DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHHATRPATI SAMBHAJINAGR.

CIRCULAR NO.SU/B.Sc.Honors/Model College/43/2023

It is hereby inform to all concerned that, the syllabi recommendation of the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted the **following Revised syllabi under National Education Policy-2020 as per Guidelines of UGC** run at Model College, Ghansawangi Dist.-Jalna in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Courses	Semester
1.	Honors Degree of B.Sc. Computer Science.	Ist and IInd semester
2.	Honors Degree of B.Sc.Biotechnology	Ist and IInd semester
3.	Honors Degree of B.Sc. Biochemistry	Ist and IInd semester

This is effective from the Academic Year 2023-24 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Chhatrpati Sambhajinagar
431 004.
REF.NO.SU/2023/16416-24
Date:- 01.11.2023.

Deputy Registrar,
Academic Section

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2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

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Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (M.S.), India

Structure and Syllabus for B.Sc. (Biotechnology)

(Four Years Multidisciplinary Degree Program with Multiple Entry and Exit Option)

FOUR YEAR BACHELOR OF SCIENCE (B.Sc.)
Biotechnology

(For Model College Ghansawangi Dist. Jalna)

Under the Faculty of
Science and Technology

Effective from Academic year 2023 – 2024

(As per NEP-2020)

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1. Preamble

Biotechnology, being one of the latest branch of Life Science, has expanded and established as advanced interdisciplinary applied science. The socio-economic potential of Biotechnology is well established which has almost become synonymous with modern development. Biotechnology has its applications in almost every field touching practically every human activity e.g. Vaccine developed against Covid-19 endemic. The applied aspect of Biotechnology is now getting established with its applications in Industry, Agriculture, Health and Environment, Biotechnology is the lead science expanding exponentially.

B.Sc. Biotechnology (Hon) syllabus provides students with an in-depth understanding of Biology, Tissue culture, biological chemistry, microbiology, molecular biology, genetics, analytical techniques, bioinformatics, computer programming and other topics are included in the B.Sc. syllabus. This syllabus entails a thorough examination of the cellular and bio molecular processes involved in creating a wide range of innovation and products that help people to live better lives with better health. This course's sole purpose is to provide students with advanced biological processes knowledge for industrial and other purposes.

B.Sc. (Hons) Biotechnology is a Four year course comprising of systematic and multidisciplinary curriculum involving theoretical and practical aspects with flexibility of multiple entry and exit as per NEP 2020 . The various subjects in Biotechnology syllabus emphasizing distribution, morphology and physiology of microorganisms in addition to skills in aseptic procedures, isolation and identification. The course also includes sophomore level material covering immunology, cell biology, Molecular Biology, biochemistry, plant science, industrial biotechnology, environmental biotechnology and medical biotechnology. The course aims at producing professionals, who can be furnished into true biotechnologist and can be capable enough to serve the nation.

The below mentioned objectives have been reflected in various features in this curriculum.

1. **Holistic development of the students**
2. **Flexibility**
3. **Multiple entry and exit facility**
4. **Academic bank of credits**

5. **Multilingualism**
6. **Research component**

2. Abbreviations

1. **GE/OE:** Generic / Open Elective
2. **VSEC:** Vocational Skill and Skill Enhancement Course
3. **VSC:** Vocational Skill Courses
4. **SEC :** Skill Enhancement Courses
5. **AEC** :Ability Enhancement Course
6. **IKS**: Indian Knowledge System
7. **VEC:** Values Education Courses
8. **OJT:** On job Training: Internship/ Apprenticeship
9. **FP:** Filed Project
10. **CEP:** Community Engagement and Service
11. **CC:** Co-Curricular Courses
12. **RM:** Research Methodology
13. **RP:** Research Project

Definitions of Key Words:

a. Academic Year: Two consecutive (one odd + one even) semesters constitute one academic year

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

c. Credit: A unit by which the course work is measured. It determines the number of hours of instructions required per week in a semester. One credit is equivalent to one hour of lecture or tutorial or two hours of practical work/field work per week in a semester.

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

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

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

g. Program: It is a study in a discipline leading to award of a Degree, diploma or certificate.

h. Semester: Each semester will consist of over 16 weeks of academic work equivalent to 90 actual teaching days. The odd semester may be generally scheduled from June to November and even semester from January to May.

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

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

3. Concepts:

1. Major Subject: A major subject/core subject is the subject that represents the main focus of a degree. A degree in major is permitted if the student opts and accrues courses with minimum of 50% credits corresponding to the major.

2. Minor Subject: A minor is secondary subject that may complement the major or can have interdisciplinary bandwidth. Minors are a bunch of courses and can be related or unrelated to the major. A university must declares the minors and make it available to the students to choose from.

3. Internship: Students at all HEIs will provided with opportunities for internship in local industries, businesses, banks, artists, crafts persons, and so on. As well as research internships with faculty and researchers at their own or other HEIs/research institution.

4. Generic/Open Elective (OE): Generic or Open Elective shall be a pool/ basket of courses which is meant to provide multidisciplinary or interdisciplinary education to students. GEs or Ses shall consist of pool/ basket of courses offered by the various departments under different discipline/faculty of study.

5. Ability Enhancement Courses (AEC) - Language, Literature & Environment Studies. The courses based upon the content that leads to knowledge enhancement through various

areas of study. They are language and literature and environment science and sustainable development which will be mandatory for all disciplines.

6. Indian Knowledge System (IKS): IKS is a generic phrase that covers practically everything about India. While designing the curriculum, it need to be understood that IKS is not about merely knowing some ancestral knowledge. IKS is also about protecting received wisdom, economic security, and national pride.

7. Vocational and Skill Enhancement Courses (VSEC): In all disciplines/faculties are aimed at providing hands-on-training, competencies, proficiencies and skills to students. The basic purpose of vocational courses is to enhance skill and employability.

8. Internship and apprenticeship: It provides for an industry led, practice oriented and outcome based learning. Forming robust industry-academia linkage. Every HEI will undertake MOUs with industry for industry-institute linkage for promotion of apprenticeship/ Internship/ research/ entrepreneurship/ employment opportunities. There will be 4-6 weeks of structured summer internship in industry or research institute.

9. Field Projects: The field based learning/ projects should attempt to provide opportunities for students to understand the different socio-economic contexts. It should aim at giving student exposure to development-related issues in rural and urban settings. It will provide opportunities for the student to observe situation in rural and urban contexts, and to observe and study actual field situation regarding issues related to socio-economic development.

10. Community engagement and service: Community engagement and service seeks to expose students to the socio-economic issues in society so that the theoretical learning can be supplemented by actual life experiences to generate solutions to real life problems. This component will include participation in activities related to NSS, NCC, adult education/ literacy initiatives and mentoring school students.

(Note: Change in Structure will be applicable as per guidelines of University Grant Commission and State Government of Maharashtra released from time to time)

4.Course Structure

B. Sc. Biotechnology First Year (Semester I) (Level 4.5)

Teaching Scheme

Year/ Semester and Level		Section	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
					Theory	Practical	Total	Theory	Practical
First Year Semester I Level 4.5	Major	DSE-1	NBT101T	Inheritance Biology	03	--	03	03	--
			NBT101P	Lab based on Inheritance Biology	...	02	02	--	04
		DSE-2	NBT102T	Genomes and Inheritance	03	--	03	03	--
			NBT102P	Lab based on Genomes and Inheritance	---	02	02	---	04
	Supportive	**Minor-1** Select any one course from Basket 1	NBT103T1	Introduction to Biotechnology	02	--	02	02	--
			NBT103T2	Biotechnology for human welfare	02	--	02	02	--
			NBT103T3	Applications of Computer in Biotechnology	02	--	02	02	--
		Generic Elective Select any one course from Basket	NBT104T1	Essentials of Microbiology	02	--	02	02	
			NBT104T2	Biomolecules I	02	--	02	02	
			NBT104T3	Forensic Biology	02	--	02	02	
	Applied	SEC Select any one course from	NBT105P1	Lab based on Essentials of Microbiology		02	02		04

		Basket							
			NBT105P2	Lab based on Biomolecules I		02	02	--	04
			NBT105P3	Lab based on Forensic Biology		02	02	---	04
		VSC	NBT106T	Aptitude and Reasoning	02	-----	02	02	--
	AES,VEC, IKS/ Language Curriculum	AEC-1 English	NBT-ENG-101	English	02				
		L1-MIL	NBT-MIL-101	Marathi/Hindi	02				
		VEC-1	NBT-VEC-101	Indian Constitution	02				
		IKS-1	NBT-IKS-101	Indian Knowledge System	02				
	VEC/Life Skill Curriculum	JOC-1	NBT107T	Presentation Skill	02	----	02	02	---
		CC-1	NBT108T	Health and wellness	02	----	02	02	---

B. Sc. Biotechnology First Year (Semester I) (Level 4.5)

Evaluation/Examination Scheme

[40% Continuous Assessment and 60% of Semester End/ University Assessment]

Year/ Semester and Level		Section	Course Code	Course Name	Credit		Evaluation Method		Total Marks	Max mark	Min Mark
					Theory	Practical	CA	UA			
First Year Semester I Level 4.5	Major	**DSE-1**	NBT101T	Inheritance Biology	03		20	30	50	50	20
			NBT101P	Lab based on Inheritance Biology	.....	02	--	50	50	50	20
		DSE-2	NCOM102T	Genomes and Inheritance	03		20	30	50	50	20
			NBT102P	Lab based on Genomes and Inheritance	-----	02	---	50	50	50	20
	Supportive	**Minor-1** Select any one course from Basket 1	NBT103T1	Introduction to Biotechnology	02	---	20	30	50	50	20
			NBT103T2	Biotechnology for human welfare							
			NBT103T3	Applications of Computer in Biotechnology							
		Generic Elective Select any one	NBT104T1	Essentials of Microbiology	02	---	20	30	50	50	20
			NBT104T2	Biomolecules I							

		course from Basket	NBT104T3	Forensic Biology							
	Applied	SEC Select any one course from Basket	NBT105P1	Lab based on Essentials of Microbiology	---	02	---	50	50	50	20
			NBT105P2	Lab based on Biomolecules I							
			NBT105P3	Lab based on Forensic Biology							
		VSC	NBT106T	Aptitude and Reasoning	02	--	20	30	50	50	20
	AES,VEC, IKS/ Language Curriculum	AEC-1 English	NBT-ENG-101	English	02	---	20	30	50	50	20
		L1-MIL	NBT-MIL-101	Marathi/Hindi	02	---	20	30	50	50	20
		VEC-1	NBT-VEC-101	Indian Constitution	02	...	20	30	50	50	20
		IKS-1	NBT-IKS-101	Indian Knowledge System	02	...	20	30	50	50	20
	VEC/Life Skill Curriculum	JOC-1	NBT107T	Presentation Skill	02	---	20	30	50	50	20
		CC-1	NBT108T	Health and wellness	02	---	20	30	50	50	20
								Total Marks	700	700	280

B. Sc. Biotechnology First Year (Semester II) (Level 4.5)

Teaching Scheme

Year/ Semester and Level		Section	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
					Theory	Practical	Total	Theory	Practical
First Year Semester II Level 4.5	Major	DSE-3	NBT201T	Cell Biology	03	--	03	03	--
			NBT201P	Lab based Cell Biology	...	02	02	--	04
		DSE-4	NBT202T	Fundamentals of Genetics	03	--	03	03	--
			NBT202P	Lab based Fundamentals of Genetics	---	02	02	---	04
	Supportive	Minor-2 Select any one course from Basket 1	NBT203T1	Agricultural Biotechnology	02	--	02	02	--
			NBT203T2	Biostatistics	02	--	02	02	--
			NBT203T3	Basic Virology	02	--	02	02	--
		Generic Elective /OE-2 Select any one course from Basket	NBT204T1	Biomolecules II	02	--	02	02	
			NBT204T2	Microbial Physiology	02	--	02	02	
			NBT204T3	Basic Bioinformatics	02	--	02	02	
	Applied	SEC-2 Select any one course from Basket	NBT205P1	Lab based on Biomolecules II		02	02		04
			NBT205P2	Lab based on		02	02	--	04

				Microbial Physiology					
			NBT205P3	Lab based on Basic Bioinformatics		02	02	---	04
		VSC	NBT206T	Web designing	02	-----	02	02	--
	AES,VEC, IKS/ Language Curriculum	AEC-2 English	NBT-ENG-201	English	02				
		L2-MIL	NBT-MIL-201	Marathi/Hindi	02				
		VEC-2	NBT-VEC-201	Environment Education	02				
		IKS-2	NBT-IKS-201	Indian Knowledge System	02				
	VEC/Life Skill Curriculum	VOC-1	NBT207T	Personality Development & Interview Techniques	02	----	02	02	---
		CC-2	NBT208T	Yoga Education/Sports and Fitness	02	----	02	02	---

B. Sc. Biotechnology First Year (Semester II) (Level 4.5)

Evaluation/Examination Scheme

[40% Continuous Assessment and 60% of Semester End/ University Assessment]

Year/ Semester and Level		Section	Course Code	Course Name	Credit		Evaluation Method		Total Marks	Max mark	Min Mark
					Theory	Practical	CA	UA			
First Year Semester II Level 4.5	Major	**DSE-3**	NBT201T	Cell Biology	03		20	30	50	50	20
			NBT201P	Lab based Cell Biology	.....	02	--	50	50	50	20
		DSE-4	NBT202T	Fundamentals of Genetics	03		20	30	50	50	20
			NBT202P	Lab based Fundamentals of Genetics	-----	02	---	50	50	50	20
	Supportive	**Minor-2** Select any one course from Basket 1	NBT203T1	Agricultural Biotechnology	02	---	20	30	50	50	20
			NBT203T2	Biostatistics							
			NBT203T3	Basic Virology							
		Generic Elective /OE-2 Select any one course from Basket	NBT204T1	Biomolecules II	02	---	20	30	50	50	20
			NBT204T2	Microbial Physiology							
			NBT204T3	Basic Bioinformatics							
	Applied	SEC-2	NBT205P1	Lab based on Biomolecules II	---	02	---	50	50	50	20

		Select any one course from Basket	NBT205P2	Lab based on Microbial Physiology							
			NBT205P3	Lab based on Basic Bioinformatics							
		VSC	NBT206T	Web designing	02	--	20	30	50	50	20
	AES,VEC, IKS/ Language Curriculum	AEC-2 English	NBT-ENG-201	English	02	---	20	30	50	50	20
		L2-MIL	NBT-MIL-201	Marathi/Hindi	02	---	20	30	50	50	20
		VEC-2	NBT-VEC-201	Environment Education	02	...	20	30	50	50	20
		IKS-2	NBT-IKS-201	Indian Knowledge System	02	...	20	30	50	50	20
	VEC/Life Skill Curriculum	VOC-1	NBT207T	Personality Development & Interview Techniques	02	---	20	30	50	50	20
		CC-2	NBT208T	Yoga Education/Sports and Fitness	02	---	20	30	50	50	20
								Total Marks	**700**	**700**	**280**

Basket 1: Minor Subject

* Students will have to choose one subject from Basket 1 as a Minor subject, from same faculty or discipline or other than DSC (in col. 3)

Semester	Details of Minor Subject	
	Code	Title of Subject
I Semester	NBT103T1	Introduction to Biotechnology
	NBT103T2	Biotechnology for human welfare
	NBT103T3	Applications of Computer in Biotechnology
II Semester	NBT203T1	Agricultural Biotechnology
	NBT203T2	Biostatistics
	NBT203T3	Basic Virology

Basket 2: Generic Elective course (GE)

* Students will choose one GE course offered as a generic major

Semester	Details of Generic Elective	
	Code	Title of Subject
I Semester	NBT104T1	Essentials of Microbiology
	NBT104T2	Biomolecules I
	NBT104T3	Forensic Biology
II Semester	NBT204T1	Biomolecules II
	NBT204T2	Microbial Physiology
	NBT204T3	Basic Bioinformatics

Basket 3: Skill Enhancement Course (SEC)

Student should Choose any one from Basket

Semester	Details of Skill Enhancement Course (SEC)	
	Code	Title of Subject
I Semester	NBT105TP1	Lab based on Essentials of Microbiology
	NBT105TP2	Lab based on Biomolecules I
	NBT105TP3	Lab based on Forensic Biology
II Semester	NBT205TP1	Lab based on Biomolecules II
	NBT205TP2	Lab based on Basic Bioinformatics
	NBT205TP3	Lab based on Microbial Physiology

Curriculum AES,VEC,IKS/Language

Semester	Name of Subject	Details of Skill Enhancement Course (SEC)	
		Code	Title of Subject
I Semester	AEC-1 English	NBT-ENG-101	English
	MIL –Marathi /Hindi	NBT-MIL-101	Marathi/ Hindi
	VEC	NBT-VEC-101	Constitution of India
	IKS	NBT-IKS-101	Indian Knowledge System
II Semester	AEC-2 English	NBT-ENG-102	English
	MIL –Marathi /Hindi	NBT-MIL-102	Marathi/ Hindi
	VEC	NBT-VEC-101	Environment Education
	IKS	NBT-IKS-101	Indian Knowledge System

5. Vision

The biotechnology program vision is to provide quality teaching with a strong core science concepts and an application-oriented undergraduate education along with solid foundation in the rapidly expanding fields of biotechnology that enable them to produce high quality professionals. Our goal is to provide students with a sound knowledge and understanding of current theories, concepts and laboratory practices in biotechnology.

6. Mission

To generate high quality students by offering UG (B.Sc. Honours) programmes in Biotechnology and to develop a premier biotechnology teaching and research department to cater the needs and challenges of the region and the country.

7. Eligibility

Candidates who have passed 10+2 with Science from recognized board and as per the eligibility criteria lay down by Dr. Balasaheb Ambedkar Marathwada University, Aurangabad will be eligible for admission to B.Sc. Biotechnology (Honours) course.

8. Duration

The undergraduate program in Biotechnology is offered though the courses designed for granting the following B.Sc Biotechnology. The duration of the program is 4 years or 8 semesters. Students who desire to undergo a 3-year UG 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 UG Certificate or UG Diploma, respectively, provided they secure the prescribed number of credits . Students who exit with a UG certificate or UG diploma are permitted to re-enter within three years and complete the degree programme.

UG Certificate: Students who opt to exit after completion of the first year and have secured 60 credits will be awarded a UG certificate.

UG Diploma: Students who opt to exit after completion of the second year and have secured 120 credits will be awarded the UG diploma.

3-year UG Degree: Students who wish to undergo a 3-year UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 180 credits.

4-year UG Degree (Honours): A four-year UG Honours degree in the major discipline will be awarded to those who complete a four-year degree programme with 224 credits.

4-year UG Degree (Honours with Research): Students who choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a faculty member of the University/College. The research project/dissertation will be in the major discipline. The students who secure 224 Credits.

9. Medium of Instructions

The medium of instruction for this course is English.

10. Attendance

A candidate is required to put in a minimum of 75% of attendance in both theory papers practical separately in each subject before admission to the examination. This relaxation in attendance includes for medical & any other reasons approved by the head of the Institution. A candidate lacking in the prescribed attendance and progress in any one of the subjects in theory and practical in the first appearance shall not be permitted for admission to the entire examination.

11. Evaluation Methods/ Scheme of Examination, Earning Credits, Grading System

Continuous assessment methods that are appropriate to a given disciplinary/subject area and a programme of study will be used to assess progress toward the course/programme learning outcomes. Priority will be accorded to formative assessment.

Evaluation will be based on continuous assessment, in which sessional work and the semester end examination will contribute to the final grade. Sessional work will consist of weekly class tests, mid-semester examination(s), homework assignments, etc., as determined by the faculty in charge of the courses of study. Progress towards achievement of learning outcomes will be assessed using the following: time-constrained examinations; closed-book and open-book tests; problem-based assignments; practical assignment laboratory reports; observation of practical skills; individual project reports (case-study reports); team project reports; oral presentations, including seminar presentation; viva voce interviews; computerized adaptive assessment, examination on demand, modular certifications, etc.

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.

Letter Grade	Grade Point
O (outstanding)	10
A+ (Excellent)	9
A (Very good)	8
B+ (Good)	7
B (Above average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Computation of SGPA and CGPA

The following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

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

$$SGPA\ (Si) = \sum(Ci \times Gi) / \sum Ci$$

Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

ii. **The Cumulative Grade Point Average (CGPA)** is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$CGPA = \sum(Ci \times Si) / \sum Ci$$

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester

12. Programme Outcomes (POs):

12.1 Program Education Objectives

PEO1	To Understand the structure and function of biological molecules, cellular energetics, cellular metabolism, and photosynthesis.
PEO2	Understand the structure and function of prokaryotic and eukaryotic cells, as whole entities and in terms of their subcellular processes..
PEO3	Understand the flow of genetic information in populations and the relationship between genetics and evolutionary theory. Understand the functioning of organisms, at the molecular, cellular, organ, and organismal levels
PEO4	To impart knowledge through updated curriculum as per need to prepare students for higher studies and national/international competitive examinations

12.2 PROGRAM OUTCOMES

PO1	**Knowledge**: Students will be able to demonstrate their knowledge of biotechnology concepts. Graduates will gain and apply knowledge of Biotechnology, Science and Engineering concepts to solve problems related to field of Biotechnology.
PO2	**Problem analysis**:. Identify, formulate, review research literature, and analyze complex problems reaching substantiated conclusions using first principles of Biotechnology and natural sciences
PO3	**Design/development of solutions**: Design solutions for complex problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern computational tools including prediction and modeling to complex computational problems with an understanding of the limitations.

PO6	**The engineer and society**: 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.
PO7	**Environment and sustainability**: Understand the impact of change in envirnment solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the ethical practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex activities with the community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions..
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

12.3PROGRAM SPECIFIC OUTCOMES

PSO1	The student will be able to apply the knowledge of biotechnology and allied disciplines in industry, research and higher studies.

PSO2	The student will be able to apply technological solutions in the area of modern biotechnological applications.
PSO3	The student will be able to apply the knowledge of biotechnology and allied disciplines to become an entrepreneur.
PSO4	Ability to design the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to biotechnological product.

13. Curriculum Semester I

Curriculum of Semester –I

B.Sc. Biotechnology Honours (Semester I)

NBT101T: Inheritance Biology

Paper: DSC-1
Contact Hours: 45 (Clock Hours)

Total Credit: 03
Marks: 30

Unit I : Historical and Evolutionary perspective

Contribution of various scientists in Evolutionary Genetics: Lamark, Russel Wallace, Darwin, Weisman, Hugo de veries. Definition of gene. Discovery of genetic material –Experimental evidences, Watson and Crick DNA structure.

Unit II : Gene Concept and Inheritance

Concept of gene: Allele, Alleles, Pseudoallele, Complementation test. Mendelian Principles:segregation; Mendels experiment, terminology, testing phenotypes, examples of gene differences and segregation. Mendelian Principle II: Independent assortment; genotypes of dihybrid corsses, testing dihybrid genotypes.

Unit III : Extension of Mendel Principles

Codominance, Incomplete dominance, Pleiotrophy, Genomic Imprinting, Penetrance and Expressivity, Phenocopy, Linkage and Crossing over, Sex determination, Sex Linkage, Sex limited and Sex influenced characters.

Unit IV: Post mendelian Genetics

Gene Intaraction and phynotype effect, Epistasic gene,hypoststic gene, types of Epistasis: Dominant, Recessive, duplicate dominant, duplicate recessive.

References:

1. Principles of Genetics, 7th edition R. H. Tamarin, Tata McGraw Hill Edition, Reprint 2004.
2. Molecular Genetics: an introductory narrative (2nd edition) Gunther S. Stent, and Riochard Calenar, CBS publishers and Distributiors, Reprint 2004
3. Genetics 5th edition, Strickberger, Pearsons Bublisher, LPE.
4. Modern Microbial Genetics Editors Uldis N Streips and Ronald E. Yassbin, Wiley Liss Pubication 1991.

5. Genetics: Conceptual approach by Benjamin Pierce

6. i-Genetics: A molecular approach 3rd edition, -Peter J. Russel.

NBT101P : Lab Based on Inheritance Biology

Paper: Lab Course

Total Credit: 02
Marks: 50

1. Problems based on monohybrid and back cross
2. Problems based on di-hybrid
3. Problems based on tri-hybrid
4. Problems based on pedigree analysis
5. Problems based on epistasis.
6. Problems based on Linkage

NBT102T: Genomes and Inheritance

Paper: DSC-2
Contact Hours: 45 (Clock Hours)

Total Credit: 03
Marks: 30

Unit I : Organization of genomes, prokaryotes, eukaryotes. *Escherichia coli* genome, examples of eukaryotic genomes; *Saccharomyces cereviceae, C. elegans, Arabidopsis thaliana,* human genome.

Unit II : C-value paradox, Repetitive DNA-satellite DNAs and interspersed repeated DNAs, Transposable elements, LINES, SINES, Alu family and their application in genome mapping. Subcellular and extrachromosomosomal inheritance, Plasmid genomes, viral genomes, Plastid genomes, Mitochondrial genomes.

Unit III : Non-Nuclear Inheritance : Maternal inheritance, maternal effect, cytoplasmic inheritance, Plastid inheritance, Endosymbiont mediated inheritance and Uniparental Inheritance

Unit IV:Genome Mapping

Linkage map, Tetrad analysis, Mapping with Molecular Markers, Mapping with Somatic cell Hybrids.

References:

1. Principles of Genetics, 7th edition R. H. Tamarin, Tata McGraw Hill Edition, Reprint 2004.
2. Molecular Genetics: an introductory narrative (2nd edition) Gunther S. Stent, and Riochard Calenar, CBS publishers and Distributiors, Reprint 2004
3. Genetics 5th edition, Strickberger, Pearsons Bublisher, LPE.
4. Modern Microbial Genetics Editors Uldis N Streips and Ronald E. Yassbin, Wiley Liss Pubication 1991.
5. Genetics: Conceptual approach by Benjamin Pierce
6. i-Genetics: A molecular approach 3rd edition, -Peter J. Russel.
7. Genomes: T. A. Brown 3rd edition
8. Principles of Genomes and Genomics 7th edition, Primrose and Twyman.

NBT102P : Lab Based on Genomes & Inheritance

Paper: Lab Course

Total Credit: 02
Marks: 50

1. Isolation & Demonstration of chloroplast from plant source
2. Isolation and Demonstration of Mitochondria
3. Comparison of Microbial and Eukaryotic genomes (structure & Function level)
4. Comparison of virus and corresponding host genomes (Structure and Function)
5. Problems based on Linkage Map

NBT103T1: Introduction to Biotechnology

Paper: Minar-1 | Total Credit: 02
Contact Hours: 30 (Clock Hours) | Marks: 30

Unit I :Scope and Introduction to Biotechnology

History & Introduction to Biotechnology What is Biotechnology? Definition of Biotechnology, Traditional and Modern Biotechnology, Branches of Biotechnology Plant, Animal Biotechnology, Marine Biotechnology, Agriculture, Healthcare, Industrial Biotechnology, Pharmaceutical Biotechnology, Environmental Biotechnology. Biotechnology Research in India. Biotechnology Institutions in India (Pub lic and Private Sector) Biotech Suceess Stories Biotech Policy Initiatives Biotechnology in context of Developing World Public Perception of Biotechnology

Unit II Applications of Biotechnology

Applications of Biotechnology in Agriculture : GM Food, GM Papaya, GM Tomato, Fungal and Insect Resistant Plants BT Crops, BT Cotton and BT Brinjal Pros and Cons Biotechnological applications in Crop and Livestock Improvements Modifications in Plant Quality Golden Rice, Molecular Pharming, Plant Based Vaccines Ethics in Biotechnology and IPR

Unit III :Food Biotechnology

Biotechnological applicationsin enhancement of Food Quality Unit Operation in Food Processing Quality Factors in Preprocessed Food Food Deterioration and its Control Rheology of Food Products Microbial role in food products Yeast, Bacterial and other Microorganisms based process and products Modern Biotechnological Regulatory Aspects in Food Industries Biotechnology and Food - Social Appraisal

Unit IV: Fermentation Biotechnology

Defination, Applications of Fermetation Technology Microbial Fermentations Overview of Industrial Production of Chemicals (Acetic Acid, Citric Acid and Ethanol), Antibiotics, Enzymes and Beverages

References:

1. Introduction to Biotechnology: S.c.Rastogi
2. Introduction To Biotechnology by William Thieman
3. Introduction To Biotechnology A Genetic Manipulation Perspective by Rup Lal
4. Smith J. E., Biotechnology, 3rd Edition, Cambridge University Press (2006)

5. Dhami, P.S., Srivastava, H.N. and Chopra, G., A Textbook of Biology, Pradeep Publications (2008).

6. Saltzman WM. Biomedical Engineering Bridging Medicine and Technology 2009 (ISBN-13:9780521840996)

7. Starr, C., Evers C. A., Starr L. Concepts of Biology, First Edition, Cengage Learning India Pvt. Ltd. (2010)

8. Roberts, M. and Ingram, N. Biology, 2nd Edition, Nelson Thomas Ltd., UK (2001)

NBT103T2: Biotechnology for Human Welfare

Paper: Minar-1
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

UNIT I

Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

UNIT II

Agriculture: N2 fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT III

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB..

UNIT IV

Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in E.coli, human genome project.

References

1. Crueger W and Crueger A. (2000). Biotechnology: A textbook ofIndustrial

Microbiology.2nd edition. Panima Publishing Co. NewDelhi.

2. Patel AH. (1996). Industrial Microbiology. 1st edition, MacmillanIndia

Limited.

3. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles ofFermentation

Technology. 2nd edition, Elsevier ScienceLtd.

4. Environmental Biotechnology, Pradipta KumarMohapatra

5. Environmental Biotechnology – Concepts and Applications, Hans-Joachim

Jordening andJesefWinter

6. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the

TwentyFirst

Century, Select Publishers, New Delhi (2001).

7. M.K. Bhasin and S. Nath, Role of Forensic Science in the NewMillennium,

University of Delhi, Delhi(2002).

8. S.H. James and J.J. Nordby, Forensic Science: An Introduction toScientific and

Investigative Techniques, 2nd Edition, CRC Press, Boca Raton(2005).

9. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences,2nd

Edition, W.G.Eckert (ED.), CRC Press, Boca Raton(1997)

NBT103T2: Applications of Computer in Biotechnology

Paper: Minar-1 Total Credit: 02
Contact Hours: 30 (Clock Hours) Marks: 30

Unit 1:

General features of a Computer. Generation of computers.Personal Computer, Workstation, Mainframe Computer and super Computers.Computer applications – data processing, information processing, Application areas of computer.

Unit II

Computer organization.Central processing module.Computer memory- primary memory and secondary memory.Secondary storage devices – magnetic and optical media. Input and output modules. OMR, OCR, MICR, scanner, mouse, Modem.

Unit III

Computer hardware and software.Machine language and high level language.Application software.Computer program.Operating system.Computer virus, Antivirus and Computer security, Windows OS and its features. Computer arithmetic.Binary, octal and hexadecimal number systems.Algorithm and flowcharts.Illustrations. Elements of database and its applications.

Unit IV

Introduction to MS office Packages- Ms-Word – Editing a Document – Move and Copy text – Formatting text and paragraph – Finding and Replacing text and spelling checking – Using tabs, Tables, and other features, Enhancing document – using mail merge and other features. Introduction to Worksheet- Getting started with excel – Editing Cells and using commands and functions – Moving And Coping, Inserting and Deleting Rows and Columns – Getting help and formatting a worksheet – Printing the worksheet – Creating Charts – using formulae and functions in excel. Introduction to Power Point Presentation

References

1. Fundamentals of Computers, V. Rajaraman 6th edition PHI Learning Private Limited 2014
2. Fundamentals of Information Technology ByChetanSrivastava, Kalyani Publishers
3. Fundamentals of Computers By V.Rajaraman, PHI Publication ,IVth Edition.

NBT104T1: Essentials of Microbiology

Paper: Generic Elective
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

Unit I : Determination of micro-organisms

Various shapes of bacteria, determination of microbes by Stains and Staining procedure,

Classification, Negative staining, Monochrome staining, Gram staining, Acid Fast staining

Unit II: Microbial Nutrition

Types of growth media: Natural, Synthetic, Enriched, Enrinchment and selection, Differential medium.

Unit III : Isolation and purification

Isolation & Purification: Pure culture techniques; streak plate, pour plate and spread plate technique. Techniques used for isolation purification of aerobic and anaerobic microbes.

Unit IV: Microbial Control

Physical: Sterilization: Heat: Dry heat, Moist heat, Tyndalization & Pasteurization. Radiations.

Chemical control :properties of disinfectant, types of disinfectants, Antimicrobial compounds

References:

1. R. Y. Stanier 6th Edition, General Microbiology, Mc Millan Press. Inc.
2. Pelczar Microbiology, TMH publication
3. Anantnarayan text book of Microbiology 9th edition, Orient Longman Delhi
4. Cappucinno Microbiology; a laboratory manual 4th edition
5. Toratora Microbiology: An introduction
6. Salle A. J. Fundamental Principles of Bacteriology
7. Prescott Microbiology

NBT104T2: Biomolecules I

Paper: Generic Elective
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

Unit-I: Basic Concepts:

Concept and definition of acid, base, Water and pH, Normality, Molarity, Buffers and biological systems, Henderson-Hassalbach equation. Types of bond in biomolecules- Covalent (Glycosidic, peptide , Phospodiester) Ionic hydrogen, Van der Waals, Hydrophobic, Co-ordinate, There Formation and interaction.

Unit-II: Thermodynamics and bioenergetics

Basic concepts of Thermodynamics, Enthalpy, entropy. Law of Thermodynamics, Thermodynamics and biological system, Application of Thermodynamics. Concepts of free energy, relation between Equilibrium constant and Standard Free energy change Biological oxidation reduction reaction. High Energy phosphate compound – Introduction, phosphate group transfer, Hydrolysis of ATP and Sugar phosphate Along with reasons for ΔG

Unit-III: Nucleic Acids

Physico-chemical properties of Nucleic acids, nitrogenous bases (Purines and Pyrimidines), structure of nucleosides and nucleotides. Structure of DNA- Watson and Crick Model, DNA forms and conformations Denaturation of DNA. RNA- types, structure and role.

Unit IV: Vitamins

Vitamins Structure and active forms of water soluble and fat soluble vitamins, deficiency diseases and symptoms, hypervitaminosis

References:

1. Cohn & Stump – Outline of Biochemistry Wiley Eastern Ltd.
2. L. Lehninger, D. L. Nelson & M M Cox – Principles of Biochemistry.
3. Lubert Stryer – Biochemistry
4. J. Jayraman- Practical Biochemistry
5. Plummer. –Practical Biochemistry
6. A.C.Deb Fundementals of biochemistry
7. Zuby - Biochemistry 4th edition
8. Boyer- Concepts in Biochemistry
9. Cooper -The tools of Biochemistry
10. Biochemistry- U Satyanarayan

NBT104T3: Forensic Biology

Paper: Generic Elective
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

UNIT-I Forensic Biology: Definition and scope Importance, nature, location, collection and preservation of biological exhibits and crime scene investigation of biological evidence.Cell: Definition, Theories, Classification and Significance of Cells in Forensic Science. Cell Organelles and their Functions, Difference between Eukaryotic and Prokaryotic Cell, Difference between Plant and Animal Cell. Cell Division: Definition, Types, Difference between Somatic and Germinal Cell and Totipotency and Apoptosis. Basic Concept in Brief for Anatomy and Physiology of Digestive, Respiratory, Circulatory, Skeleton, Nervous, Excretory and Reproductive System etc.

Unit-2 Basic Plant biology- plant cell structure and function, basic plant tissues, modes of plant reproduction, plant classification schemes, subspecialties of forensic botany such as plant morphology, plant anatomy, plant ecology, limnology etc. Essential parts of plants.Plant as evidence.Common poisonous plant and types of plant toxins.

Unit-3 Botanical evidences:- Forensic importance, Introduction, types, location, collection, preservation and evaluation of – Wood: types of wood and anatomy, methods of identification and comparison. Leaves: Identification of various types of leaves and their anatomy, methods of comparison.Pollens: Structure, function, methods of identification and comparison. Seeds and spores: structure and formation in fungi, gymnosperm and angiosperm. Forensic Diatomology: Diatoms: Nature, classification, location, structure, life cycle, extraction from various body tissues including bone marrow, preparation of slides, methods of identification and comparison, forensic significance.

Unit-4 Basic Molecular biology- the structure of DNA, source of dna sample, extraction, profiling, restriction fragment length polymorphism, polymerase chain reaction, short tandem repeat markers, single nucleotide polymorphism markers, determination of ethnicity, determination of physical appearance, determination of personality traits, mitochondrial dna, RNA, and DNA database.

References

1. Essential Forensic Biology: Allen Gunn
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 NewMillennium, University of Delhi, Delhi(2002).
4. S.H. James and J.J. Nordby, Forensic Science: An Introduction toScientific andn Investigative Techniques, 2nd Edition, CRC Press, Boca Raton(2005).

5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences,2nd Edition, W.G.Eckert (ED.), CRC Press, Boca Raton(1997).

NBT105P1: Lab Based on Essentials of Microbiology

Paper: SEC

Total Credit: 02
Marks: 50

1. Simple staining/Monochrome staining
2. Negative staining
3. Differential staining –Grams staining and Acid Fast staining
4. Media preparation & Test of sterility
5. Isolation of bacteria from soil, water by streak plate, pour plate and spread plate method
6. Preparation of Slant
7. Biochemical characterization (IMViC Test)
8. Assay of Antibiotics

NBT105P2: Lab Based on Biomolecules I

Paper: SEC

Total Credit: 02
Marks: 50

1. Preparation of reagents, Molar and normal solution
2. Preparation of various buffers and determination of p^H
3. Quantitative estimation of DNA by diphenylamine method
4. Quantitative estimation of RNA by Orcinol method.

NBT105P3: Lab Based on Forensic Biology

Paper: SEC

Total Credit: 02
Marks: 50

1. To examine hair morphology and determine the species to which the hair belongs.
2. . To prepare slides of scale pattern of human hair.
3. To examine human hair for cortex and medulla.
4. To carry out microscopic examination of pollen grains.
5. To carry out microscopic examination of diatoms.
6. To cite a crime case in which diatoms have served as forensic evidence.
7. To prepare a case report on forensic entomology.
8. To prepare a case report on problems of wildlife forensics.

NBT106T: Aptitude and Reasoning

Paper: VSC
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

Unit-I: : Quantitative Ability (Basic Mathematics) (10 periods)

1.1. Number Systems

1.2. LCM and HCF

1.3. Decimal Fractions

1.4. Simplification

1.5. Square Roots and Cube Roots

1.6. Average

1.7. Problems on Ages

1.8. Surds & Indices

1.9. Percentages

1.10 Problems on Numbers

Unit-II: Quantitative Ability-I (Applied & Engineering Mathematics) (10 periods)

2.1. Logarithm

2.2. Permutation and Combinations

2.3 Probability

Unit-III: Quantitative Ability-II (Applied & Engineering Mathematics) (05 periods)

3.1 Profit and Loss

3.2 Simple and Compound Interest

3.3 Time, Speed and Distance

3.4 Time & Work 3.5 Ratio and Proportion 3.6 Area
Unit-IV: Logical Reasoning (Deductive Reasoning): (10 periods) 4.1. Analogy 4.2. Blood Relation 4.3 Directional Sense 4.4. Number and Letter Series 4.5. Coding – Decoding 4.6. Calendars 4.7. Clocks 4.8. Venn Diagrams 4.9. Seating Arrangement 4.10. Syllogism 4.11. Mathematical Operations
Unit-V: Data Interpretation **(10 periods)** 5.1. Data Interpretation 5.2. Tables 5.3. Column Graphs 5.4. Bar Graphs 5.5. Line Charts 5.6. Pie Chart 3.7. Venn Diagrams.

Reference books:

1. A Modern Approach To Verbal & Non Verbal Reasoning By R S Agarwal

2. Analytical and Logical reasoning By Sijwali B S

3. Quantitative aptitude for Competitive examination By R S Agarwal

NBT107T: Presentation Skill

Paper: VSC
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

Unit-I: : Communication Skills (10 periods) Communication Skills: The Communication Process, Elements of Interpersonal Communication, Non-Verbal Communication: Body Language, Posture, Eye Contact, Smile, Tone of Voice, Barriers to Communication. Effective Listening Skills: Active Listening, Passive Listening, Asking Questions, Empathizing, Being Non-Judgmental, Being Open Minded, Mass Communication: Design of Posters, Advertisements, notices, writing formal and informal invitations
Unit-II: Presentation (10 periods) Focus on Audience Needs, focus on the Core Message, Use Body Language and Voice, Start Strongly, Organizing Ideas& Using Visual Aids:
Unit-III: Model and Ruls (05 periods) SPAM Model, Effective Opening and Closing Techniques, GuyKawasaki'sRule Overcoming Stage Fear, Story Telling
Unit-IV: Group Discussion (10 periods) Group Discussion: Understanding GD, Evaluation Criteria, Nine Essential Qualities for Success, Positive and Negative Roles, Mind Mapping, structuring Response, Methods of Generating Fresh Idea
Unit-V: Data Interpretation **(10 periods)** Data Interpretation: Interpretation and analysis of data in Tables, Case lets, Line-graphs, Pie-graphs, Boxplots, Scatterplots and Data Sufficiency

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay

2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMSetc

Curriculum of Semester –II

B.Sc. Biotechnology Honours (Semester II)

NBT201T: Cell Biology

Paper: DSC-3
Contact Hours: 45 (Clock Hours)

Total Credit: 03
Marks: 30

Unit1. Cell Structure and organelles

Cell theory Organization :Origin of eukaryotic cells-endosymbiotic theory,. Overview of cell specializations: Plants-epidermis,vascular tissue and cortex, Animals-epithelia,connective tissue, nervous tissue, muscle, blood, germ cells and sensory cells. Structure and Functions of Organelles

Unit II. Membrane Structure

Membrane models -Overton's lipid nature of membrane, Langmuir's lipid monolayer, Davson and Danielli's lipid bilayer plus protein sheet, Robertson's Unit membrane, Singer and Nicolson's fluid mosaic. Membrane structure-2D Lipid bilayer, composition of lipid bilayer, asymmetric nature, fluidity, membrane proteins and their function.

Unit III. Cell Division and Cell Cycle

Mitosis, Meiosis, and Cytokinesis, role of protein kinases and Cyclin-Cdk-complex in controlling cell cycle, control of cell proliferation in multicellular organisms, programmed cell death

Unit IV: Cell Communication and Cell Signalling

Cellular Communication and Cell signaling: general principles of cell communication, , cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins,Neurotransmissions and its regulation, Hormones and their receptors, cell surface receptor, G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

References:

1. Cell Biology by -Sadava
2. Molecular Cell Biology, Lodishet al.,FreemanandCompany,NewYork,1999
3. Essential Cell Biology -An introduction to the molecular Biology of thec ell-Alberts,Bray,Johnson,Lewis,Raff,Roberts,Walter,GarlandPublishing.
4. Molecular Biology of the cell-BruceAlberts,GarlandPublishingInc.

5. Cell Biology-Ashortcourse,Secondedition,StephenR.Bolsover,WielyPublication
6. Genes XI-BenjaminLewin,PrenticeHallPublication
7. An introduction to Practical Biochemistry- David T Plummer, Tata McGraw-HillEdition
8. Developmental Biology,Ninthedition,S.F.Gilbert,SinauerAssociatesInc.

NBT201P: Lab Based on Cell Biology

Paper: DSC-3 Total Credit: 02

Marks :50

1. Demonstration of golgi body, endoplasmic reticulum, peroxisomes (Permanent preparations)
2. Studies on various stages of Mitosis and
3. Studies on various stages of Meiosis
4. Studies on Plasmoptysis and Plasmolysis
5. Transport across membrane
6. Effect of detergent on permeability of membrane

NBT201T: Fundamentals of Genetics

Paper: DSC-4 Total Credit: 03
Contact Hours: 45 (Clock Hours) Marks: 30

Unit I :Chromosomal Abberations

Mutation: spontaneous, replica plating, fluctuation test, induced mutation: physical, chemical and biological. UV and gamma ray induced mutation, base substitution analogue, hydroxyl amine, nitrous acid, acridine dyes mediated mutations. Mutations by transposition.

Unit II :Safe Guarding principles

Choice of restriction and modification within cell, type I, type II and type III restriction enzymes. UV repair, Photoreactivation, post replication repair and SOS repair system. Homologous: general and site specific examples, non homologous recombination.

Unit III :Genetic Code

Codon, degeneracy of codon, amino acids and their codon , wobble hypothesis, unusual amino acids, codon usage, tRNAstucrutre and classes of tRNAsynthetases, charging of tRNA,

Unit IV:Microbial Genetics

Gene transfer methods, Transformation, Conjugation, and Transduction.

References:

1. Principles of genetics : Tamarin, McGrahall
2. Principles of genetics 8th edition, E. J. Gardner, MJ. Simmons and D. P. Snustad.
3. Genetics : 5th edition Strickberger Pearson Publisher, Low Price Edition,
4. General Microbiology: RY Stanier, 6th edition
5. Genes XI, Benjamin Lewin
6. Molecular genetics : An introductory narrative 2nd edition, Gunther S. Stent and R. Calendar, CBS publisher and Distributors, reprint 2004

NBT201P: Lab Based on Fundamentals of Genetics

Paper: DSC-4 Total Credit: 02

Marks :50

1. Spontaneous mutant isolation (Streptomycin resistant)
2. UV induced mutations (Streptomycin resistant)
3. Mutations induced by chemical mutagen (Nitrous acid, hydroxyl amine, acridine dyes)
4. Fluctuation test analysis
5. Replica plate analysis
6. Transformation
7. Conjugation
8. transduction

NBT203T1: Agricultural Biotechnology

Paper: Minar-2
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

Unit1

Introduction to Agricultural biotechnology. Microbes of agricultural importance : Prokaryotes: Bacteria, Cyanobacteria and viruses-general form, growth and reproduction. Culture of bacteria and viruses; identification of auxotrophic mutants for genetic analysis. Eukaryotes: Protozoa, Nematodes, Algae and Fungi. Outline classification of algae and fungi to serve as a key for identifying taxonomic status of agriculturally important genera. General form and different model reproductive cycles in the three groups

Unit II

Crop improvement hybridization and plant breeding techniques. Micropropagation and plant tissue culture technique and its application in agriculture.Somatic hybridization, haploid production and cryopreservation. Study of biopesticides used in agriculture (neem as example). integrated pest management.

Unit III

Microbe based biofertilizers: Cyanobacterial biofertilizers. Azolla and Anabena symbiotic association. Bacteria (Rhizobium) biofertilizers, Fungal (Mycorhiza) bio-fertilizers. Nitrogen fixation-asymbiotic and symbiotic, nodule formation.

Unit IV

Genetics and biochemistry of nitrogen fixation. Nif genes. Transfer of nif genes. Soil microbes releasing plant growth substances. Use of plant growth regulators in agriculture and horticulture.

References Books:

1. Y.P.S. Bajaj: Biotechnology in Agriculture and forestry, Vol. 22 Springer Verlas.
2. Biotechnology in Agriculture, Mac Millon India Ltd., 1992, Edn.
M.S.Swaminath.
3. Trends in Agricultural insect pest management, G.S. Dhaliwel & Ramesh Arora

Bio-router of plant diseases, K.G. Mukherji & K.L. Gang, C.B.S. Purnachand distribution (1980).

4. S.S. Purohit: Agricultural Biotechnology (2003) Agribion India.

5. R.S. Mehrote: Plant Pathology Tata Mc Graw Hill (1980).

6. Winnacker : From Genes to clones Panima Publishing Corporation (2003).

NBT203T2: Biostatistics

Paper: Minar-2 Total Credit: 02
Contact Hours: 30 (Clock Hours) Marks: 30

Unit I: Sampling, Data Collection and Presentation

Introduction to Biostatistics, Common Terms and Notations, Applications. Sampling: Representative Sample, Sample Size, Sampling Bias and Sampling techniques.

Unit II :Data Collection and Presentation:

Type of Data, Method of Collection of Primary and Secondary Data, Methods of Data Presentation, Graphical Representation by Histogram, Polygon, Ogive Curve, Pie Diagram.

Unit III : Central Tendency

Measure of Central Tendency: Mean, mode, median Measure of Variability : Standard Deviation, Standard Error Range ,Mean Deviation, Coefficient of Variation, Correlation Coefficient and Regression (Positive & Negative),Calculation of Correlation Coefficient & Regration Coefficient , Linear Regression and Regression Equation, ANOVA: One and Two Way Classification

Unit IV: Test of Significance & Computer based statistical techniques:

Test of Significance : F-test , Z-test .T-test and Chi-Square ,Probability Distribution : Binomial,Poison and Normal Distributions. Computer based statistical techniques: Frequency Table of Single Discrete Variable , Bubble Sort , Computation of Mean , Variance and Standard Deviation, T-test , Correlation Coefficient

References :

1. B.K Mahajan method in Biostatistics Jaypee brother medical pulisher Ltd india .
2. Richard ah Introduction to Biostatistics prentice hall of biostat
3. Campbell R.C Statistics for biologist, Cambridge University Press,Cambridge
4. Wardlaw,A.C.(1985) Practical Statistics for experimental Biologists
5. Baily N.T.J. Statistical methods in Biology English University press
6. P.S.S. Sunderrao & J.Richard An Introduction to Biostatistics Prentice hall of India pvt.ltd.
7. Khan, Fundementals of Biostatistics
8. B.K. Mahajan Methods in Biostatistics, Jaypee brothers medical publisher ltd,India
9. Robert sokal and James Rohlf Introduction to Biostatistics W.H. Freeman Press

NBT203T3: Basic Virology

Paper: Minar-2 Total Credit: 02
Contact Hours: 30 (Clock Hours) Marks: 30

Unit I: Fundamental concepts in Virology

History and principles of virology, molecular biology of bacterial virus, viral classification, nomenclature,taxonomy; viral strategies for attachment and entry, different strategies for viral replication - the Baltimore Classification System; Basic immune response to viral infection, general virus pathogenesis; virus structure and morphology

Unit II: Cultivation of Viruses

Cultivation and purification of viruses: Different in vivo, in vitro and in ovo growth systems for bacterial, plant and animal viruses, determination of yields; Purification of viruses using ultracentrifugation technique.

Unit III: Virological Methods

Immunological techniques: Immunodiagnosis, haemagglutination and haemagglutination inhibition assays, complement fixation, neutralization, western blot, radio-immunoprecipitation (RIPA) assay, single radial immunodiffusion (SRID) assay, flow-cytometry, immunohistochemistry (IHC), immunofluorescence assay (IFA).

Unit IV: Viral diagnostics

Nucleic acid based techniques: Nucleic acid hybridization, PCR, microarray and sequencing.Microscopic techniques: Fluorescence, confocal and electron microscopic techniques—principles and applications Analytical techniques: Chromatography techniques, membrane filtration, NMR, X-ray Crystallography. Emerging techniques in viral diagnostics

Reference Book

1) E. K. Wagner, et al., Basic Virology, Wiley, 2007, 3rd edition

2) T. Shores, Understanding Viruses, Jones and Bartlett, 2009, 1st edition

3) J. S. Flint, et al., Principles of Virology: Molecular Biology, Pathogenesis, and Control,American Society for Microbiology, 2009

4. D. M. Knipe and P. M. Howley, Fields Virology, Lippincott Williams & Wilkins, 2013, 6th edition

NBT204T1: Biomolecules II

Paper: Generic
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

Unit I :Carbohydrates

Structure of monosccharides, steroisomerism and optical isomeris of sugars. Structure, occurrence and biological importance of monosaccharides, oligosaccharides, and polysaccharides e. g. cellulose, chitin, agar, algenic acids, pectins, proteoglycans, sialic acids, blood group polysaccharides, glycogen and starch. Bacterial cell wall polysaccharides and glycoproteins

Unit II: Lipids

Definition and classification. Fatty acids: introduction, classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids, prostaglandins.Triacylglycerols: nonmenclature, physical properties, chemical properties and characterization of fats –hydrolysis, saponification value, rancidity of fats, ReichertMeissel number and reaction of glycerol. Biological sifnificance of fats.Glycerophospholipids (lecithins, lysolecithins, cephalins, phsophatidyl serine, phosphatidyl inositol, polasmalogens), sphingomyelins, glyolipids –cerebrosides, gangliosides.Properties and functions of phospholipids, isoprenoids and sterols.

Unit III :Proteins

Amino acids: Classification and properties.

Peptides; structure of peptide bond, chemical synthesis of polypeptides –protection and deprotection of N-terminal, and C-terminal ends and functional groups in the side chains, formation of peptide bonds, condensing agents, strategy of chemical synthesis, Merrfield solid-phase peptide synthesis. Determination of the amino acid sequence of a polypeptide chain, specific chemical and enzymatic cleavage of a polypeptide chains and separation of peptides. Protein structure: primary structure of proteins, secondary structure of proteins, -helix and pleated sheets, tertiary structure of proteins, forces stabilizing the tertiary structure and quaternary structure of proteins. Denaturation and renaturation of proteins.

Unit IV: Hormones :

Classification of hormones, Endocrine glands, basic mechanism of hormone action, neuroendocrine regulation [TSH,T3 ,T4,] Pitutary gland secreted hormone :Prolactin;Gonadotrophin releasing hormone:LH; role of hormones in reproduction (Estrogen,

Testesteron, hCG, FSH,LH), control of fertility(Prolactin, Progesteron, FSH, LH), gametogenesis, human growth hormones,hormonal disorders Thyroiditis hypothyroidism,

References:

1. Cohn & Stump – Outline of Biochemistry Wiley Eastern Ltd.
2. L. Lehninger, D. L. Nelson & M M Cox – Principles of Biochemistry.
3. LubertStryer – Biochemistry
4. J. Jayraman- Practical Biochemistry
5. Plummer. –Practical Biochemistry
6. A.C.DebFundementals of biochemistry
7. Zuby - Biochemistry 4th edition
8. Boyer- Concepts in Biochemistry
9. Cooper -The tools of Biochemistry
10. Biochemistry- U Satyanaran

NBT204T2: Microbial Physiology

Paper: Generic
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

Unit I :Microbial Growth

Growth curve, quantification of growth –direct/indirect, Arithmatic, continuous and synchronous growth

Unit II:Transport of Nutrients

Uptake of Nutrient,Passivediffusion,facilateddiffusion,active transport (ABC transporters) ,simple transport(Uniport,symport,andantiport.) group translocation and protein export system.

Unit II:Microbial Differentiation

Bacterial sporulation, stages and biochemical changes during sporulation and germination of spore, Typical Structure of spore.

Unit III :Microbial toxins and stress response

types of toxin, Shiga toxin, toxins from *E. coli*, cholera toxin, Staphylococcal toxin, spectic shock, botulism. Heat shock and cold schock, stress during prolonged stationary phase and other environmental conditions.

References:

1. R. Y. Stanier 6th Edition, General Microbiology, McMillan Press. Inc.
2. Pelczar Microbiology, TMH publication
3. Anantnarayan text book of Microbiology 9th edition, Orient Longman Delhi
4. Cappucinno Microbiology; a laboratory manual 4th edition
5. Toratora Microbiology: An introduction
6. Salle A. J. Fundamental Principles of Bacteriology
7. Prescott Microbiology
8. Rose Chemical Microbiology
9. Cruickshank, Duguid Medical Microbiology

NBT204T3: Basic Bioinformatics

Paper: Generic
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

Unit 1:

Introduction to bioinformatics and data generation Bioinformatics and its relation with molecular biology. Examples of related tools (FASTA, BLAST, BLAT, RASMOL),databases(GENBANK, Pubmed, PDB) and software(RASMOL,Ligand Explorer).

Unit 2:

Biological Database and its Types Introduction to data types and Source. Population and sample, Classification and Presentation of Data. Quality of data, private and public data sources. General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genomedatabases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum)

Unit 3:

Data storage and retrieval and Interoperability Flat files, relational, object oriented databases and controlled vocabularies. File Format (Genbank, DDBJ, FASTA, PDB, SwissProt). Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search. The challenges of data exchange and integration. Ontologies, interchange languages and standardization efforts. General Introduction to XML, UMLS, CORBA, PYTHON and OMG/LIFESCIENCE.

Unit 4:

Sequence Alignments and Visualization Introduction to Sequences, alignments and Dynamic Programming; Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm). Methods for presenting large quantities of biological data: sequence viewers (Artemis, SeqVISTA), 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol), Anatomical visualization

Suggested Readings

1. Teresa K Attwood and David J. Parry-Smith, Introduction to Bioinformatics, Pearson

Education Asia, 2001

2. Bexavanis & Francis, Bioinformatics-A practical guide to the analysis of genes and proteins, John Wiley and Sons, 2001

3. Rushidi, Basics of Bioinformatics, CRC Publications, 2001

4. Irfan Khan and Atiya Khanum, Emerging trends in Bioinformatics, Ukaaz Publishers, 2002

5. David M. Hill, Craig Martiz and Barke Mable, Molecular systematics

6. Khan Imtiyaz alam ,Rai University, Hydrabad:- Elementry Bioinformatics

7. N. Gautam Bioinformatics- Databases and algorithm

8. Bioinformatics: Sequence and Genome Analysis by D.W. Mount, 2001, Cold Spring Harbor Laboratory Press.

NBT205P1: Lab Based on Biomolecules II

Paper: SEC Total Credit: 02

Marks :50

1. Qualitative/ Quantitative test: demonstration of reducing sugar
2. Qualitative/quantitative test :demonstration of non-reducing sugar
3. Demonstration of starch hydrolysis
4. Sugar estimation
5. Demonstration of rancidity
6. Demonstration of saponification
7. Qualitative test for detection of proteins and amino acids both: purified and natural sources
8. Protein Estimation

NBT205P2: Lab Based on Microbial Physiology

Paper: SEC Total Credit: 02

Marks :50

1. Growth curve –optical density method
2. Standard plate count
3. Total viable count (samples from prolonged stationary phase of growth curve experiment)
4. Arithmetic growth
5. Synchronous culture
6. Demonstration of sporulation
7. Spore staining

NBT205P2: Lab Based on Basic Bioinformatics

Paper: SEC

Total Credit: 02

Marks :50

1. Introduction to NCBI
2. Retritivig the DNA Sequences
3. Retritivig the DNA Sequences
4. Retrieval of a Genbank Entry using an accession number
5. Primary structure analysis of a protein
6. finding the official Symbol, alias name, chromosome number and ID for gene using NCB
7. Similarity Search using BLAST

NBT206T: Web Designing

Paper: VSC
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

UNIT-1: Introduction to Web Designing: (10 period)
Web page, Website, Web browser, www, Developing web Documents-Web design process, and Publishing documents: Web publishing. Maintaining documents: maintenance phases of web page

UNIT-2: HTML Introduction: (10 period)
HTML Markup tags: Tags-Definition, Basic Tags-HTML, HEAD, TITLE, BODY. Paragraph Tags, List tags, Horizontal Rule Tag, Headings Tags, Block quote Tags, Address Tags, FONT Tag, PRE tag, DIV tags, SPAN tag& other different formatting tags.

UNIT-3: Linking and Image tag in HTML:: **(10 period)**
Linking in HTML: U.R.L. concept, Hyperlink (Anchor) Tag & it's all attributes, Creating Email Hyperlinks (using mailto anchor).
Images in HTML:
Introduction: Image & image formats, <img> tag& it's all attributes, Inline & Floating Images, Using Images as links

UNIT-4: Tables in HTML (10 period)
Tables in HTML: Introduction, Table Tags:- TABLE, TR, TH, TD & all Attributes, Row span, Cols pan, Cell spacing, Cell padding, Table examples

UNIT-5: Forms in HTML: (05 period)
Introduction to forms, FORM tag& it's attributes (Action, Enctype, Method, Name), Simple form examples, Form controls: Text Field, Password Field, Multiline Text Area, Drop, Down List, Check Box, Radio Buttons, Scrolled List, Reset Button, Submit button.

Reference Books:

1. Thommas A Powel, "The complete Reference (HTML & XHTML)", 4th Edition (Tata McGraw Hill publication.)

2. HTML completes 2nd Edition-BPB Publication

NBT206T: Personality Development and Interview Techniques

Paper: VOC-2
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

UNIT-1: Introduction (10 period)
Introducing the connect with work programme
What is in it for me? Understanding the objective of the CWW programme

UNIT-2: Interview Skills (SEO) (10 period)
Interview Skills :Online Image Building a strong impression online and sustaining online credibility
Self-Awareness :To Know your personality through an MBTI ,Grooming To study corporate grooming habits (The right attire) ,
Body Language :To imbibe the right body language for a professional environment ,**Confidence:** To increase self-belief and faith in one's own abilities Interview FAQs Learn to face frequently asked interview questions
Resume: To build a strong profiles through effective resume writing
Rejections: To understand how to handle interview rejections and come back from set-backs

UNIT-3: Corporate Readiness (10 period)
Corporate Readiness
Values: An introduction to values in a corporate environment
Ownership: To learn how to be accountable and own tasks, projects etc.
Respect: To understand the importance of respect as a critical corporate value
Teamwork: To understand collaboration and its importance in the corporate world
Autodidactism: To leverage self-learning and self-directed education
Flexibility: To learn how to be flexible while playing multiple roles
Time Management: To improve effectiveness at work and achieve a balance
Stress Management: To understand how stress can be managed and to lower depression
Positive Attitude: To take the step towards positive success by adapting the right approach
LinkedIn (Profile Management): To gain knowledge on LinkedIn account management and tips to enhance a profile
SWOT Analysis: To Self evaluate and analyze strengths and areas of improvement

UNIT-4: Group Discussions (10 period)
Group Discussions: Group Discussion rules and enhance Public Speaking skills (Group Discussion)
Demo session of group discussion.

UNIT-5: Mock Interviews (05 period)
Mock Interviews: Tips to handle Interviews and be able to create the right impression (Mock Interviews)
Demo session of mock interview.

Reference Books

1."Personality Development and Soft Skills" by Barun Mitra
2."Personality Development" by Swami Vivekananda
3."The Power of your Subconscious Mind" by Joseph Murphy
4."50 Mantra's of Personality Development" by Aarti Gurav
5."Personality Development for Students" by Dr Vijay Agrawal

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