calvin cycle, CAM plants, photorespiration, compensation point. Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants.	10
4	Growth and development: Definitions, phases of growth, growth curve, growth hormones (auxins, gibberellins, cytokinins, abscisic acid, ethylene). Physiological role and mode of action, seed dormancy and seed germination, concept of photoperiodism and vernalization.	10

SUGGESTED TEXTBOOKS:

1. Ambast, R.S. (2008). Plant Ecology. New Delhi: CBS.
2. Dutta, S.C. (2012). Plant Physiology. New Delhi: New age International Publishers.
3. Hopkins, W.G., & Huner, N.P.A. (2008). Introduction to Plant Physiology. New Jersey: John Wiley and Sons Inc.

SUGGESTED REFERENCE BOOKS:

1. Narst, V., Devlin & Witham. (1974) Plant Physiology. New Delhi: East West Press.
2. Noggle, G.R., & Fritz, G.J. (1992). Introductory Plant Physiology. New Delhi: Prentice Hall of India.

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COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Students will be able to understand the various physiological life processes in Plants
2. They will also gain about the various uptake and transport mechanisms in plants and are able to coordinate the various processes.
3. They understand the role of various hormones, signaling compounds, thermodynamics and enzyme kinetics.
4. students will gain knowledge about various mechanisms such as channel or transport proteins involved in nutrient uptake in plants

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	2	-	1	-	1
CO2	-	-	3	-	2
CO3	-	-	2	1	-

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(CORE COURSE-5)

MAMMALIAN PHYSIOLOGY (BBT 213)

COURSE OBJECTIVES: The course will make the students understand regarding the mammalian physiology at the molecular, cellular, and system levels in integrative physiology.

Credits: 04

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1	Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice. Respiration: Exchange of gases, Transport of O ₂ and CO ₂ , Oxygen dissociation curve, Chloride shift.	10
2	Composition of blood, Plasma proteins & their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.	10
3	Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.	10
4	Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters	10

SUGGESTED TEXTBOOKS & REFERENCES:

1. Chaterjee, C.C. (2005). Human Physiology Vol-II (11th ed.).
2. Chaterjee, C.C. (2018). Human Physiology Vol-I (12th ed.). New Delhi: CBS Publishers & Distributors.
3. Guyton, A.C., & Hall, J.E. (2015). Textbook of Medical Physiology (13th ed.). USA: Saunders.
4. Jurd, R.D. (2003). Instant notes in Animal Biology. New Delhi: Viva Books Pvt. Ltd.

COURSE LEARNING OUTCOME:

On completion of this course, the students will be able to:

1. Gain basic understanding of structure and functions of each physiological system of human.
2. Describe principles and pathway of metabolism of carbohydrate, protein and lipids.
3. Develop an understanding about principles of human anatomy and physiology.

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MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	2	1	2	1	3
CO2	3	2	3	2	1
CO3	3	1	2	1	2

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PHYSIOLOGY LAB (BBT 272)**



COURSE OBJECTIVES: The course will make the students learn about various solution standardization, viscosity and basics of titration.

Credits: 01

L-T-P: 0-0-2

Module No	Content	Teaching Hours
1	1. Estimation of Haemoglobin percentage by Haemocytometer. 2. Enumeration of the total number of red blood corpuscles (R.B.C.) & (W.B.C.) 3. Determination of ABO blood groups and Rh factor. 4. Study of effect of isotonic, hypotonic and hypertonic solutions on R.B.C. 5. Determination of the presence of sugar and albumin in the urine sample. 6. Preparation of stained mounts of anatomy of monocot and dicot's root, stem & leaf. 7. Respiration: CO₂ is produced during respiration, Loss of dry weight in respiration, Anaerobic respiration. 8. Osmosis: Grapes and dried raisins, Potato osmoscope and semi permeable membrane, Plasmolysis and deplasmolysis. Demonstration of opening & closing of stomata 9. Separation of photosynthetic pigments by paper chromatography. 10. Isolation and observation of stomatal density through leaf disc	20

SUGGESTED TEXTBOOKS & REFERENCES:

1. Chatterjee, C.C. (2018). Human Physiology Vol-I (12th ed.). New Delhi: CBS Publishers & Distributors.
2. Guyton, A.C., & Hall, J.E. (2015). Textbook of Medical Physiology (13th ed.). USA: Saunders.
3. Jurd, R.D. (2003). Instant notes in Animal Biology. New Delhi: Viva Books Pvt. Ltd.
4. Dutta, S.C. (2012). Plant Physiology. New Delhi: New age International Publishers.
5. Hopkins, W.G., & Huner, N.P.A. (2008). Introduction to Plant Physiology. New Jersey: John Wiley and Sons Inc

COURSE LEARNING OUTCOME:

On completion of this course, the students will be able to:

1. Understand the estimation of Haemoglobin percentage
2. Handling for ABO blood groups determination
3. Understand the physiological details of photosynthesis and respiration.
4. Design experiments, collect and analyze data, critically evaluate, and present the data produced in physiology.

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(ABILITY ENHANCEMENT COMPULSORY COURSE-2)
FUNCTIONAL ENGLISH -I (BBT 214)**



COURSE OBJECTIVES: To introduce corrective measures to eliminate grammatical errors in speaking and writing.

Credits: 02

L-T-P: 2-0-0

Module No	Content	Teaching Hours
1	Fundamentals of Grammar and Vocabulary: Parts of speech: nouns, verbs, adjectives, adverbs, pronouns, prepositions, conjunctions, Sentence structure: subject-verb agreement, types of sentences (simple, compound, complex), Tenses and verb forms: past, present, and future tenses, Common errors in grammar: articles, prepositions, and word order, Vocabulary building: synonyms, antonyms, and contextual usage	8
2	Reading and Comprehension Skills: Skimming and scanning techniques, Identifying main ideas and supporting details, Understanding scientific and technical vocabulary, Reading comprehension of scientific articles and reports, Summarizing and paraphrasing academic texts	8
3	Writing Skills: Paragraph writing: topic sentences, coherence, and unity, Writing scientific essays and short reports, Drafting and editing academic papers, Writing formal letters, emails, and applications, Introduction to citation and referencing styles (APA/MLA)	8
4	Speaking and Listening Skills: Pronunciation, stress, and intonation for clear speech, Presenting scientific topics orally, Engaging in academic discussions and debates, Listening to lectures, academic talks, and scientific podcasts, Listening for specific information and note-taking techniques	8

SUGGESTED TEXTBOOKS & REFERENCES:

1. Leech, G. & J. Svartvik (2002) A Communicative Grammar of English. Pearson, India.
2. Pandey J. H. (2008) Complete Grammar, Shree Book Centre, Mumbai, India.
3. Murphy, R. (2009) Intermediate English Grammar. Cambridge Univ. Press, India.
4. Hewings, M. (2011) Advanced English Grammar. Cambridge Univ. Press, India.
5. Wren, P. C. & H. Martin (2000) High School English Grammar and Composition, S. Chand & Co, New Delhi.

COURSE OUTCOME: On completion of this course, the students will be able to:

1. Theoretical and conceptual understanding of the elements of grammar.
2. To enhance the learners' ability of communicating accurately and fluently.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	2	1	1	3
CO2	1	2	1	2	3

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(SKILL ENHANCEMENT COURSES-2)**



APPLICATION OF BIOTECHNOLOGY IN AGRICULTURE (BBT 215)

COURSE OBJECTIVES: This course is designed to impart knowledge and skill on understanding the Concepts of diversified Biotechnological application in the field of Agriculture,

Credits: 03

L-T-P: 3-0-0

Module No	Content	Teaching Hours
1	Principles of Biotechnological Application in Agriculture , Introduction to microbial world , Prokaryotic and eukaryotic microbes. Microbial growth in models of bacterial, yeast and mycelia growth curve. Use of Bioinformatics tools for marker assisted breeding.	10
2	Role of microbes in soil fertility and crop production. Biological nitrogen fixation- symbiotic, associative and asymbiotic. Azolla, blue green algae and mycorrhiza. Rhizosphere and phyllosphere.	10
3	Microbes in human welfare and silage production, biofertilizers, biopesticides, biofuel production and biodegradation of agro-waste. Mushroom culture.	10
4	Applications of Plant Genetic Engineering – crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors. Genetic modification in Agriculture –transgenic plants, genetically modified foods, application, future applications, ecological impact of transgenic plants. Case studies on Golden Rice, Bt Cotton, draught tolerant maize.	10

SUGGESTED TEXTBOOKS

Naveen Kango , 2010, Text Book of Microbiology , I.K. International Publishing House Pvt.Ltd
G. Rangaswami, D.J. Bagyaraj , 2016 , Agricultural Microbiology, PHI Learning Pvt.Ltd
Shiva Aithal, Nikhilesh Kulkarni , 2010, Modern Approaches Soil Agriculture .
Environmental Microbiology , Himalaya Publishing House
Ahindra Nag , 2008 , Text Book Of Agricultural Biotechnology, PHI Learning

REFERENCE BOOKS

Microbiology. Pelczar, J.r.,M.J.E.C.S.Chan and Krieg, N.R, 2009, McGraw Hill Publishers
Microbiology. Prescott, L.M, Harley, J.P. and Klein, D.A., 2008, McGraw Hill Publishing Ltd

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COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Learn and gain knowledge about Concept of application of diversified biotechnological applications in the field of Agriculture
2. Learn and gain knowledge about Concept , types , components , production and application and impacts of Biofertilizers, Biopesticides , Mushrooms , GMOs , Genetic Engineering , Recombinant DNA Technology , Tissue culture , Biofuel etc.
3. Comprehend the systems , components , types , process of operation demands of the Agriculture Biotechnology Industry
4. Learn to apply technical knowledge and skills required for understanding and application of the Agriculture Biotechnology

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	2	2
CO2	3	3	3	2	2
CO3	3	2	2	1	1
CO4	3	3	2	2	2

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**(VALUE ADDITION COURSE-2)
ECOLOGY AND ENVIRONMENTAL SCIENCE (VBT 211)**

COURSE OBJECTIVES: Recognize major concepts in environmental sciences and demonstrate in depth understanding of the environment. The course deals with the components of environment, ecosystem, environmental pollution and health hazards and finally the protection and preservation of environment.

Credits: 02

L-T-P: 2-0-0

Module No.	Content	Teaching Hours
1	Introduction to Environmental Science: Definition and scope and need for public awareness; Ecosystem: Concept, Structure and Function of Ecosystem, Productivity and Food chain and Food web, Ecological Pyramids, Energy flow in Ecosystem, Restoration of Damaged Ecosystem.	10
2	Biodiversity: Definition, Description at National and Global level, Levels, Gradients and Use of Biodiversity, Hot Spots of Biodiversity, Threats and Conservation of Biodiversity. Extinction of species, Biodiversity assessment, Biosphere Reserves, International Efforts to conserve Biodiversity.	10
3	Natural Resources: Renewable and Non-renewable and their equitable use for sustainability, Material Cycles: Carbon, Nitrogen and Sulphur Cycle, Conventional and Non-Conventional Energy Resources – Fossils fuel based, Hydroelectric, Wind, Nuclear and Solar Energy, Biomass, Biodiesel, Hydrogen as an alternative fuel, Resettlement and Rehabilitation. Biotechnology based solutions for climate change mitigations: Biochar technology, Phytoremediation of polluted Environments, Algal-based CO ₂ capture systems.	10
4	Environmental Changes and Human Health: Social issues related to environment – sustainable development, urban problems related to water and energy conservation and waste management, resettlement and rehabilitation, Environmental ethics. Environmental pollution – causes and effect, control measures for water, air and soil, marine, land, noise, thermal pollution, Climate change, green house effect, Global Warming Acid Rain, Ozone layer formation and depletion, Impact on human health	10

SUGGESTED TEXTBOOKS & REFERENCES:

1. Chapman, J.L., Reiss, M.J. 1999. Ecology: Principles and applications (2nd edition) Cambridge University Press.
2. Divan Rosencraz, Environmental laws and policies in India, Oxford Publication.
3. Ghosh, S.K., Singh, R. 2003. Social forestry and forest management. Global Vision Publishing House

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COURSE OUTCOME:

By the end of this class, the student should be able to:

1. Integrate the various disciplines and fields related to the environment to solve the environmental issues
2. Create an awareness, knowledge, and appreciation of the intrinsic values of ecological processes and communities.
3. Adopt integrative approach towards the environmental issues with a special focus on sustainability.
4. Describe human population characteristics and growth, and recognize the impacts of human society on Earth's systems and resources
5. Describe ecosystems in terms of how they vary, are structured, and function both internally and as part of the larger biosphere.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	-	1
CO2	3	2	1	2	2
CO3	1	2	3	-	1
CO4	1	2	-	1	2
CO5	3	2	-	2	1

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Students exiting the programme after securing 40 credits will be awarded UG Certificate in the relevant Discipline /Subject provided they secure 4 credits in work based vocational courses offered during summer term or internship / Apprenticeship in addition to 6 credits from skill-based courses earned during first and second semester.

**(VOCATIONAL COURSE 1)
PLANT BIOTECH & GENETIC IMPROVEMENT (VBT 212)**

OBJECTIVES: The course focuses on the fundamental principles and applications of plant biotechnology for genetic improvement. Students will gain hands-on experience in techniques like plant tissue culture, transgenesis, and genetic engineering, which are crucial for developing genetically improved plant varieties.

Credits: 02

L-T-P: 2-0-0

Module No	Content	Teaching Hours
1	Overview of Plant Biotechnology: Importance of plant biotechnology in agriculture and food security, Key areas: tissue culture, genetic engineering, marker-assisted selection Genetic Improvement in Plants: Traditional plant breeding vs. biotechnological approaches, Role of genetic diversity, domestication, and hybridization in crop improvement	10
2	Introduction to Plant Tissue Culture: Principles of plant tissue culture, Types of cultures: callus culture, organ culture, cell suspension culture Applications of Tissue Culture in Genetic Improvement: Micropropagation, somatic embryogenesis, and clonal propagation, Production of disease-free and high-yielding plants	10
3	Principles of Genetic Transformation: Agrobacterium-mediated transformation: Ti plasmid, T-DNA integration, Direct gene transfer methods: gene gun, electroporation Transgenic Plants and GM Crops: Development of genetically modified crops (Bt crops, herbicide resistance), Ethical considerations and regulatory aspects of GM crops	10
4	Molecular Markers in Plant Breeding: Types of markers: RFLP, RAPD, SSR, SNP - Marker-assisted selection (MAS) and its role in plant breeding CRISPR-Cas9 and Genome Editing in Plants: Basics of CRISPR-Cas9 technology, Applications of genome editing in developing improved crops	10
5	Successful Case Studies of Transgenic Crops: Bt cotton, Golden Rice, drought-resistant crops, Applications in sustainable agriculture and food security Challenges and Future Prospects: Environmental and socio-economic impacts of GM crops, Innovations in plant biotechnology: synthetic biology, precision agriculture	10

SUGGESTED TEXT BOOKS:

1. "Plant Biotechnology: Principles and Applications" by Adrian Slater, Nigel Scott, and Mark Fowler
2. "Plant Tissue Culture: Theory and Practice" by S.S. Bhojwani and M.K. Razdan
3. "Transgenic Plants: Methods and Protocols" edited by Leandro Peña
4. Online resources: NCBI, TAIR, Phytozome, etc.

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COURSE OUTCOME:

By the end of this class, the student should be able to:

1. Understand the basic principles of plant biotechnology and genetic improvement.
2. Gain practical experience in plant tissue culture and genetic transformation techniques.
3. Learn how to apply molecular markers and bioinformatics tools for plant genetic analysis.
4. Be able to critically evaluate the use of GM crops and their impact on agriculture.
5. Acquire the skills needed to pursue internships or careers in plant biotechnology and related industries.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	2	1	3	-
CO2	-	-	-	-	-
CO3	-	-	3	3	2
CO4	-	-	3	3	2
CO5	-	-	2	3	-

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**(VOCATIONAL COURSE 2)
GENETIC ENGINEERING TECHNIQUES (VBT 213)**

OBJECTIVES: This course aims to introduce students to essential genetic engineering techniques used in biotechnology research and industry. Students will gain hands-on experience in gene cloning, DNA manipulation, and the use of advanced molecular tools such as CRISPR-Cas9 for gene editing..

Credits: 02

L-T-P: 2-0-0

Module No	Content	Teaching Hours
1	Overview of Genetic Engineering: Definition, history, and applications in medicine, agriculture, and industry, Difference between genetic modification and genetic engineering Basic Tools and Enzymes Used in Genetic Engineering: DNA ligases, restriction enzymes, reverse transcriptase, and polymerases, Vectors: plasmids, viral vectors, cosmids, BACs, and YACs	10
2	DNA Isolation from Various Sources: Isolation of genomic DNA from bacteria, plant, or animal tissues, Extraction of plasmid DNA from bacterial cultures DNA Purification and Quantification: Techniques for purifying DNA: phenol-chloroform extraction, ethanol precipitation, Quantification of DNA using spectrophotometry (A260/A280 ratio)	10
3	Introduction to Gene Cloning: Basic steps: cutting, ligation, transformation, selection, and screening, Use of restriction enzymes and ligases for cloning Transformation and Selection of Recombinant DNA: Bacterial transformation methods: heat shock, electroporation, Screening methods: blue-white screening, antibiotic selection	10
4	Principles and Types of PCR: Components and steps in PCR: denaturation, annealing, extension, Variations: Reverse transcription PCR (RT-PCR), quantitative PCR (qPCR) Applications of PCR in Genetic Engineering: PCR-based cloning, gene amplification, mutation analysis, Diagnostic applications in detecting genetic disorders	10
5	Applications of Genetic Engineering: Production of recombinant proteins (e.g., insulin, growth hormones), Development of genetically modified organisms (GMOs) in agriculture (e.g., Bt crops) Ethical Considerations in Genetic Engineering: Bioethics in genetic engineering: GMOs, gene editing in humans, Regulatory frameworks: FDA, USDA, biosafety concerns	10

SUGGESTED TEXT BOOKS:

1. "Gene Cloning and DNA Analysis: An Introduction" by T.A. Brown
2. "Molecular Cloning: A Laboratory Manual" by Michael R. Green and Joseph Sambrook
3. "Genetic Engineering: Principles and Methods" edited by Jane K. Setlow
4. Online resources: NCBI, Addgene, CRISPR tools (CRISPR design websites), etc.

COURSE OUTCOME:

By the end of this class, the student should be able to:

1. Understand the principles and applications of genetic engineering techniques.
2. Gain practical skills in gene cloning, DNA isolation, and PCR-based methods.
3. Be familiar with advanced gene editing techniques like CRISPR-Cas9.

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4. Critically evaluate the ethical and regulatory issues surrounding genetic engineering.
5. Be prepared for internships or research roles in molecular biology, genetic engineering, or biotechnology industries.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	2	1	3	-
CO2	-	-	-	-	-
CO3	-	-	3	3	2
CO4	-	-	3	3	2
CO5	-	-	2	3	-

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**SEMESTER-3
(CORE COURSE-6)**

GENERAL MICROBIOLOGY (BBT 311)

OBJECTIVES: This course introduces students to the basic concepts of microbiology, the history and development of microbiology.

Credits: 04

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1	Fundamentals, History and Evolution of Microbiology. Classification of microorganisms: Microbial taxonomy, criteria used including Molecular approaches, Microbial phylogeny and current classification of bacteria.	10
2	Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms eg. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.	
3	Cultivation and Maintenance of microorganisms: Nutritional categories of microorganisms, methods of isolation, Purification and preservation. Control of Microorganisms: By physical, chemical and chemotherapeutic agents.	10
4	Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria. Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways. Genetic recombination in bacteria: Transformation, Transduction and Conjugation.	10
5	Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal. Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods. Introduction to microbial ecology.	10

SUGGESTED TEXTBOOKS & REFERENCES:

1. Jay JM, Loessner MJ and Golden DA. (2005). *Modern Food Microbiology*. 7th edition, CBS Publishers and Distributors, Delhi, India.
2. Kumar HD. (1990). *Introductory Phycology*. 2nd edition. Affiliated East Western Press.
3. Madigan MT, Martinko JM and Parker J. (2009). *Brock Biology of Microorganisms*. 12th edition. Pearson/Benjamin Cummings

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4. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book.

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Understand the basic microbial structure, function and study the comparative characteristics of prokaryotes and eukaryotes.
2. Understand the structural similarities and differences among various physiological groups of bacteria/archaea.
3. General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	-	1
CO2	3	-	1	-	1
CO3	3	-	3	2	-

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GENERAL MICROBIOLOGY LAB (BBT 371)**



COURSE OBJECTIVES: The main purpose of this course is to master the students with practical knowledge of microbiology that they are being taught, and to provide practical technical training related to microbiology.

Credits: 01

L-T-P: 0-0-2

Module No	Content	Teaching Hours
1	1. Study of different sterilization methods used in microbiology lab. 2. Preparation of various media for microbes. 3. Methods of isolation of bacteria from different sources. 4. Serial dilution analysis . 5. Isolation of bacteria and their biochemical characterization. 6. Determination of bacterial cell size by micrometry. 7. Enumeration of microorganism - total & viable count. 8. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.	20

SUGGESTED TEXTBOOKS & REFERENCES:

1. Jay JM, Loessner MJ and Golden DA. (2005). *Modern Food Microbiology*. 7th edition, CBS Publishers and Distributors, Delhi, India.
2. Kumar HD. (1990). *Introductory Phycology*. 2nd edition. Affiliated East Western Press.
3. Madigan MT, Martinko JM and Parker J. (2009). *Brock Biology of Microorganisms*. 12th edition. Pearson/Benjamin Cummings.

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Culture, isolate and purify microbes from various sites.
2. Learn various techniques of media preparation and sterilization method.
3. Observe the morphology by using different staining techniques.

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(CORE COURSE-7)

BIOINSTRUMENTATION (BBT 312)

COURSE OBJECTIVES: The primary objectives of this course are to develop the skills to understand the theory and practice of bio analytical techniques.

Credits: 04

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	Biophysical methods: Introduction of concept of pH, Measurement of pH, pOH, Buffer action.	10
2	Separation & Identification of Materials: Concept mechanism and applications of Chromatography (Partition Chromatography, Paper Chromatography, Adsorption Chromatography, TLC, GLC, Ion Exchange Chromatography, Gel Chromatography, HPLC, Affinity Chromatography); Electrophoresis (Gel Electrophoresis, Paper Electrophoresis), Isoelectric focussing	10
3	Centrifugation: Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical), Factors affecting Sedimentation velocity, Standard Sedimentation Coefficient, rotor types, Rate-Zonal centrifugation, sedimentation equilibrium Centrifugation and its applications	10
4	Microscopy: Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, Electron microscopy (TEM, SEM), Spectroscopy: Basic concepts, principle, working, care & maintenance of UV VIS and FT-IR Spectroscopy.	10
5	X-Ray Crystallography: Concept of X-ray diffraction, Bragg equation, Reciprocal lattice, Miller indices & Unit cell, Concept of different crystal structure, determination of crystal structure (concept of rotating crystal method, powder method).	

SUGGESTED TEXTBOOKS:

1. Cromwell, L. and Weibell, F.J. and Pfeiffer, E.A., Biomedical Instrumentation and Measurement, Dorling Kingsley (2006) 2nd ed.
2. Carr, J.J. and Brown, J.M., Introduction to Biomedical Equipment Technology, Prentice Hall (2000) 4th ed.
3. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.

REFERENCE BOOKS:

1. Khandpur, R.S., Handbook of Biomedical Instrumentation, McGraw Hill (2003) 2nd ed.

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2. Webster, J.G., Medical Instrumentation Application and Design, John Wiley (2007) 3rd ed.
Biophysical Techniques By Iain Campbell • 2012, 9780199642144, 0199642141, QUP Oxford.

Online links for study & reference materials:

<https://microbenotes.com/category/instrumentation/>

<https://lecturenotes.in/download/material/18824-note-of-biinstrumentation-by-nithya-biotech.>

<http://biomedikal.in/2009/12/lecture-notes-on-biomedical-instrumentation/>

COURSE OUTCOME:

After completion of the Course, the student will be able to:

1. Enable the student to get sufficient knowledge in principles and applications of bio instruments.
2. To enable the students to learn the immuno techniques and radio labelling techniques.
3. To differentiate and analyze the biomedical signal sources.
4. Describe the Basic concept of various microscopic techniques
5. Understand the basic principle and application of X-Ray Crystallography and spectroscopy.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	-	2
CO2	3	-	2	1	3
CO3	3	1	2	1	-
CO4	3	-	3	1	2
CO5	3	1	2	-	-

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BIOINSTRUMENTS LAB (BBT 372)**



COURSE OBJECTIVES: This course contains bio analytical techniques along with their theory, working principal, common instrumentation and possible applications.

Credits: 01

L-T-P: 0-0-2

Module No.	Contents	Lab Hours
I	1. Operation of shakers, incubators, pH meters and centrifuges 2. Buffer preparation- Phosphate/Acetate/Citrate 3. Demonstration of different types of centrifuges 4. Separation of amino acids by paper chromatography 5. Native gel electrophoresis of proteins 6. Agarose Gel Electrophoresis. 7. To verify the validity of Beer's law and determine the molar extinction coefficient of NADH.	20

SUGGESTED TEXTBOOKS & REFERENCES:

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

Further Readings:

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

COURSE OUTCOME

After completion of the Course, the student will be able to:

1. The students will become familiar with working principals, tools and techniques of analytical techniques.
2. After completion students can get employment in academic and industrial research organization based on biotechnology, pharmacy, agriculture, and chemical.

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(DISCIPLINE SPECIFIC ELECTIVE COURSE-2)

MOLECULAR DIAGNOSTICS TECHNIQUES (BBT 313)

COURSE OBJECTIVES: The course in skill enhancement provides an insight into different diagnostic techniques to the students.

Credits: 04

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1	Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes, immuno blotting, histochemical techniques. Paper based diagnosis (biosensor, colorimetric), Immunodiagnostic tests. Immuno florescence. Radioimmunoassay. Applications of enzyme immunoassays in disease diagnosis.	10
2	Applications of various kinds of PCR: qPCR, RTPCR. RFLP, RAPD, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology Laboratory tests in chemotherapy: Susceptibility tests: Micro-dilution and macro-dilution broth procedures.	10
3	Automation in microbial diagnosis, standardization of antigen and specific antibodies, Concepts and methods in idiotypes. Antiidiotypes and molecular mimicry and receptors. Epitope design and applications.	10
4	Genetic testing: chromosome banding patters, banding techniques and their correlates, karyotyping; Ethical, Social and Legal Issues to Molecular -Genetic Testing.	10
5.	Cell sorting- Flow cytometry and FACS. Neonatal and prenatal diagnosis. Sex identification in forensics. Diagnostic Testing for Cystic Fibrosis. Molecular Testing for HIV-1.	10

SUGGESTED TEXTBOOKS & REFERENCES:

1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
2. Bioinstrumentation, Webster
3. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
4. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.

COURSE LEARNING OUTCOME:

On completion of this course, the students will be able to:

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1. Knowledge of different diagnostic techniques.
2. Learn the concept of histochemical-immuno assay.
3. Know about the applications of molecular marker.
4. Know the applications and clinical role of the monoclonal and polyclonal antibodies.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	1	3
CO2	3	1	2	-	1
CO3	3	-	2	-	1
CO4	3	1	2	-	3

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MOLECULAR DIAGNOSTICS TECHNIQUES LAB (BBT 373)

COURSE OBJECTIVES: The course in skill enhancement provides an insight into different diagnostic techniques practically to the students.

Credits: 01

L-T-P: 0-0-2

Module No	Content	Teaching Hours
I	Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.) 1. Kirby-Bauyer method (disc-diffusion method) to study antibiotic sensitivity of a bacterial culture 2. A kit-based detection of a microbial infection (Widal test). 3. Demonstration of study of Electron micrographs. 4. Immuno-diagnostic test (Typhoid, Malaria, Dengue) (anyone) 5. PCR analysis/ demonstration. 6. Perform/demonstrate RAPD and its analysis.	20

SUGGESTED TEXTBOOKS & REFERENCES:

1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
2. Bioinstrumentation, Webster
3. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
4. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
5. Microscopic Techniques in Biotechnology, Michael Hoppert

Online:

<https://microbiologyinfo.com/widal-test-introduction-principle-procedure-interpretation-and-limitation/>

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Knowledge of detection methods of communicable diseases.
2. Knowledge of molecular marker analysis.

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(GENERIC ELECTIVE-1)**



DEVELOPMENTAL BIOLOGY (BBT 314)

COURSE OBJECTIVE: The course in Developmental Biology provides an insight into the genetic and physiological control of animal development.

Credits: 04

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1	Gametogenesis: Definition, scope & historical perspective of development Biology, Gametogenesis – Spermatogenesis, Oogenesis. Fertilization - Definition, mechanism, types of fertilization. Different types of eggs on the basis of yolk	10
2	Early embryonic development: Cleavage: Definition, types, patterns & mechanism Blastulation: Process, types & mechanism Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers, Fate Maps in early embryos	10
3	Embryonic Differentiation; Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level.	10
4	Concept of embryonic induction: Primary, secondary & tertiary embryonic induction, Neural induction and induction of vertebrate lens.	10
5	Organogenesis: Neurulation, notogenesis, development of vertebrate eye. Fate of different primary germ layers Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals	10

SUGGESTED TEXTBOOKS:

1. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
3. Kalthoff, (2000). Analysis of Biological Development, II Edition, McGraw-Hill Professional.

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Gain expertise in explaining how a variety of interacting processes generate an organism's heterogeneous shapes, size and structural features that arise on the trajectory from embryo to adult or more generally throughout a life cycle.
2. Gain an understanding of systematic and organized learning about the knowledge and concepts of

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growth and development of organisms.

3. Demonstrate a rich array of material and conceptual practices that could be analysed to better understand the scientific reasoning exhibited in experimental life sciences.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOME

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	-	1
CO2	3	-	-	2	2
CO3	3	1	2	-	-

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(ABILITY ENHANCEMENT COMPULSORY COURSE-3)

COMMUNICATION SKILL (BBT 315)

COURSE OBJECTIVE: This course will enhance the English communication, speaking, reading and writing skills of a student.

Credits: 02

L-T-P: 2-0-0

Module No	Content	Teaching Hours
1	Introduction: Theory of Communication, Types and modes of Communication	8
2	Language of communication: Verbal, and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication	8
3	Speaking skills: Monologue, Dialogue, Group Discussion, Effective Communication, / Mis Communication, Interview, Public speech.	8
4	Reading and understanding: Close reading comprehension, Summary paraphrasing analysis, & interpretation, translation, Literary knowledge text.	8
5	Writing skills: Documenting, report writing, making notes, Letter writing.	8

SUGGESTED TEXTBOOKS & REFERENCES:

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. To make students proficient in oral communication and writing.
2. Students should be able to write analytically in a variety of formats, including essays, reflective writing, and critical reviews of secondary sources.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	1	2	-	-	2
CO2	-	2	-	1	2

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**(VALUE ADDITION COURSE-2)
PHYSICAL EDUCATION AND YOGA (VBT 311)**

COURSE OBJECTIVES: This course is designed to impart knowledge on understanding the concepts of Physical Education and Yoga for Health fitness and wellness.

Credits: 02

L-T-P: 2-0-0

Module No	Content	Teaching Hours
1	Physical Education: Meaning, Definition, Aim and Objective, Misconception About Physical Education. Need, Importance and Scope of Physical Education in the Modern Society, Physical Education Relationship with General Education.	10
2	Concept of Fitness and Wellness: Meaning, Definition and Importance of Fitness and Wellness, Components of Fitness, Factor Affecting Fitness and Wellness. Weight Management: Meaning and Definition of Obesity, Causes of Obesity., Management of Obesity, Health problems due to Obesity. Lifestyle: Meaning, Definition, Importance of Lifestyle, Factor affecting Lifestyle, Role of Physical activity in the maintains of Healthy Lifestyle	10
3	Yoga and Meditation: Historical aspect of yoga. Definition, types scopes & importance of yoga, Yoga relation with mental health and value education, Yoga relation with Physical Education and sports, Definition of Asana, differences between asana and physical exercise, Definition and classification of pranayama, Difference between pranayama and deep breathing. Practical: Asana, Suraya-Namaskar, Bhujang Asana, Naukasana, Halasana, Vajrasana, Padmasana, Shavasana, Makrasana, Dhanurasana, Tad Asana. Pranayam: Anulom, Vilom.	10

SUGGESTED TEXTBOOKS

1. Singh, Ajmer, Physical Education and Olympic Abhiyan, "Kalayani Publishers", New Delhi, Revised Addition, 2006
2. Patel, Shri krishna, Physical Education, "Agrawal Publishers", Agra, 2014-15
3. Panday, Preeti, Sharirik Shiksha Sankalan, " Khel Sanskriti Prakashan, Kanpur

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Learn the introduction of Physical Education, Concept of fitness and wellness

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2. Weight management and lifestyle of an individual.
3. Learn about the relation of Yoga with mental health and value Education.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	2	-	1	1
CO2	-	3	-	1	2
CO3	1	3	1	1	2

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RAMA UNIVERSITY, KANPUR, U.P (INDIA)**



**SEMESTER-4
(CORE COURSE-8)**

MOLECULAR BIOLOGY (BBT 411)

Objectives: This course aims to enable students to master the following knowledge about genetic material i.e., DNA, DNA transcripts, i.e., RNA and protein biosynthesis and their interrelationship.

Credits: 04

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1	Introduction to Molecular Biology, Types of genetic materials- Experiments of Griffith, Avery, MacLeod and McCarty, Hershey and chase, John Cairns experiment, Meselson- Stahl experiment, Central dogma of life.	8
2	Replication of DNA, Models of DNA replication, Mechanism of DNA replication in prokaryotes (initiation, elongation, replication fork, replication machinery, termination), Rolling Circle mechanism. Enzymes and proteins involved in DNA replication (nucleases, DNA polymerases, DNA helicases, gyrases, SSBP, topoisomerase, primase).	10
3	DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, non-homologous end joining. Homologous recombination: models and mechanism.	10
4	Mechanism of transcription in prokaryotes and eukaryotes. Enzymes and proteins involved in transcription, post transcriptional modifications. Inhibitors of transcription.	10
5	Genetic code - characteristics and properties, Wobble hypothesis. Protein biosynthesis in prokaryotes and eukaryotes, post translational modifications, protein degradation, Inhibitors of protein synthesis. Regulation of gene expression (lac, trp and gal operons).	10

SUGGESTED TEXT BOOK:

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.

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REFERENCE BOOKS

3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

COURSE OUTCOMES:

On completion of this course, the students will be able to:

1. Learn DNA replication, transcription and translation
2. Understand the regulation of gene expression
3. Knowledge about DNA repair and damage

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	1	2
CO2	3	1	2	-	1
CO3	3	-	2	1	-

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MOLECULAR BIOLOGY and RDT LAB (BBT 471)

COURSE OBJECTIVES: Provide hands on experiments in performing basic molecular biology techniques such as DNA isolation, gel electrophoresis

Credits: 01

L-T-P: 0-0-2

Module No	Content	Teaching Hours
I	Develop skills and understanding about different techniques used in Molecular Biology experiments. 1. Isolation of genomic DNA from bacterial cells. 2. Isolation of Plasmid DNA by <i>E.coli</i> . 3. Isolation of Plant DNA by CTAB method. 4. Agarose gel electrophoresis of genomic DNA & plasmid DNA. 5. Preparation of restriction enzyme digests of DNA samples. 6. Polymerase Chain Reaction 7. Restriction Analysis and Restriction digestion of pBR322	20

SUGGESTED TEXTBOOKS:

1. Brown T. A, Gene Cloning and DNA Analysis: An Introduction, (6th Edition) Wiley- Blackwell, 2010.
2. Winnacker L Ernst, From genes to clones -Introduction to gene technology (4th edition), Panima Publishing Corporation, 2003.

REFERENCE BOOKS:

1. Dubey R.C, Advanced Biotechnology (1st edition), Chand and Company, 2014.
2. Watson D James; et al Recombinant DNA: genes and genomes, (3rd edition), Basingstoke: Palgrave pacmillan, 2007.
3. Sathyanarayanan U, Biotechnology (2013) Books and allied (P) ltd.
4. Michael R. Green, Molecular Cloning: A Laboratory Manual (4th Edition), Cold Spring Harbor Laboratory Press.

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Know about the isolation of chromosomal and plasmid DNA.
2. Perform application of PCR in rDNA technology.
3. Gain hands-on training in various molecular techniques for gene manipulation

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(CORE COURSE-9)

ENZYMOLGY (BBT 412)

COURSE OBJECTIVES: This course has been designed to teach the student majoring in science all the major aspects of the study of enzymes.

Credits: 04

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1	Introduction to Enzymes: General introduction and historic background- General Terminology, Nomenclature and Classification of Enzymes. Criteria of purity of enzymes- Specific activity. Enzyme units-Katal and IU. Enzyme activity- chemical nature of enzymes. Protein nature of enzymes and Non protein enzymes- Ribozymes and DNAzymes. Metalloenzymes and metal activated enzymes. Coenzymes and Cofactors- Prosthetic group.	10
2	Enzyme Catalysis: Lock and key, Induced fit and Transition state Hypotheses. Mechanism of enzyme catalysis- Acid-base catalysis, covalent catalysis, Metal ion catalysis, Proximity and orientation effects etc. Mechanism of Serine proteases- Chymotrypsin, Lysozyme, Carboxypeptidase A and Ribonuclease., Proenzymes (Zymogens).	10
3	Enzyme Kinetics and Inhibition: Kinetics of a single-substrate enzyme catalysed reaction, Michealis-Menten Equation, Km, Vmax, L.B Plot, Turnover number, Kcat. Kinetics of Enzyme Inhibition. Kinetics Allosteric enzymes. Factors affecting the enzyme activity- Concentration, pH and temperature. Reversible Inhibition- Competitive, Non Competitive, Uncompetitive, Mixed, Substrate, Allosteric and Product Inhibition. Irreversible Inhibition.	10
4	Enzyme Regulation: Feedback Regulation, Allosteric Regulation, Reversible Covalent Modification and Proteolytic Activation. Enzymes in the cell, localization, compartmentation of metabolic pathways, enzymes in membranes, concentrations. Mechanisms of enzyme degradation, lysosomal and nonlysosomal pathways, examples.	10
5	Industrial Enzymes- Thermophilic enzymes, amylases, lipases, enzymes in industry, enzymes used in various fermentation processes, cellulose degrading enzymes, Metal degrading enzymes. Clinical enzymes- Enzymes as thrombolytic agents, Anti-inflammatory agents, strptokinase, asparaginase, Isoenzymes like CK and LDH, Transaminases (AST, ALT), Cholinesterases, Phosphatases.	10

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SUGGESTED READINGS:

Text Books:

1. Cox, M.M and Nelson, D.L. (2008). Lehninger Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.

Reference Books:

2. Voet D and Voet J (2012) Biochemistry . Fifth edition, Wiley.
3. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009).
4. Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw-Hill Companies Inc.

Online links for study & reference materials:

<https://www.youtube.com/watch?v=ozdO1mLXBQE>

https://www.youtube.com/watch?v=k5BFZ3_9MT8

<https://courseware.cutm.ac.in/courses/enzymology/>

COURSE OUTCOME: On completion of this course, the students will be able to:

1. To understand the basic concepts of Enzyme
2. To learn about functioning and kinetics of several enzymes
3. To provide basic knowledge of enzyme use as a tool in industry, agriculture and medicine.
4. To study about the different applications of enzymes.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	1	2
CO2	2	-	2	1	2
CO3	1	3	2	1	-
CO4	2	-	3	2	1

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ENZYMOLOGY LAB (BBT 472)

COURSE OBJECTIVES: The course in skill enhancement provides an insight into enzymology and enzymes to the students

Credits: 01

L-T-P: 0-0-2

Module No	Content	Teaching Hours
1	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. Quantitative estimation of proteins by Bradford/Lowry's method. 8. Effect of temperature on enzyme activity 9. Calculation of kinetic parameters such as Km, Vmax	20

SUGGESTED TEXTBOOKS & REFERENCES:

1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGraw Hill, 2009.
3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley and Sons, 1995.
4. Practical Enzymology Hans Bisswanger Wiley-VCH 2004

COURSE OUTCOMES:

On completion of this course, the students will be able to:

1. know the principles of isolation and purification of enzymes from various sources.
2. comprehend various methods involved in enzyme technology and their commercial

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(CORE COURSE-10)**



BASIC IMMUNOLOGY (BBT 413)

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

Credits: 4

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	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	10
2	Antigens & Immunogenicity. Antigens - Types, properties, Haptens, Adjuvants, Toxoids, Immunoglobulins- structure, types and properties, Theories of antibody formation, Structural and genetic basis of antibody formation.	10
3	Antigen and antibody reactions, Immunodiagnostic methods - Agglutination, precipitations, complement fixation, Coomb's test, RIA, ELISA and its types, Immunofluorescence, Production of Monoclonal Antibodies and Hybridoma technique..	10
4	Cytokines & Chemokines - Classification, types and its functions, Complement system: - structure, properties, functions of complement components and its pathways	10
5	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.	10

SUGGESTED TEXTBOOKS & REFERENCES:

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.

REFERENCE BOOKS

1. Male. D and Roth. D, Immunology (8 edition), Reed Elsevier India Pvt Limited 2013.

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2. Khan. F.H. The Elements of Immunology, Pearson Education India, 2009

COURSE OUTCOMES:

On completion of this course, the students will be able to:

1. To learn fundamental principles of modern immunology.
2. Understand and apply related immunological techniques in medical laboratory.
3. Learn the concepts of developing bacterial and viral vaccines and adjuvants.
4. Learn the various immuno-diagnostic tests- RIA, ELISA.
5. Relate and apply medical laboratory science knowledge to immunological changes in healthy and disease contexts.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	1	2	2	-	-
CO2	3	2	1	-	2
CO3	3	3	3	2	2
CO4	3	-	-	-	-
CO5	-	3	2	3	2

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BASIC IMMUNOLOGY LAB (BBT 473)**



COURSE OBJECTIVES: The objective of this course is to provide an introduction to experimental design and basic techniques commonly used in immunology research laboratories.

Credits: 01

L-T-P:0-0-2

Module No.	Contents	Lab Hours
I	1. Differential leucocytes count 2. Total leucocytes count 3. Total RBC count 4. Haemagglutination assay 5. Haemagglutination inhibition assay 6. Separation of serum from blood 7. Double immunodiffusion test using specific antibody and antigen 8. ELISA.	20

SUGGESTED TEXTBOOKS & REFERENCES:

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.

COURSE OUTCOMES:

On completion of this course, the students will be able to:

1. Have the ability to specimen handling
2. Can perform various immunological tests which augment the capability to understand related theory.

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(GENERIC ELECTIVE-2)**



ROLE OF BIOTECHNOLOGY IN FORENSIC SCIENCE (BBT 414)

COURSE OBJECTIVES: The course in skill enhancement provides an insight into various aspects of forensic sciences to the students.

Credits: 4

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1.	Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science.	10
2.	Causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.	10
3.	Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink in various samples.	10
4.	Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification.	10
5.	Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, e-Discovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.	10

SUGGESTED TEXTBOOKS & REFERENCES:

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).
3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).

COURSE OUTCOMES:

On completion of this course, the students will be able to:

1. To understand the principles and the tools and techniques of forensic science.

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2. Gain knowledge of the applications of DNA profiling in forensic medicine.
3. Know the various investigation tools used in forensic science.
4. Have knowledge about the causes of crime, crime investigation and the medico-legal aspects of injuries.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	-	2	2
CO2	1	2	1	3	3
CO3	3	2	3	2	3
CO4	-	2	1	3	1

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(SKILL ENHANCEMENT COURSES-3)**



BIO-SAFETY AND ETHICS IN BIOLOGICAL SCIENCES (BBT 415)

COURSE OBJECTIVES: To apprise the students of the various societal, governance and regulatory issues in biotechnology with special emphasis on ethics, safety and intellectual property rights. Through this course, the students develop a perspective on the importance of these aspects in the success of biotechnology products and services in the market.

Credits: 03

L-T-P: 3-0-0

Module No	Content	Teaching Hours
1	Bioethics: Ethical issues related to biotechnology, legal and socioeconomic impacts of biotechnology, health and safety issues, Ethical issues in Human Cloning and stem cell research.	10
2	Biosafety– Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).	10
3	Risk assessment in biotechnological research and their regulation, physical and biological contaminants, Biosafety guidelines in India, Biosafety levels for plant, animal and microbial research.	10
4	Regulatory framework in Biotechnology: Regulation of RDT research, Prevention Food Adulteration Act (1955), Food Safety and Standards Bill (2005).	10

SUGGESTED TEXTBOOKS & REFERENCES:

1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers.
3. The law and strategy of Biotechnological patents by Sibley. Butterworth publications.

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Knowledge on Indian Patent Law, intellectual property.
2. Knowledge on biosafety issues related to Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).
3. Knowledge on Bioethics i.e., National & International. Ethical issues

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MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	3	-
CO2	1	3	-	3	3
CO3	3	2	2	2	-

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**(VALUE ADDITION COURSE-4)
INNOVATION AND ENTREPRENEURSHIP (VBT 411)**

COURSE OBJECTIVES: This course focus on the basis of Skills of bio-entrepreneur and biotechnology entrepreneurship. It basically covers the patenting, licensing and partnership in biotechnology industry It also covers the scope and importance of product development in biotech industries. It also includes about the marketing of the desired pharmaceutical drug..

Credits: 2

L-T-P: 2-0-0

Module No	Content	Teaching Hours
1	Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Scope of Biotechnology Entrepreneurship.	10
2	Biotechnology Marketing: Biotechnology in capital market; Initial Public Offering (IPO) in the capital market; examples of success and failure of biotechnology companies and the possible reasons; factors that influence success of company; product selection; failure of the product ; product development ; R&D with expertise ; cost of product development.	10
3	Patenting, licensing and partnership in biotechnology industry: Patents on biological inventions, licensing revenue, selection of right partner; negotiations of the terms of the terms of deal.	10
4	Entrepreneurship Skills: Entrepreneurship Skills of bio-entrepreneur, bio entrepreneurial training; research experience, creativity, communication skills and other attributes; participation in conferences, training and educational courses; institutes offering entrepreneurship courses.	10

SUGGESTED TEXTBOOKS & REFERENCES:

1. Holt DH. Entrepreneurship: New Venture Creation.
2. Kaplan JM Patterns of Entrepreneurship.
3. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.
4. Biotech Entrepreneur-to-Entrepreneur: <http://www.bioe2e.org>

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Have the ability to discern distinct entrepreneurial traits.
2. Know how about the loans and repayments for the start-up industries.

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3. Understand the fundamentals of marketing research and importance of survey, physical distribution and raw materials.
4. Know the parameters to assess opportunities and constraints for new business ideas.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	1	3	-	3
CO2	-	-	-	-	-
CO3	-	-	-	-	-
CO4	-	-	-	1	-

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Students exiting the programme after securing 80 credits will be awarded UG, Diploma in the relevant Discipline /Subject provided they secure additional 4 credit in, skill based vocational courses offered during first year or second year summer term.

**(VOCATIONAL COURSE 3)
INDUSTRIAL ENZYME TECHNOLOGY (VBT 413)**

OBJECTIVES: This course is designed to introduce students to enzyme production, characterization, and applications in various industries. Students will learn about enzyme kinetics, the use of bioreactors in enzyme production, and the practical steps involved in enzyme purification and industrial-scale applications.

Credits: 02

L-T-P: 2-0-0

Module No	Content	Teaching Hours
1	Overview of Enzymes: Classification, structure, and function of enzymes, Introduction to enzyme kinetics: Michaelis-Menten equation Industrial Importance of Enzymes: Applications of enzymes in food, pharmaceutical, textile, and detergent industries, Advantages of enzyme use over chemical processes	10
2	Microbial Sources of Industrial Enzymes: Isolation of microorganisms producing industrial enzymes (e.g., fungi, bacteria), Genetic modification for enhanced enzyme production Fermentation Technology for Enzyme Production: Solid-state and submerged fermentation, Use of bioreactors for large-scale enzyme production	10
3	Methods of Enzyme Purification: Precipitation methods: ammonium sulfate, organic solvents, Chromatographic techniques: ion exchange, affinity, gel filtration Optimization of Purification Processes: Assessing purity and activity during purification, Factors affecting enzyme stability during purification	10
4	Kinetics of Enzyme Catalysis: Determination of V _{max} and K _m using Lineweaver-Burk plot, Effect of pH, temperature, and substrate concentration on enzyme activity Inhibition of Enzyme Activity: Types of enzyme inhibitors: competitive, non-competitive, uncompetitive, Industrial relevance of enzyme inhibitors	10
5	Enzyme Immobilization Techniques: Methods of immobilization: adsorption, covalent bonding, entrapment, encapsulation, Advantages of immobilized enzymes in industry Applications of Immobilized Enzymes in Industry: Use of immobilized enzymes in bioreactors, Case studies: immobilized enzymes in the production of high-fructose corn syrup, biofuel production, etc.	10

SUGGESTED TEXT BOOKS:

1. "Enzymes: Biochemistry, Biotechnology, and Clinical Chemistry" by Trevor Palmer
2. "Industrial Enzymes: Structure, Function, and Applications" edited by Julio Polaina and Andrew P. MacCabe
3. "Enzyme Technology" by Martin F. Chaplin and Christopher Bucke
4. Online Resources: Articles, case studies, and databases related to industrial enzyme applications

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Have a solid understanding of the role of enzymes in various industries.
2. Gain practical experience in enzyme production, purification, and characterization.

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3. Be able to assess enzyme activity and optimize conditions for industrial use.
4. Learn how to apply enzyme immobilization techniques for large-scale applications.
5. Be prepared for roles in enzyme technology-related industries such as food, pharmaceuticals, and biofuels.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	2	2
CO2	3	3	3	2	2
CO3	3	2	2	1	1
CO4	3	3	2	2	2

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**(VOCATIONAL COURSE 4)
ALLPIED MICROBIOLOGY IN INDUSTRY (VBT 414)**

OBJECTIVES: The objective of this course is to equip students with the knowledge of industrial microbiology and its applications. Students will gain practical experience in microbial processes used in industries such as fermentation, biofuel production, pharmaceutical manufacturing, and bioremediation.

Credits: 02

L-T-P: 2-0-0

Module No	Content	Teaching Hours
1	Overview of Microbes in Industry: Types of microorganisms used in industrial processes (bacteria, fungi, yeast), Historical development of industrial microbiology Applications of Microbes in Industry: Role of microbes in the production of enzymes, antibiotics, vitamins, and biofuels, Microbial roles in waste management and bioremediation	10
2	Microbial Growth and Cultivation: Growth phases: lag, log, stationary, and death phase, Types of culture: batch, fed-batch, and continuous culture Microbial Metabolism in Industry: Primary and secondary metabolites in industrial microbiology, Metabolic pathways for the production of alcohol, organic acids, and antibiotics	10
3	Basics of Fermentation Processes : Types of fermentation: aerobic and anaerobic , Industrial fermenters (bioreactors): design, components, and operation Microbial Fermentation for Product Synthesis: Fermentation of pharmaceuticals (e.g., penicillin production), Fermentation for food and beverages (e.g., yogurt, cheese, beer, and wine)	10
4	Microbial Production of Pharmaceuticals: Production of antibiotics (e.g., penicillin, streptomycin), vitamins, and amino acids, Use of genetically modified microorganisms in pharmaceutical production Biofuel Production: Role of microorganisms in the production of bioethanol, biogas, and biodiesel, Sustainable energy production using microbial fermentation	10
5	Microbes in Food Industry: Role of microbes in food preservation, probiotics, and food spoilage, Production of fermented foods (sauerkraut, soy sauce, vinegar) Microbes in Agriculture: Microbial biofertilizers and biopesticides, Plant growth-promoting rhizobacteria (PGPR) and nitrogen fixation	10

SUGGESTED TEXT BOOKS:

1. "Industrial Microbiology" by L.E. Casida
2. "Prescott & Dunn's Industrial Microbiology" by Gerald Reed
3. "Comprehensive Biotechnology" by Murray Moo-Young
4. Online Resources: Research articles, case studies, and industry reports on microbial processes

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Understand the role of microorganisms in industrial applications.
2. Gain practical experience in microbial fermentation, product synthesis, and bioremediation.
3. Learn about microbial contributions to food, agriculture, and environmental sustainability.
4. Acquire skills to pursue careers in industries related to food, pharmaceuticals, biofuels, and waste management.

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MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	2	1	3	-
CO2	-	-	-	-	-
CO3	-	-	3	3	2
CO4	-	-	3	3	2
CO5	-	-	2	3	-

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**SEMESTER-5
(CORE COURSE -11)**

RECOMBINANT DNA TECHNOLOGY (BBT 511)

COURSE OBJECTIVES: This course would familiarize students with facile molecular techniques involved in isolation and manipulation of genetic material for achieving the desired goal. To train the students in various techniques involved in Genetic engineering.

Credits: 4

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	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, Deoxynucleotidyl transferases, DNA polymerase), Restriction mapping.	10
2	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.	10
3	Gene transfer techniques - physical (Electroporation, microinjection and biolistic transformation), chemical (CaCl ₂ mediated transformation and Lipofection), transduction. Selection of recombinants - blue and white screening and plus and minus screening.	10
4	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;	10
5	Manipulation of gene sequences by random mutations and site directed mutagenesis, Applications of Genetic engineering in industry, medicine and agriculture. Bioethics and Biosafety..	10

SUGGESTED TEXT BOOKS:

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

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Publishing Corporation, 2003.

4. Dubey R.C, Advanced Biotechnology (1st edition), Chand and Company, 2014.

REFERENCE BOOKS:

1. Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings
2. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
3. Maloy SR, Cronan JE and Friefelder D(2004) Microbial Genetics 2nd EDITION., Jones and Barlett Publishers

Online links for study & reference materials:

<https://learn.genetics.utah.edu/>

<https://ocw.mit.edu/courses/biology/7-03-genetics-fall-2004/>

COURSE OUTCOMES:

On completion of this course, the students will be able to:

1. Apply landmark discoveries in developing a number of facile molecular techniques used in rDNA technology.
2. Learn how to select the suitable hosts for the individual vectors for different purposes.
3. Know the extraordinary power of restriction and other enzymes in molecular cloning and genetic manipulations.
4. Perform application of PCR in rDNA technology. healthy and disease contexts.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	-	2
CO2	1	2	2	3	2
CO3	3	-	2	-	-
CO4	3	-	-	-	2

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(CORE COURSE -12)**



FERMENTATION TECHNOLOGY (BBT 512)

COURSE OBJECTIVES: The course in skill enhancement provides an insight into microbial technologies and fermentations to the students.

Credits: 4

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1.	Introduction to Fermentation technology: History, Scope and Development of Fermentation technology; Isolation and screening of industrially important microorganisms – primary and secondary screening; Maintenance of Strains; Strain improvement: Mutant selection and Recombinant DNA technology.	
2	Fermentation media and Fermenter design: Natural and Synthetic media; Basic components of an media (Carbon sources; Nitrogen sources; Vitamins; Minerals; Anti-foaming agents); Role of buffers in media; Process of aeration, and agitation. Basic designs of Fermentor; Type of fermentors: Waldhof, Tower, Deepjet, Cyclone column, Packed tower and airlift fermenter.	
3.	Types of fermentations: batch, continuous and fed batch fermentations. Surface, solid state and submerged fermentation. Monitoring and control of agitation, aeration, pH, temperature and dissolved oxygen. Industrial sterilization of media and air.	10
4	Down-stream processing and Product recovery: Purification & characterization of proteins, Upstream and downstream processing, solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth, ultra centrifugation, liquid extraction, ion-exchange recovery of biological products. Experimental model for design of fermentation systems, Anaerobic fermentations.	10
5.	Production of Microbial Products: Production of alcohol- ethanol; Organic acid – Citric acid, Lactic acid; Antibiotic – Penicillin, Amino acid – Glutamic acid; Vitamin – B1; Single Cell Protein (SCP).	10

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SUGGESTED TEXTBOOKS

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
5. Salisbury, Whitaker and Hall. Principles of fermentation Technology

REFERENCE BOOKS:

6. Peter F Stanbury, Allan Whitaker, Stephen J Hall. Principles of Fermentation Technology. (2016) Butterworth-Heinemann Press. UK.
7. H. J. Peppler, D. Perlman. Microbial Technology: Fermentation Technology. (2014). Academic Press

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Design of various reactors used in Industries.
2. Criteria for selection of media for microbial growth and fermentative media
3. Methods for strain improvement and preservation of cultures.
4. Upstream as well as downstream processing involved in fermentation industries

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	-	1
CO2	3	-	-	-	-
CO3	3	-	2	-	1
CO4	2	2	2	-	1

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FERMENTATION TECHNOLOGY LAB (BBT 572)

COURSE OBJECTIVES: To acquaint students with technical and biological aspect of microbial utilisation for production of metabolites..

Credits: 01

L-T-P:0-0-2

Module No.	Contents	Lab Hours
I	1. Isolation of antibiotic producing microorganisms from soil 2. Isolation of enzyme producing microorganisms from soil 3. Isolation of organic acid producing microorganisms from soil 4. Isolation of protease and amylase producers 5. Production of Alcohol 6. Production of Citric acid	20

SUGGESTED TEXTBOOKS & REFERENCES:

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2n edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Learn the isolation of antibiotic producer microorganisms.
2. Perform enzyme assay of industrially important enzymes.

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(CORE COURSE -13)**



BIOINFORMATICS (BBT513)

COURSE OBJECTIVES: Bioinformatics involves the analysis of biological information using computers and statistical techniques.

Credits: 04

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	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, Expressed sequence tags (ESTs).	10
2	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) – signifiante. Softwares : ClustalW and Meme.	10
3	Phylogenetics, cladistics and ontology; Phylogenetic representations – graphs, trees and cladograms 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 –PHYLP	10
4	Structure prediction: protein- 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. Identification of motifs and domains, protein family database. RNA structure prediction.	10
5	Finding new drug targets to treat diseases – Pharmacophore identification - Structure based drug design.	

SUGGESTED TEXTBOOKS :

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II

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Edition. Benjamin Cummings.

4. Rastogi, S.C, Mendiratta. N and Rastogi. R. Bioinformatics: Concepts, Skills and Applications, CBS Publishers, New Delhi, India. 2006 .

REFERENCE BOOKS:

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

COURSE OUTCOMES:

On completion of this course, the students will be able to:

1. Gain knowledge on Computational Biology and Bioinformatics
2. Gain knowledge on structure prediction and drug designing using Bioinformatics tools.
3. Learning of database searching and sequence retrieval
4. Gain the knowledge about multiple sequence analysis and phylogenetic analysis.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	2	1	-	-	-
CO2	2	-	-	-	1
CO3	3	2	-	-	-
CO4	3	2	-	-	-

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BIOINFORMATICS LAB (BBT572)**



COURSE OBJECTIVES: Bioinformatics involves the analysis of biological information using computers and statistical techniques.

Credits: 01

L-T-P: 0-0-2

Module No	Content	Teaching Hours
1	1. Sequence information resource 2. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR) 3. Using various BLAST and interpretation of results. 4. Retrieval of information from nucleotide databases.	20

SUGGESTED TEXTBOOKS & REFERENCES:

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Students can implement a suite of core bioinformatics services and describe their application.
2. Perform the retrieve the Nucleotide sequence and BLAST analysis.
3. Gain the Knowledge about phylogenetic analysis

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(DISCIPLINE SPECIFIC ELECTIVE COURSE-3)**



ANIMAL BIOTECHNOLOGY (BBT514)

COURSE OBJECTIVES: The course provides the basic knowledge and understanding of cell culture techniques. The students will learn the maintenance and various in vitro applications of cell and molecular techniques.

Credits: 04

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	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).	10
2	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.	10
3	Artificial insemination, Super ovulation, In vitro fertilization and embryo transfer, applications and limitation, Transgenic animals (avian, rodent & ruminants), Transgenic methods, Embryonic Stem cell transfer, Targeted Gene Transfer, Detection of transgenic animals, Production of useful proteins in transgenic animals,	10
4	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..	10
5	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.	8

SUGGESTED TEXT BOOKS

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

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Sciences, (2001)

REFERENCE BOOKS:

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

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Explain the fundamental scientific principles that underlie cell culture and acquire knowledge for isolation, maintenance and growth of cells.
2. The students will gain an insight into the concepts and techniques of genetically modified animals and its applications in various fields of science.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	1	1
CO2	1	3	3	2	1

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(ABILITY ENHANCEMENT COMPULSORY COURSE-04)**



BIOSTATISTICS (BBT515)

COURSE OBJECTIVES: The discipline of biostatistics provides tools and techniques for collecting data and then summarizing, analyzing, and interpreting it.

Credits: 02

L-T-P: 2-0-0

Module No.	Contents	Teaching Hours
1	Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Measures of central tendency and Dispersion. Measures of Skewness and Kurtosis.	10
2	Probability classical & axiomatic definition of probability, Theorems on total and compound probability, Elementary ideas of Binomial, Poisson and Normal distributions.	10
3	Methods of sampling, confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, and chi-square test for goodness of fit.	10
4	Correlation and Regression. Emphasis on examples from Biological Sciences.	10

SUGGESTED TEXTBOOKS & REFERENCES:

1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA
2. Glaser AN (2001) High Yield™ Biostatistics. Lippincott Williams and Wilkins, USA
3. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.
4. Danial W (2004) Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.

COURSE OUTCOME:

After completion of the course, student will be able to:

1. Develop and apply different of statistical methods.
2. Learn the graphical representation of data.
3. Enhance the applicability in data analysis.

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MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	-	-	2
CO2	2	1	-	-	-
CO3	3	2	-	-	1

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(SKILL ENHANCEMENT COURSE-04)
INDUSTRIAL INTERNSHIP (BBT573)**



COURSE OBJECTIVES: The objective of industrial training is to enhance the employability of students and prepare them for their future careers.

Credits: 03

L-T-P: 0-0-6

Industrial training offers the students with important practical knowledge and skills and encourage them in becoming a successful and best professional engineer. The main objectives of the industrial training is to provide the best and relevant theoretical knowledge to gain in a particular time period. Students complete their industrial training during minimum period of 4 weeks and pass the training assessment in order to graduate. It provides the liability for real life work and internships to choose the career options with different work environments and publicity to the latest technologies that are currently being used by an important and relevant industry, etc.

COURSE OUTCOME:

After completion of the course, student will be able to:

1. Participate in the projects in industries during his or her industrial training.
2. Describe use of advanced tools and techniques encountered during industrial training and visit
3. Interact with industrial personnel and follow engineering practices and discipline prescribed in industry.
4. Develop awareness about general workplace behavior and build interpersonal and team skills.
5. Prepare professional work reports and presentations.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	3	3	-	3
CO2	2	-	-	-	1
CO3	-	2	2	-	-
CO4	-	2	3	-	-
CO5	-	2	1	1	1

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SEMESTER-6

CORE COURSE-14

BIOPROCESS TECHNOLOGY (BBT611)

COURSE OBJECTIVES: This course is to provide basic concepts of bioprocess engineering to the students. They will learn engineering principles that can be applied to processes involving cell or enzyme catalysts with applications in the industry

Credits: 04

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	Introduction to bioprocess technology. Range of bioprocess technology and its chronological development – Introduction and history of traditional and modern bioprocess 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,	10
2	Basic principal components of fermentation technology. Sterilization (batch & continuous)-Air, Filter and Media sterilization, Types of microbial culture and its growth kinetics– Batch, Fedbatch and Continuous culture.	10
3	Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing – Media preparation, Inoculum development.	10
4	Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.	10
5	Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.	10

SUGGESTED TEXT BOOKS

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

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REFERENCE BOOKS:

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

COURSE OUTCOME:

After completion of the course, student will be able to:

1. At the end of this course, the students will learn the basics of bioprocess engineering.
2. Will also learn the principle, design, and operation control of various types of bioreactors
3. and their scale-up strategies.
4. Develop skills to understand Bioprocess Engineering at Industrial level for its applications.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	1	1	-	-
CO2	3	1	1	-	1
CO3	3	1	1	-	1

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CORE COURSE-15

NANOTECHNOLOGY (BBT612)

COURSE OBJECTIVES: To understand the nature and properties of nanomaterials. To provide scientific understanding of application of nanomaterials and nanotechnology in agriculture, health and environmental conservation.

Credits: 04

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	Introduction to nanomaterials; Various types of nanomaterials, Three-dimensional, twodimensional, one-dimensional and zero-dimensional nanomaterials. Carbon nanotubes, Graphene, Carbon dots, metal nanoparticles, metal oxide-based nanomaterials, semiconductor nanomaterials, quantum dots, hybrid nanoparticles,	10
2	Structural properties, chemical properties, surface functionalization, physical properties. Characterization of nanomaterials by various analytical methods, optical characterization and spectroscopy such as FTIR, UV-Vis, DLS, Zetapotential, structural characterization by X-Ray Diffraction, XPS and advanced microscopy (TEM, SEM, AFM) etc	10
3	Nanobiotechnology in healthcare; Role of nanobiotechnology in the area of infectious & noninfectious diseases, Nanopharmaceutical, Diagnosis, sensors and biosensors, Delivery vehicles, biomedical applications of nanomaterials.	10
4	Nanobiotechnology for Agriculture: Nanotechnology based tools to enhance agricultural productivity, Nanobased Agri and Food Products, food preservation and Toxicity, Nanopesticides and Nanofertilizers, Nano-biostimulants and soil enhancers	10
5	Nanobiotechnology for Crop improvement, Precision Delivery Systems, Diagnostics and sensing, Nanotechnology for environment: contamination detection and remediation	10

SUGGESTED TEXT BOOKS

1. L. Rogach, Semiconductor nanocrystal quantum dots synthesis, assembly, spectroscopy and applications (Springer, Wien; London, 2008).
2. E. Gazit, Plenty of room for biology at the bottom: an introduction to bionanotechnology (Imperial College Press ; Distributed by World Scientific Pub. in the USA. London : Hackensack, NJ, 2007).

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3. G. E. J. Poinern, A laboratory course in nanoscience and nanotechnology (CRC Press, Taylor & Francis Group, Boca Raton, 2015).
4. C.A. Mirkin, C. M. Niemeyer, Eds., More concepts and applications (Wiley-VCH, Weinheim, 2007), Nanobiotechnology.
5. P. N. Prasad. Nanophotonics (Wiley, New York, 2003).
6. A.K. Mishra, Ed., Application of nanotechnology in water research (Wiley, Scrivener Publishing, Hoboken, New Jersey, 2014).

COURSE OUTCOME:

After completion of the course, student will be able to:

1. Familiarity with working principles, tools and techniques in the field of nanomaterials.
2. Understanding of the strengths, limitations and potential uses of nanomaterials.
3. Gain the knowledge of Nanobiotechnology use in different sectors.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	1	1	-	-
CO2	3	1	1	-	1
CO3	3	1	1	-	1

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CORE COURSE-16

ENVIRONMENTAL BIOTECHNOLOGY (BBT613)

COURSE OBJECTIVES: The students will learn the application of processes for the protection and restoration of the quality of the environment.

Credits: 4

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	Introduction to environmental biotechnology, Non Renewable resources - coal, petroleum, and natural gas. Renewable resources - solar, wind, tidal, biomass, nuclear, geothermal and hydroelectric resources. Current status and environmental impact of renewable and non-renewable resources.	10
2	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.	10
3	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.	10
4	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.	10
5	Biomonitoring - Bioassays, Biosensors, Biochips, Biological indicators and Biomarkers, Biore Restoration of waste land, Bioleaching – microbes involved, Role of Biotechnology in pollution abatement.	10

SUGGESTED TEXT BOOKS:

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

REFERENCE BOOKS:

1. Varnam A. H - Environmental Microbiology (1st Edition), ASM Press 2001

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2. Wang, L.K., Ivanov, V., Tay, J.H., Hung, Y.T, Environmental Biotechnology (Volume 10), Humana Press 2010

COURSE OUTCOME:

After completion of the course, student will be able to:

1. Comprehend environmental issues and role of biotechnology in the cleanup of contaminated environments
2. Comprehend fundamentals of biodegradation, biotransformation and bioremediation of organic contaminants and toxic metals
3. Apply biotechnological processes in waste water and solid waste management.
4. Demonstrate innovative biotechnological interventions to combat environmental challenges.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	2	2	3	-	2
CO2	-	2	3	-	-
CO3	3	2	3	-	1
CO4	2	2	3	-	2

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ENVIRONMENTAL BIOTECHNOLOGY LAB (BBT671)

COURSE OBJECTIVES: The course content aims to make the students understand how biotechnology can help in monitoring or removing the pollutants and management.

Credits: 01

L-T-P: 0-0-2

Module No	Content	Teaching Hours
1	1. Calculation of Total Dissolved Solids (TDS) of water sample. 2. Calculation of BOD of water sample. 3. Calculation of COD of water sample. 4. Estimation of salinity in water samples 5. Bacterial Examination of Water by MPN Method.	20

SUGGESTED TEXTBOOKS & REFERENCES:

1. Environmental Science, S.C. Santra
2. Environmental Biotechnology, Pradipta Kumar Mohapatra
3. Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter
4. Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill

COURSE OUTCOME:

After completion of the course, student will be able to:

1. Apply biotechnological processes in waste water and solid waste management.
2. demonstrate innovative biotechnological interventions to combat environmental challenges.
3. Gain the Knowledge about enviromental practical handling.

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(DISCIPLINE SPECIFIC ELECTIVE COURSE-4)
PLANT BIOTECHNOLOGY (BBT 614)**



COURSE OBJECTIVES: The main objective of the study program is to prepare motivated, able to think creatively plant biotechnology specialists familiar with plant biotechnological processes.

Credits: 04

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	Introduction of plant biotechnology, types of culture: Seed, Embryo, Callus, Organs, Cell and Protoplast culture. Micro-propagation Axillary bud proliferation, Meristem and shoot tip culture, cud culture, organogenesis, embryogenesis, advantages and disadvantages of micro-propagation.	10
2	In vitro haploid production Androgenic methods: Anther culture, Significance and use of haploids, chromosome doubling. Diploidization, Gynogenic haploids, factors effecting gynogenesis, chromosome elimination techniques for production of haploids in cereals.	10
3	Protoplast Isolation and fusion Methods of protoplast isolation, Protoplast development. Somatic hybridization, identification and selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations. Somaclonal variation, applications basis and disadvantages.	10
4.	Molecular Marker, RAPD, RFLP, AFLP, SSR, ISSR, Application in plant science.	10
5	Plant Growth Promoting bacteria. Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation, Biocontrol of pathogens, Growth promotion by free-living bacteria.	10

SUGGESTED TEXTBOOKS & REFERENCES:

1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
2. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
3. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8 edition Principles of Genetics. Wiley India.

COURSE OUTCOME:

On the completion of course students will able to-

1. Students will gain foundational knowledge of different types of plant cultures, including seed, embryo, callus, organ, cell, and protoplast culture, and the principles of micro-propagation and its applications in biotechnology.
2. Students will comprehend androgenic and gynogenic methods for haploid production, explore

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chromosome doubling and elimination techniques, and understand their significance in crop improvement, particularly in cereals. Know about the plant growth promoting bacteria and their role in yield of plants.

3. Students will learn about various molecular marker techniques, including RAPD, RFLP, AFLP, SSR, and ISSR, and apply these tools in plant genetics, breeding, and the identification of growth-promoting bacteria.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	2	2	3	-	3
CO2	3	2	3	-	2
CO1	2	-	-	-	-

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PLANT BIOTECHNOLOGY LAB (BBT 672)**



COURSE OBJECTIVES: The course content aims to make the students understand how biotechnology can help crop improvement and develop new variety.

Credits: 01

L-T-P: 0-0-2

Module No	Content	Teaching Hours
1	1. Preparation of simple growth nutrient (knop's medium), full strength, half strength, solid and liquid. 2. Preparation of complex nutrient medium (Murashige & Skoog's medium) 3. To selection, Prune, sterilize and prepare an explant for culture. 4. Significance of growth hormones in culture medium. 5. To demonstrate various steps of Micropropagation. 6. Isolation of total genomic DNA from leaves by CTAB method 7. Microbial population in rhizospheric soil of various crops.	20

SUGGESTED TEXTBOOKS & REFERENCES:

1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
2. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
3. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8 edition Principles of Genetics. Wiley India.

COURSE OUTCOME:

On the completion of course students will able to

1. By applying complex biotechnology means, a graduate is able to use bioprocesses and possibilities of to create and produce novel and useful products for humans.
2. Know the application of plant tissue culture in agro-industry.

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(DISCIPLINE SPECIFIC ELECTIVE COURSE-5)
FOOD BIOTECHNOLOGY (BBT 615)**



COURSE OBJECTIVES: Identify the conditions under which the important pathogens are commonly inactivated, killed or made harmless in foods.

Credits: 04

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	Historical Background, Composition of Food, Growth of microorganisms in food: Intrinsic and extrinsic factors. Food Spoilage (microbial and non-microbial), Control mechanisms of food spoilage: Physical and Chemical. Food preservation and storage. Basic principles of the equipment involved in the commercially important food processing methods and unit operations	10
2	Common Food and water borne diseases: Gastroenteritis, Diarrhoea, Salmonellosis, Typhoid, Cholera, Polio, Hepatitis, Food borne intoxications: Staphylococcal, Bacillus, Clostridium etc. Detection of food-borne pathogens.	10
3	Starter cultures, Production process of fermented foods: cheese, butter, yoghurt, alcoholic beverages (beer, wine, distilled beverages), Pickles, Soy products. Process of Brewing, malting, mashing, primary & secondary fermentation. Problems in food industry: catabolic repression, High gravity brewing, B-glucan problem, getting rid of diacetyl.	10
4	Value added products: High Fructose Corn Syrup, Invert Sugars, Edible fungus: Mushrooms. Concept of Prebiotics and Probiotics. Improvement of food resources through Biotechnology (e.g. Golden Rice, Flavor savor tomato), Traditional fermented foods (meat, fish, bread, sauerkraut, tea)	10

SUGGESTED TEXTBOOKS & REFERENCES:

1. Frazier, W.S. and Weshoff, D.C., 1988. Food Microbiology, 4th Edn., McGraw Hill Book Co., New York.
2. Jay, J.M., 1987. Modern Food Microbiology, CBS Publications, New Delhi.

COURSE OUTCOME:

On the completion of course students will able to

1. Contribution of microbes in food borne diseases.
2. Understand the microbial and non-microbial causes of food preservation.

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3. Principles of the physical and chemical techniques of food preservation.
4. Production process of fermented foods in food industry.
5. Know about the production of value added food products.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	3	2	-	-
CO2	-	2	2	-	-
CO3	-	3	2	-	-
CO4	-	3	2	-	3
CO5	-	3	2	-	3

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FOOD BIOTECHNOLOGY LAB (BBT673)**



COURSE OBJECTIVES: To demonstrate the application of modern biotechnological tools and techniques for the manufacture and processing of food.

Credits: 01

L-T-P: 0-0-2

Module No.	Contents	Lab Hours
1.	1. Estimation of Total Plate Count in any food sample. 2. Detection of Salmonella, E. coli in food material. 3. MBRT test of milk samples. 4. Sauerkraut production 5. Acetic acid/Vinegar Production and estimation of the product. 6. Toxin detection in the food materials. 7. Effect of internal factors on microbial growth in food i.e. pH, Temperature, Water Activity.	20

SUGGESTED TEXTBOOKS & REFERENCES:

1. Frazier, W.S. and Weshoff, D.C., 1988. Food Microbiology, 4th Edn., McGraw Hill Book Co., New York.
2. Mann & Trusswell, 2007. Essentials of human nutrition. 3rd edition. Oxford university press.
3. Jay, J.M., 1987. Modern Food Microbiology, CBS Publications, New Delhi.

COURSE OUTCOME:

On the completion of course students will able to

1. Practical aspects of the different biotechnological processes
2. Food transformation, as well as those usually used by the food industry with the objective of improve production.

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SEMESTER-7

CORE COURSE-17

STEM CELL ENGINEERING (BBT 711)

COURSE OBJECTIVES: The objective of this paper is to familiarize the students with stem cell technology and its applications for betterment of the society. The course is designed to give a broad view of mammalian stem cells, reviewing where they are found in the body, the different types and how they are cultured..

Credits: 4

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1	Introduction to stem cells: Definition, properties, proliferation, culture of stem cells, medical applications of stem cells, ethical and legal issues in use of stem cells.	10
2	Types of stem cells: Stem Cell biology and therapy, types embryonic stem cell, Adult stem cell, Stem Cell Biology and Therapy, Embryonic Stem Cells, culture and the potential benefits of stem cell technology	10
3	Therapeutic applications of stem cells Gene Therapy: Introduction, History and evolution of Gene therapy, optimal disease targets, Failures and successes with gene therapy and future prospects, Genetic Perspectives for Gene Therapy, Gene Delivery methods: Viral vectors and Non-viral Vectors.	10
4	Ethical Issues associated with stem cell-based regenerative medicine field: Regulatory and Ethical Considerations of stem cell and Gene Therapy, Assessing Human Stem Cell Safety, Use of Genetically Modified Stem Cells in Experimental Gene Therapies.	10

SUGGESTED TEXT BOOKS

1. Stem Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold Spring HarbouLaboratory Press
2. Stem cell biology and gene therapy, Booth C., Cell Biology International, Academic Press.
3. Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, Alexander Battler, Jonathan Leo, Springer,

REFERENCE BOOKS

1. Stem Cell Biology and Gene Therapy. Quesenberry PJ, Stein GS, eds. (£65.00.) Wiley, 1998.,
2. Progress in gene therapy, Volume 2,Pioneering stem cell/gene therapy trials, Roger Bertolotti, Keiyo Ozawa and H. Kirk Hammond, VSP international science publishers

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3. Stem Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003,
4. Human Embryonic Stem Cells: The Practical Handbook by Stephen Sullivan and Chad A Cowan.

COURSE OUTCOMES:

On the completion of course students will be able to

1. Learn about the Basics of stem cell and related ethical issues.
2. Understand the concepts of stem cell based therapy and types of stem cells.
3. Know the therapeutic application of stem cell
4. Understand the ethical issues associated with stem cell-based regenerative medicine field.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	3	1
CO2	2	3	3	-	-
CO3	-	2	1	1	-
CO4	3	3	3	3	1

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CORE COURSE-18

MEDICAL MICROBIOLOGY (BBT 712)

COURSE OBJECTIVES: This course will introduce basic principles and conceptual basis for understanding pathogenic microorganisms.

Credits: 04

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels. Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: <i>S.aureus</i> , <i>S.pyogenes</i> , <i>B.anthraxis</i> , <i>C.perferinges</i> , <i>C.tetani</i> , <i>C.botulinum</i> , <i>C.diphtheriae</i> <i>M.tuberculosis</i> , <i>M. leprae</i> .	10
2	Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: <i>E. coli</i> , <i>N. gonorrhoea</i> , <i>N. meningitidis</i> , <i>P. aeruginosa</i> , <i>S. typhi</i> , <i>S. dysenteriae</i> , <i>Y. pestis</i> , <i>B. abortus</i> , <i>H. influenzae</i> , <i>V. cholerae</i> , <i>M. pneumoniae</i> , <i>T. pallidum</i> <i>M. pneumoniae</i> , <i>Rickettsiaceae</i> , <i>Chlamydiae</i> .	10
3	Diseases caused by viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses.	10
4	Fungal and Protozoan infections. Dermatophytoses (<i>Trichophyton</i> , <i>Microsporun</i> and <i>Epidermophyton</i>) Subcutaneous infection (<i>Sporothrix</i> , <i>Cryptococcus</i>), systemic infection (<i>Histoplasma</i> , <i>Coccidioides</i>), opportunistic fungal infections (<i>Candidiasis</i> , <i>Aspergillosis</i>), Gastrointestinal infections (<i>Amoebiasis</i> , <i>Giardiasis</i>), Blood-borne infections (<i>Leishmaniasis</i> , <i>Malaria</i>).	10

SUGGESTED TEXTBOOKS & REFERENCES:

1. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
2. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
3. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

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COURSE OUTCOMES:

On the completion of course students will be able to

1. Know about the normal microflora of human body, pathogenicity and virulence factors of disease causing microorganisms.
2. Detailed knowledge of diseases caused by different types of bacteria and viruses.
3. Understand the mechanism of fungal and protozoan infections.
4. Develop diagnostic skills in microbiology, including the practical application and interpretation of laboratory tests for the diagnosis of infectious diseases.
5. Learn about the preventive measures and prophylactic measures to control microbial infections.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	3	2	-	-
CO2	2	2	2	-	-
CO3	2	2	2	-	-
CO4	1	2	2	1	3
CO5	-	3	1	-	-

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(DISCIPLINE SPECIFIC ELECTIVE COURSE-6)
GENOMICS AND PROTEOMICS (BBT 713)**



COURSE OBJECTIVES: Students will acquire extensive and in-depth knowledge about the structure and function of the genome at all basic levels of living systems.

Credits: 04

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods.	10
2	Computer tools for sequencing projects: Genome sequence assembly software. Managing and Distributing Genome Data: Web based servers and software's for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.	10
3	Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, vander waal interactions, hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE, Determination of covalent structures–Edman degradation.	10
4	Introduction to Proteomics, Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry-based methods for protein identification. <i>De novo</i> sequencing using mass spectrometric data.	10

SUGGESTED TEXTBOOKS & REFERENCES:

1. Terence A. Brown, Genomes 2, (2nd edition) – Garland Science publishing, 2002.
2. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
3. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987.
4. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010.

COURSE OUTCOMES:

On the completion of course students will be able to

1. Explain the properties of genetic materials and storage and processing of genetic information.

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2. Analyze genomic data.
3. Explain biological phenomena based on comparative genomics
4. Design transcriptomics and proteomics experiments for studying differential gene expression and related analysis

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	2	2	-	-	-
CO2	2	2	-	-	1
CO3	3	2	-	-	-
CO4	3	2	2	-	-

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GENOMICS AND PROTEOMICS LAB (BBT 772)

COURSE OBJECTIVES: To demonstrate the application of modern biotechnological tools and techniques for the manufacture and processing of food.

Credits: 01

L-T-P: 0-0-2

Module No.	Contents	Lab Hours
1.	1. Use of SNP databases at NCBI and other sites 2. Use of OMIM database 3. Detection of Open Reading Frames using ORF Finder 4. Proteomics 2D PAGE database 5. Softwares for Protein localization. 6. Hydropathy plots 7. Native PAGE 8. SDS PAGE	20

SUGGESTED TEXTBOOKS & REFERENCES:

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

COURSE OUTCOME:

On the completion of course students will be able to

1. Explain biological phenomena based on comparative genomics
2. Design transcriptomics and proteomics experiments for studying differential gene expression and related analysis

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(DISCIPLINE SPECIFIC ELECTIVE COURSE-7)
RESEARCH METHODOLOGY (BBT 714)**



COURSE OBJECTIVES: The course will give the concept of research design, sampling and data analysis.

Credits: 04

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process, Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance	10
2	Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.	10
3	Qualitative and Quantitative Research: Qualitative research – Quantitative research Concept of measurement, causality, generalization, replication. Merging the two approaches. Measurement: Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio.	10
4	Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.	10
5	Data Preparation & Analysis: Interpretation of Data and Paper Writing Layout of a Research Paper, Journals in Life Science, Impact factor of Journals, Ethical issues related to publishing, Plagiarism and Self-Plagiarism.	10

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SUGGESTED TEXT BOOKS :

1. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
2. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
3. Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.

REFERENCE BOOKS:

4. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
5. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.

COURSE OUTCOME:

On the completion of course students will be able to

1. Understand the basic concept of research and development.
2. Discuss the qualitative and quantitative research methods.
3. Describe the basic procedure of sampling.
4. Explain the data analysis procedure and interpretation of the data.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	-	-
CO2	3	2	2	-	-
CO3	2	2	-	-	-
CO4	3	-	-	-	-

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(DISSERTATIONS-1)

Major Project -1 (BBT 771)

COURSE OBJECTIVES: Develop an ability to understand the basic requirement to conduct a research project. Student also develop skill of writing and presentation on the assigned research topics in the field of biotechnology

Credits: 06

L-T-P: 0-0-12

COURSE CONTENTS:

Every student will be required to undertake a research project based on any of the areas of biotechnology. The research project should have applied significance. The project report will be submitted in the form of dissertation duly certified by the supervisor of the Department of Biotechnology or at national institutes and Universities in India, by seeking the placement. The project will be presented for evaluation at the end of semester by external examiner.

COURSE OUTCOMES:

On the completion of course students will be able to

1. Understand about the Research in Biotechnology
2. Develop presentation skill during the conduction of research, discussion and presentation.
3. Student will develop analysis of results, drafting and writing skill.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	3
CO2	3	3	3	2	3
CO3	3	3	3	-	-

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(SKILL ENHANCEMENT COURSE-5)**



APPLICATION OF BIOSENSOR IN BIOTECHNOLOGY (BBT 715)

COURSE OBJECTIVES: To learn the Fundamentals of biosensors. To acquaint the student with design and construction of biosensors. To expose the students to recent advances in application of biosensors in health, environment, agriculture and food industry.

Credits: 02

L-T-P: 2-0-0

Module No.	Content	Teaching Hours
1	Introduction to biosensor: General configuration of biosensor, Generations of biosensors, Basic principle and instrumentation of different biosensors, electrochemical, optical, acoustic, piezoelectric, and calorimetric biosensors.	10
2	Biological recognition systems: Biomolecules in biosensors such as enzyme, antibody, nucleic acid, cell, and tissue	10
3	Properties of ideal materials for biosensors; Classes of materials for biosensors: polymers, material containing metal complex, sol-gel materials, nanomaterials, composite materials, metal oxides, photonic crystals, and zeolite materials	10
4	Applications of biosensors in health and environment: Biosensors and diabetes management, Microfabricated biosensors and point-of-care diagnostics systems, Noninvasive biosensors in clinical analysis; Surface plasmon resonance and evanescent wave biosensors, Biosensor in cancer and HIV early diagnosis..	10
5	Applications of biosensors in food and agriculture industry: Detection of product content, allergic components, pathogens, pesticide residues. Monitoring of raw material Conversions. Detection of crop diseases, pathogens in plants, detection of soil nutrients, pesticide and its residual Detection.	10

SUGGESTED TEXT BOOKS :

1. Jeong-Yeol Yoon, Introduction to Biosensors, Springer-Verlag New York Ed. 2016
2. Mohammed Zourob, Recognition Receptors in Biosens; Publisher: Springer-Verlag New York Ed. 2010

SUGGESTED REFERENCE BOOKS:

1. Zvi Liron, Novel Approaches in Biosensors and Rapid Diagnostic Assays; Publisher: Springer US Ed..2001
2. Pierre R. C, and Loïc J.B, Biosensor Principles and Applications, , CRC Press, 2019

Web links and Video Lectures (e-Resources):

<https://www.youtube.com/watch?v=kQ6CYlqpGjY>

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<https://nptel.ac.in/courses/102101054>

https://onlinecourses.nptel.ac.in/noc20_ph13/preview

https://onlinecourses.nptel.ac.in/noc22_ph01/preview

COURSE OUTCOME:

On the completion of course students will be able to

1. Classify types of biosensors based on principle
2. Able to differentiate different types of transducers based on their physicochemical characteristics
3. Apply bio sensing techniques in health, environment, agriculture and food industry.
4. Use biomaterial and nanomaterials in biosensors for signal amplification, Detection and Transducer Fabrication

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	2	-	-	2
CO2	2	2	-	-	2
CO3	3	2	-	-	2
CO4	3	2	-	-	2

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(DISCIPLINE SPECIFIC ELECTIVE COURSE-11)
EVOLUTIONARY BIOLOGY (BBT716)**



COURSE OBJECTIVES: The course will give an outline on basic Concepts of Evolution and descriptive background about Origin of Life.

Credits: 04

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	Introduction to evolutionary Biology, Classification, Phylogeny & the tree of life. Patterns of evolution. Evolution of genes and genomics. Evolution and development. Macroevolution. Evolution & society. Human evolution.	10
2	Evolution & fossil record. History of life on earth. Geography of evolution. Evolution of biodiversity. Genetic variation.	10
3	Phenotypic variation. Genetic drift. Natural selection and adaptation. Genetic theory of natural selection. Evolution of phenotypic traits.	10
4	Conflict and cooperation. Species and speciation. Reproductive success. Co-evolution- interactions amongst species.	10

SUGGESTED TEXTBOOKS & REFERENCES:

1. Evolutionary Biology, 2nd Edition, 1979; Douglas J. Futuyma.
2. Evolutionary Biology, 3rd Edition, Douglas J. Futuyma. (ISBN: 9780878931897).

COURSE OUTCOME:

On the completion of course students will be able to

1. Learn most of the essential aspects of Evolutionary Biology in detail which will help them in acquiring better understanding regarding the subject.
2. Understanding about Phenotypic variation during evolution.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	-	3	2	3
CO2	1	1	1	-	1

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**SEMESTER-8
(CORE COURSE-19)**

ADVANCE CELL BIOLOGY (BBT 811)

COURSE OBJECTIVES: The aim of the course is to provide students with in depth knowledge of cell as a functional unit of life. The intra and intercellular interactions among the various cellular organelles, their structure and function communication that facilitates optimal function and development of any organism.

Credits: 04

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1	Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.	10
2	Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.	10
3	Organization of genes and chromosomes. unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons. Cell division and cell cycle Regulation and control of cell cycle.	10
4	Cell Signaling: Cell signaling Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.	10
5	Cell communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.	10

Text Books:

1. GM Cooper, Cell: A Molecular approach, 8th edition, Oxford University Press, 9781605358635, 1605358630, 2018
2. deRobertis and deRobertis, Cell and Molecular Biology, 8th edition, Lea & Febiger, 9780812110128

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Reference Books:

1. Gerald Karp, Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc, 9780470483374, 0470483377 (2010)
2. G.M. Cooper, and R.E. Hausman. The Cell: A Molecular Approach. 5th Edition. ASM Press 780878931064, 0878931066 (2009)
3. B Alberts et al Molecular Biology of the Cell. 6th edition, Garland Science, Taylor and Francis group, 9781317563754, 1317563751

Online links for study and reference materials:

www.khanacademy.org

<https://www.ncbi.nlm.nih.gov/pmc>

COURSE OUTCOME:

On the completion of course students will be able to

1. Will have understanding of Cell membrane as a dynamic entity with numerous functions that facilitates normal cellular function as well as cellular transport.
2. Will have a clear understanding of the structural organization and function of all intracellular organelles.
3. Insight on regulation of cell cycle and organization gene and chromosomes.
4. How pathogens interact with their host in higher eukaryotes. Deciphering disease mechanisms.
5. Basic concept of all the pathways and mechanisms involved in cell signalling and communication

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	3	-	-	-
CO2	-	3	-	-	-
CO3	1	3	-	-	-
CO4	2	2	-	-	1
CO5	2	-	-	-	-

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ADVANCE CELL BIOLOGY LAB (BBT 872)**



COURSE OBJECTIVE: The course aims at providing students with the methodological concepts and tools needed to acquire top-level skills in the field of cell and molecular biology.

Credits: 01

L-T-P: 0-0-2

Module No.	Content	Lab Hours
1.	1. Chromosome preparation: Mitosis-Onion root tip/human lymphocytes 2. Chromosome preparation: Meiosis- Rat/mouse testis/Grasshopper testis/ anthers. 3. Study of polyploidy in onion root tip by colchicine treatment followed by acetocarmine stain 4. Identification and study of properties of different types of cancerous cells through light and electron micrographs	20

SUGGESTED BOOKs

1. A Cell Biology Manual by J. Francis. Kendall/Hunt Publishing Co, USA. 2022.
2. Practical Laboratory Manual- Cell Biology by A. Gupta, B.K. Sati. Lambert Academic Publishing, USA. 2019.
3. Cell Biology Practical Manual by R. Gupta, S. Makhija and R. Toteja. Prestige Publishers, India. 2018.
4. Laboratory Manual of Cell Biology by R. Majumdar, R. Sisodia. Prestige Publishers, India. 2018.
5. Essential Cell Biology Vol 1: Cell Structure- A Practical Approach by J. Davey and M.Lord. Oxford University Press, UK. 2003.
6. Essential Cell Biology Vol 2: Cell Function- A Practical Approach by J. Davey and M. Lord. Oxford University Press, UK. 2003

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Gain hands-on training for operating microscope for cell analysis
2. Use relevant tools and techniques for the analysis of chromosomes, and cell size determination using micrometry.
3. Utilize their knowledge for the research work during their higher studies



(DISCIPLINE SPECIFIC ELECTIVE COURSE-08)

FUNDAMENTAL OF BIOMEDICAL SCIENCES (BBT 812)

COURSE OBJECTIVES: It is intended to impart basic knowledge in the area of Medical Biotechnology & Molecular Medicine. This course will introduce the students with basic concept of biotechnology, medical genetics and Medical oncology and therapeutics..

Credits: 04

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1	Medical Biotechnology & Molecular Technology: Introduction to Biotechnology, Different classes of Biotechnology and its application: Medical Biotechnology, DNA Mapping, DNA Marker, Cloning of DNA, DNA Sequencing, Recombinant DNA technology, Mutation & Polymorphism.	10
2	Medical Genetics: Introduction of Medical Genetics and Genetic Diseases. Thalassaemia – Model for Molecular Genetics, Chromosomal Disorders, Heterogeneity, Genetic counseling, Stem cell and its application.	10
3	Medical Oncology: Introduction of medical oncology, Tumour and Cytogenetic Markers, Gene regulation in cancer: Oncogenes and Tumour Suppressor genes, Genetic Models and Cancer, Diagnostic Application & Therapeutics.	10
4	Therapeutics: rDNA derived Drugs, Gene Therapy, Hybridoma Technology, Monitoring & Response to Therapy Immunotherapy.	10
5	Bioethical issues and Forensic Medicine: Introduction to Bioethics & Biosafety in Research, Human Genome Project, Introduction to Forensic Medicine, Tissue identification and DNA profiling.	10

Text Books:

1. An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology, Wiley, ed. 2, 2011
2. Campbell, M.A and Heyer L.J., Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition, CSHL Press, Pearson/Benzamin Cummings San Francisco, USA, 2007.
3. Andrew Read and Dian Donnai, New Clinical Genetics, Scion Publishing Ltd, Oxfordshire, UK, 2007.

Reference Books:

1. New Clinical Genetics, Scion Publishing Ltd, Oxford shire, UK, 2007
2. Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition, CSHL Press,

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3. Pearson/Benzamin Cummings San Francisco, USA, 2007
4. Strachan T and Read A P, Human molecular genetics, 3rd Edition Wiley Bios, 2006.

Online links for study and reference materials:

<http://www.onlinebiologynotes.com>

http://www.ornl.gov/TechResources/Human_Genome/home.html

<https://www.biotecharticles.com>

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Basic concept of Medical Biotechnology and its scope.
2. Develop an understanding of medical genetics and chromosomal disorder. Insight on regulation of cell cycle and organization gene and chromosomes.
3. Understand basic concept of Molecular Oncology, and Gene regulation in cancer development.
4. Explain the basic concept of gene therapy and its application
5. Discuss the basic introduction to Bioethics & Biosafety in Research and concept of forensic medicine.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	3	2	-	1
CO2	3	3	2	-	-
CO3	3	3	3	-	1
CO4	3	3	3	2	1
CO5	2	2	2	3	1

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(DISCIPLINE SPECIFIC ELECTIVE COURSE-09)
SCIENTIFIC WRITING SKILL (BBT 813)**



COURSE OBJECTIVES: This course will understand the formulate a research problem and translate it into an empirical step-by-step approach for working with data. To practice statistical techniques required in research for presentation and analysis of research data.

Credits: 04

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	Curriculum Vitae: Basic introduction and importance of Curriculum Vitae and Resume. Difference between CV and Resume. How to introduce yourself in corporate and academic meetings. Academic writing and its importance.	10
2	Cover Letter: Prepare a Cover letter, Application for Job in Academic and industrial purpose. Scope of Biotechnology, Microbiology, Biochemistry, Agriculture and Forensic Science.	10
3	Research article: Basic background of Structural, non-structural and graphical abstracts, Introduction, materials, methodology, results, discussion and Conclusion.	10
4	Review article: Basic background of narrative review and systemic review, Introduction, materials, methodology, results, discussion and Conclusion.	10
5	Research Report: Research report writing, Steps in drafting, Use of Indexing, Content drafting, Research ethics, Plagiarism, and types of Plagiarism..	10

SUGGESTED TEXT BOOKS :

1. Kothari, C.R., Research Methodology (Methods and Techniques). New Age Publisher
2. Broota, K. D., Experimental designs in psychological research, Wiley eastern, New York, 1992.
3. Guilford, Statistics in Psychology and Education, McGraw Hill, New York, 1986.

COURSE OUTCOME:

After successful accomplishment of the course, the students will be able to:

1. Understand the basic structure of CV and Resume.
2. Develop skill to write cover letter for academic and industrial interviews.
3. Understand some basic concepts of research article and basic structure including abstracts, Introduction, materials, methodology, results, discussion and Conclusion.
4. Understand some basics of review articles and their types in details.

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5. Understanding of concepts of Research report drafting, Research ethics, Plagiarism, and other related issues

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	-	-	-	-
CO2	-	-	-	-	-
CO3	3	-	-	-	-
CO4	3	-	-	-	-
CO5	3	-	-	-	-

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(DISCIPLINE SPECIFIC ELECTIVE COURSE-10)
INTELLECTUAL PROPERTY RIGHTS (BBT 814)**



COURSE OBJECTIVES: The main objective of the IPR is to make the students aware of their rights for the protection of their invention done in their project work.

Credits: 04

L-T-P: 4-0-0

Module No	Content	Teaching Hours
1.	Concept of IPR: Introduction to Intellectual Property Rights, Kinds of Intellectual Property Rights, Need for Private Rights versus Public Interests, Advantages and Disadvantages of IPR .	10
2.	International scenario of IPR Relating to IPR, International Regime, TRIPS and other Treaties (WIPO , WTO , GATTs), Economic analysis of Intellectual Property Rights	10
3.	Copyright Act , 1957: Overview of Copyright Act , 1957, Terms of Copyright conditions for grant of copyright , the extent of rights exception to copyright protection , fair use provision , assignment and licensing, Copyright in Literary , Dramatic and Musical , Works , Sound Recording ,Cinematograph Films, Copyright in Computer Programme , Author Special Rights , Rights of Broadcasting and performers	10
4.	Overview of Patent Act 1970, Main objectives of the Patent Act, Registration of Patent, Duration of Patent	10
5.	Emerging Issues and Challenges: Traditional knowledge and IPR, Bio – piracy, Domain Name Disputes and Cyber – squatting, IPR and Climate change, Patents and Biotechnology	10

SUGGESTED TEXT BOOKS:

1. Intellectual Property Rights and the Law, Gogia Law Agency, by Dr. G.B. Reddy
2. Law relating to Intellectual Property, Universal Law Publishing Co, by Dr. B.L.Wadehra
3. IPR by P. Narayanan
4. Law of Intellectual Property, Asian Law House, Dr.S.R. Myneni.

REFERENCES :

Bare Act :

1. Trademarks Act , 1999
2. Sale and the rights of buyer and seller

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2. Patents Act , 1970 Instruments and their legist impact .
3. Copyright Act , 1957
4. Designs Act , 2000

COURSE OUTCOME:

On completion of this course, the students will be able to:

1. Competent after study of this law on how to file a property dispute case .
2. Understand to seek and get remedies for violating intellectual property rights .
3. Learn the procedure for obtaining Patents , Copyrights , Trademarks & Industrial Design .

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	1	-	-	-
CO2	-	3	-	-	-
CO3	1	2	-	-	-

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(DISCIPLINE SPECIFIC ELECTIVE COURSE-11)
DRUG DESIGN (BBT 815)**



COURSE OBJECTIVES: Drug Design course aims to provide students with an understanding of the process of drug discovery and development.

Credits: 04

L-T-P: 4-0-0

Module No.	Content	Teaching Hours
1	Structural Analysis of Biomolecules: Introduction to the primary, secondary, and tertiary structure of proteins, Distinct forms of DNA structure, 2D and 3D forms of ligand molecules. The binding cavity of biomolecules.	10
2	Three-dimensional structural analysis of protein: Protein fold and protein folding, protein topology, monomer, homo-dimer, homo-trimer, homo-tetramer, hetero-dimer, hetero trimer, and hetero-tetramer.	10
3	Structural Databases of Biomolecules and drug-like compounds: Introduction to Protein Data Bank, PDBSum database. Ligand and drug-like compounds databases: Drug Bank, Zinc database, Pubchem, and Natural compounds databases..	10
4	Introduction to molecular interactions in Biomolecules: Covalent and Non-covalent bonding, Attractive or repulsive forces between molecules. Hydrogen bonding, Van-der wall forces, non-bonding electrostatic interrelations, pi-pi interactions, cation-anion interactions, and other weak interactions.	10
5	Various types of Molecular docking: Introduction to Molecular docking, types of docking, types of protein-ligands docking (Rigid docking, flexible docking, manual docking), protein-protein docking, protein-peptide docking, and protein-DNA docking. Docked complex analysis, and molecular docking leading to virtual screening and identification of lead hit molecule.	10

SUGGESTED REFERENCE BOOKS :

1. Molecular Docking for Computer-Aided Drug Design: Fundamentals, Techniques, Resources and Applications by Mohane S. Coumar (Editor).
2. Docking Screens for Drug Discovery: Editors: Walter Filgueira de Azevedo Jr.
3. Stephen Misener, Stephen A. Krawetz . Bioinformatics Methods and Protocols, Humana Press, 1999, ISBN 978-0- 89603-732-8

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COURSE OUTCOMES:

After successful accomplishment of the course, the students will be able to:

1. Understanding the importance of drug design and different techniques of drug design
2. Knowledge about chemistry of drugs with respect to their biological activity and its application
3. Knowledge about metabolism, adverse effects and therapeutic value of drugs and its use
4. Understanding the importance of structural activity relationship of different class of drugs
5. Ability to carry out synthesis and assay of specific medicinal compounds

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	2	2	-	-
CO2	2	3	1	-	-
CO3	1	3	1	-	-
CO4	2	3	1	-	-
CO5	-	-	-	-	

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DRUG DESIGN LAB (BBT 873)

COURSE OBJECTIVES: The practical syllabus for drug design aims to provide undergraduate students with hands-on experience in computational methods and laboratory techniques used in modern drug discovery and development. The course will cover various aspects of drug design, including molecular modeling, structure-based drug design, and quantitative structure-activity relationship (QSAR) analysis.

Credits: 01

L-T-P: 0-0-2

Module No.	Contents	Lab Hours
1.	1. Introduction to Drug Design, Overview of drug discovery process 2. Basic concepts in drug design 3. Introduction to molecular modeling software (e.g., AutoDock, PyMOL) Building and visualizing small molecules and macromolecules 4. Introduction to SBDD concepts, Docking studies: Preparing protein and ligand structures 5. Performing docking simulations and analyzing results 6. Introduction to Ligand-Based Drug Design concepts, Pharmacophore modeling Virtual screening of compound libraries	20

COURSE OUTCOME:

After successful accomplishment of the course, the students will be able to:

1. Understand the principles and techniques of drug design.
2. Gain proficiency in computational tools for molecular modeling and drug discovery.
3. Develop skills in designing and optimizing drug candidates.
4. Apply QSAR and other computational techniques to predict drug activity

SUGGESTED TEXTBOOKS & REFERENCES:

1. Drug Design: Structure- and Ligand-Based Approaches" by Kenneth M. Merz, Dagmar Ringe, and Charles H. Reynolds
2. Computational Drug Design: A Guide for Computational and Medicinal Chemists" by David C. Young
3. Molecular Modelling: Principles and Applications" by Andrew R. Leach

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(DISSERTATIONS-2)**



Major Project -2 (BBT 871)

COURSE OBJECTIVES: Develop an ability to understand the basic requirement to conduct a research project. Student also develop skill of writing and presentation on the assigned research topics in the field of biotechnology

Credits: 06

L-T-P: 0-0-6

COURSE CONTENTS:

Every student will be required to undertake a research project based on any of the areas of biotechnology. The research project should have applied significance. The project report will be submitted in the form of dissertation duly certified by the supervisor of the Department of Biotechnology or at national institutes and Universities in India, by seeking the placement. The project will be presented for evaluation at the end of semester by external experiments.

COURSE LEARNING OUTCOMES (CLOS):

After completion of the course, students will be able to:

1. Understand about the Research in Biotechnology
2. Develop presentation skill during the conduction of research, discussion and presentation.
3. Student will develop analysis of results, drafting and writing skill.

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	3
CO2	3	3	3	2	3
CO3	3	3	3	-	-

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Annexure -1**Bachelor of Science (Biotechnology) First Semester (I Year) Batch (2024-25)**

S. No.	Paper Code	Name of Paper	No. of Students			Pass (%)
			Appeared	Pass	Fail	
1.	BBT-111	Elementary Cell Biology	21	21	0	100
2.	BBT-112	Basics Of Genetics	21	21	0	100
3.	BBT-113	Chemistry For Biology	21	17	4	80.95
4.	BBT-114	Computer And It Skill	21	21	0	100
5.	BBT-115	Biotechnological Skills and Analytical Techniques	21	16	5	76.19
6.	BBT-171	Elementary Cell Biology And Genetics Lab	21	21	0	100
7.	BBT-172	Computer And It Skill Lab	21	21	0	100
8.	VBT-111	Indian Knowledge System	21	21	0	100

Main Result:

1.	No. of Students Appeared	21
2.	No. of Students Passed	21
General / Overall Pass %		100



Bachelor of Science (Biotechnology) Third Semester (II Year) Batch (2024-25)

S. No.	Paper Code	Name of Paper	No. of Students			Pass (%)
			Appeared	Pass	Fail	
1.	BSBT-351	General Microbiology Lab	19	19	0	100
2.	BSBT-301	Genetics	19	15	4	78.94
3.	BSBT-302	General Microbiology	19	15	4	78.94
4.	BSBT-303	Bioinformatics	19	15	4	78.94
5.	BSSE-302	Enzymology	19	15	4	78.94
6.	BSGE-311	Bioethics and Biosafety	19	19	0	100
7.	BSBT-352	Bioinformatics Lab	19	19	0	100
8.	BSSE-354	Enzymology Lab	19	19	0	100

Main Result:

1.	No. of Students Appeared	19
2.	No. of Students Passed	15
General / Overall Pass %		78.94



Bachelor of Science (Biotechnology) Fifth Semester (III Year) Batch (2023-24)

S. No.	Paper Code	Name of Paper	No. of Students			Pass (%)
			Appeared	Pass	Fail	
1.	BHBT-501	Bioprocess Technology	7	6	1	85.71
2.	BHBT-502	Recombinant DNA Technology	7	7	0	100
3.	BHBT-503	Food Biotechnology	7	6	1	85.71
4.	BBTD-001	Enzymology	7	6	1	85.71
5.	BBTD-009	Animal Biotechnology	7	7	0	100
6.	BHBT-551	Food Biotechnology Lab	7	6	1	85.71
7.	BHBT-552	Seminar	7	6	1	85.71
8.	BBTD-051	Enzymology Lab	7	6	1	85.71

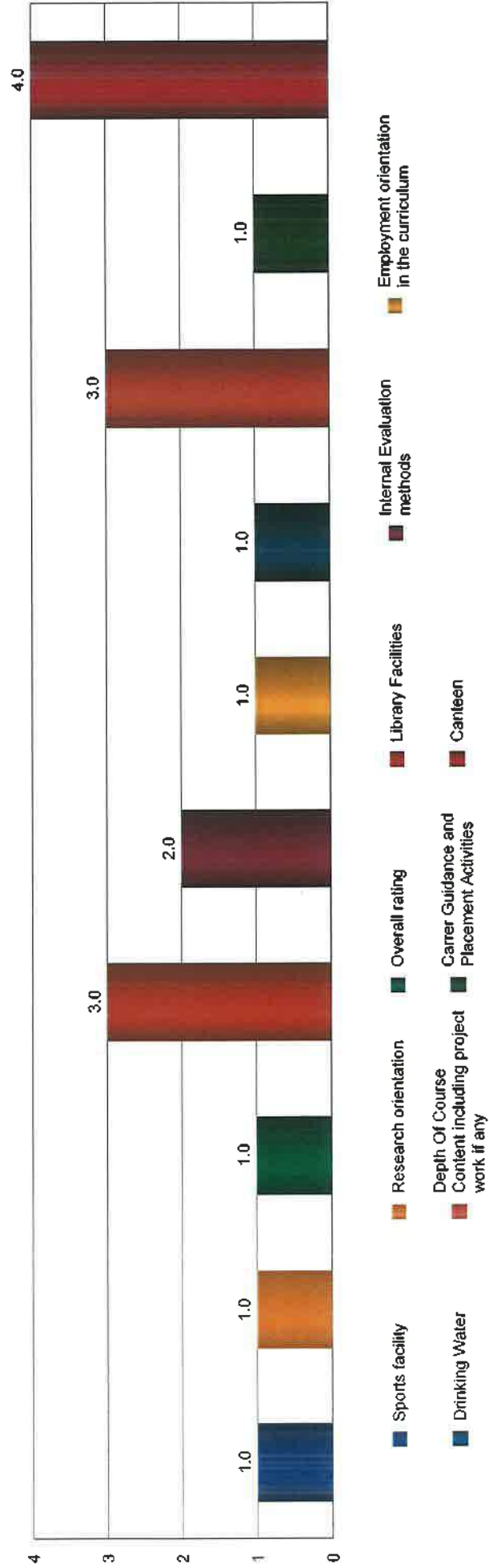
Main result:

1.	No. of Students Appeared	7
2.	No. of Students Passed	6
General / Overall Pass %		85.71





Curriculum Program Feedback Analysis [Alumni Student], Session : 2024-2025



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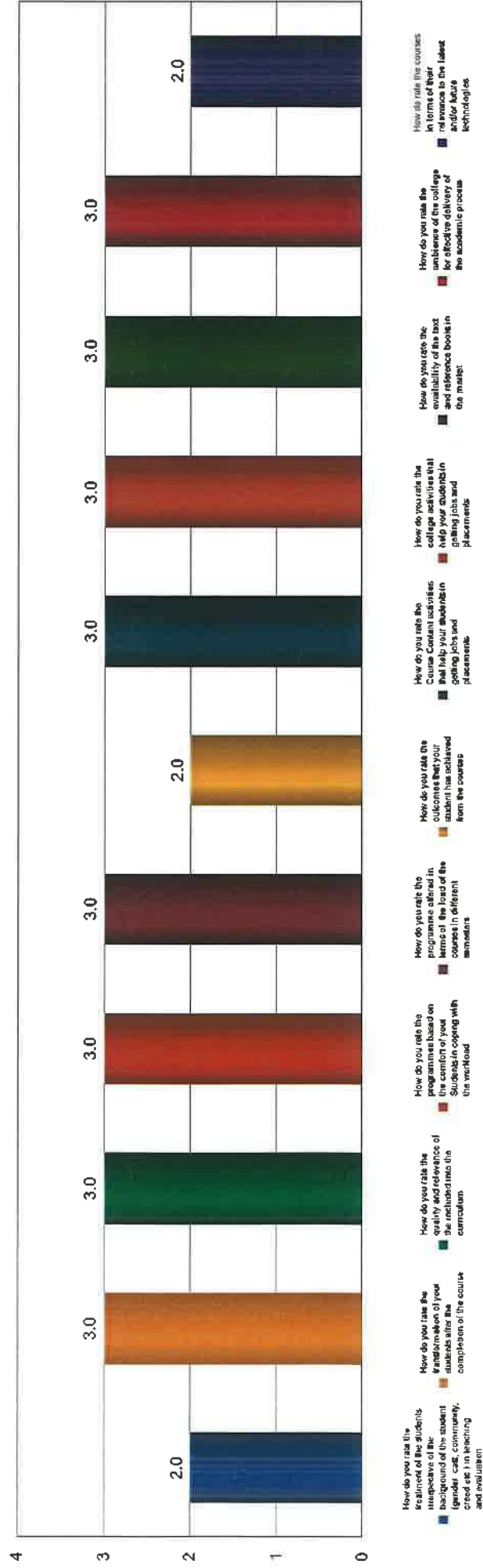
Department	Program	Sports facility	Research orientation	Overall rating	Library Facilities	Internal Evaluation methods	Employment articulation in the curriculum	Drinking Water	Depth Of Course Content including project work if any	Career Guidance and Placement Activities	Carbon
DEPARTMENT OF BIOTECHNOLOGY	BSC (HONS.)	1.0	1.0	1.0	3.0	2.0	1.0	1.0	3.0	1.0	4.0

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Curriculum Program Feedback Analysis [Faculty], Session : 2024-2025



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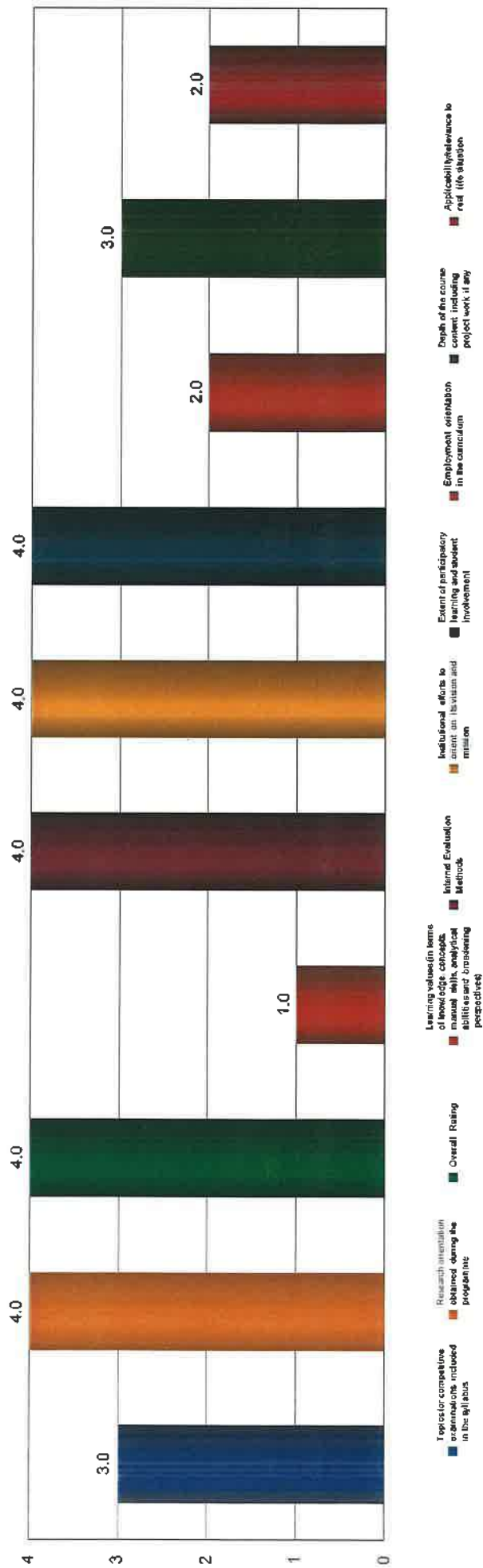
Department	Program	How do you rate the treatment of the students irrespective of the background of the student (gender, cast, community, creed etc) in teaching and	How do you rate the transformation of your students after the completion of the course	How do you rate the quality and relevance of the included into the curriculum	How do you rate the programmes based on the content of your Students in coping with the workload	How do you rate the programme offered in terms of the total of the courses in different semesters	How do you rate the outcomes that your student has achieved from the course	How do you rate the Course Content activities that help your students in getting jobs and placements	How do you rate the college activities that help your students in getting jobs and placements	How do you rate the availability of the test and reference books in the market	How do you rate the evidence of the college for effective delivery of the academic process	How do you rate the courses in terms of their relevance to the latest and/or future technologies
DEPARTMENT OF BIOTECHNOLOGY	BSC(HONS.)	2.0	3.0	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	2.0

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Curriculum Program Feedback Analysis [Student], Session : 2024-2025



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Department	Program	Targets for competitive standards included in the syllabus	Research orientation elicited during the programme	Overall Rating	Learning values (in terms of knowledge, conceptual skills, analytical abilities and broadening perspectives)	Internal Evaluation Methods	Institutional efforts to orient on its vision and mission	Extent of participatory learning and student involvement	Employment orientation in the curriculum	Depth of the course content including project work, if any	Applicability/relevance to real life situation
DEPARTMENT OF BIOTECHNOLOGY	BSCS(HONS.)	3.0	4.0	4.0	1.0	4.0	4.0	4.0	2.0	3.0	2.0

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