



आईएफटीएम विश्वविद्यालय, मुरादाबाद, उत्तर प्रदेश

IFTM University, Moradabad, Uttar Pradesh

NAAC ACCREDITED

SCHOOL OF BIOTECHNOLOGY

**BACHELOR OF SCIENCE
(BIOTECHNOLOGY)**

[III YEAR PROGRAMME]

**NEP2020/CHOICE BASED CREDIT SYSTEM (CBCS)
COURSE STRUCTURE AND SYLLABUS**

**[Applicable w.e.f Academic Session: 2022-23]
[As per CBCS guidelines given by UGC]**

IFTM UNIVERSITY

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SCHOOL OF BIOTECHNOLOGY

Study and Evaluation Scheme

of

Bachelor of Science

(Biotechnology)

Choice Based Credit System (CBCS)

[Applicable w.e.f Academic Session: 2022-23]

[As per CBCS guidelines given by UGC]

Summary

Programme:	Bachelor of Science (Biotechnology)
Programme Level:	Degree (Under Graduation)
Duration:	Three years (Six Semesters) Fulltime
Medium of Instruction:	English
Minimum Required Attendance:	75%
Maximum Credits:	146

IFTM University, Moradabad

Bachelor of Science (Biotechnology)

Preamble

The twenty-first century is known as the "Century of Biotechnology". Biotechnology is one of the newest branches of Life Science, having grown and established itself as an advanced interdisciplinary applied science in recent years. Biotechnology, at its core, envisions the comprehensive study of Life, and the Interdisciplinary potential of Biotechnology has resulted in a unique status for Biotechnology in Research and Industry. The socio-economic potential of biotechnology is well established. The applied aspect of biotechnology is now becoming established, with applications in industry, agriculture, health, and the environment. Biotechnology is the leading science that is expanding exponentially.

School of Biotechnology, IFTM University offers **B.Sc. (Biotechnology)** to establish the Industry and Research sectors in biotechnology, trained and skilled human resources are required. The field is new and expanding, necessitating investments in infrastructure and technology. The global and local emphasis on developing new technological applications is rapidly expanding. The demand for skilled workers in biotechnology is increasing in both the fundamental research and industrial sectors. Academic and research sectors, too, require interdisciplinary trained personnel to advance the Biotechnology Revolution.

The need of the hour is to create appropriate syllabi that keep up with changing times and technology, emphasizing applications while delving deeply into technology.

Considering this B.Sc. Biotechnology CBCS (2022-23) program is designed to anticipate the future needs of the biotechnology sector, with a greater emphasis on imparting hands-on skills. The primary emphasis is on making the curriculum compatible with developments in the education, research, and industrial sectors. The Uniqueness of the course is having industrial training along with Core Courses, Generic Elective, Ability Enhancement Compulsory Course and Discipline Specific Elective.

Programme Objectives: The program aims to achieve the following objectives:

- To make the students knowledgeable with respect to the subject and its practicable applicability.
- To promote understanding of basic and advanced concepts in Biotechnology.
- To expose the students to various emerging areas of Biotechnology.
- To prepare students for further studies, helping in their bright career in the subject.
- To expose the students to different processes used in industries and in research field.
- To prepare the students to accept the challenges in life sciences.
- To develop skills required in various industries, research labs and in the field of human health.

Following Program Outcomes will be achieved:

PO1- Fundamental understanding: To enrich knowledge and train in basic concepts of Basic Sciences and various branches of Biotechnology such as genetics, molecular biology, biochemistry, immunology, fermentation technology, environmental biotechnology and tissue culture techniques.

PO2- Interdisciplinary approach: Analyze the relationships among animals, plants, microbes, environment and Industry.

PO3- Practical learning: Perform procedures as per laboratory standards in the areas of Biochemistry, Bioinformatics, molecular biology, immunology, industrial biotechnology and fermentation technology.

PO4- Technical Ability: Acquaint with the knowledge of different techniques and their principles along with working of the instruments for research and diagnostic applications.

PO5- Analytical opinion: Perceive things and the events that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) in the light of scientific principal.

PO6- Effective Communication: Speak, read, write and listen clearly in person and through different communication medium in English. Social Interaction, elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO7- Ethics and Rights: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO8- Environment and Sustainability: Understand the issues of environmental deterioration, pollution and sustainable development. Developing critical problem-solving approach for these societal concerns via bioremediation and integrated management.

PO9- Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PO10- Contemporary Problem worldwide: Awareness of contemporary issues that can be mitigated or supported through life science know how and biotechnology skills

1. Eligibility

a. **Admission Criteria:** Admission to this undergraduate course shall be carried out through merit.

b. **Qualifying Examination:** 10 + 2 level with Physics, Chemistry and Maths/ Biology.

c. Marks 45% aggregate for general and OBC category and 40 % aggregate for SC/ST category.

2. Curriculum: B.Sc. courses shall be based on semester system which will be of three years duration, divided into three sessions and six semesters. Each session shall be of two semesters, Session- I shall comprise of two semesters i.e., semester-I and semester-II; Session-II shall comprise of two semesters i.e., semester-III and semester-IV; Session- III shall comprise of two semesters i.e., semester-V and semester-VI. The academic will follow the pattern as mentioned below:

Academic Calendar	Classes
I, III and V Semester	August to December
II, IV and VI Semester	January to May
Summer Vacation	June and July

3. Cancellation of Admission: If a student at any stage is found to have concealed any information or have furnished false documents or found to be indulged in gross indiscipline/ misconduct, his/ her admission shall be cancelled and fee deposited by the student shall not be refunded in any case.

Evaluation of Performance

- 1. Programme:** Evaluation of performance of the students in a programme shall be a continuous process based on their performance in the class test, quizzes, assignments and the end semester examinations.
 - a. Theory papers in semester system (Maximum Marks: 100)**

The evaluation will be done through two class test and one end semester examination. This will be in addition to quizzes, assignments, attendance, etc. Each class test will carry a weightage of 10 marks, and the end semester examination will carry a weightage of 70 marks. The remaining 10 marks will be awarded on the basis of attendance and performance in quizzes and assignments.
 - b. Practical in semester system (Maximum Marks: 100)**

In each practical, the student will be required to carry out the number of experiments as specified in the syllabus. Each practical conducted will be assessed by the teacher based on the experiment done during the lab, submission of the practical file, and understanding of the experiment done, which will carry a weightage of 30 marks. There shall be an end semester practical examination with or without an external examiner which will carry a weightage of 70 marks.
- 2. Summer Training, Project, Dissertation, Seminar etc.:** Summer Training, Project, Seminar, Dissertation, and other learning-oriented activities shall have associated maximum marks and credits, as stated in the syllabus.
- 3. Examination:**
 - a.** The minimum Grade required to pass in each Theory & Practical paper is 'GRADE D'.
 - b.** A candidate, in order to pass, minimum CGPA of 4.50 is required in a particular academic year inclusive of both semesters of that academic. And maximum numbers of Carryover paper permissible for promotion to next academic year are 06 theory / practical / project papers.
 - c.** There shall be no minimum Grade required to pass in General Proficiency (GP). However, Grade obtained in General Proficiency (GP) shall be included in SGPA.
 - d.** In case of audit paper, the minimum Grade required to pass is Grade D. However, the Grade obtained in audit paper shall not be included in SGPA.

Groups of CBCS:

The 09 groups of courses have been identified to provide student comprehensive exposure to a large number of areas, leading to the holistic development of an individual. These groups / clusters are as follows:

1. Core Courses Theory (CC-T)
2. Core Courses Practical (CC-P)
3. Discipline Specific Elective (DSE)
4. Generic Elective (GE)
5. Ability Enhancement Compulsory Courses (AECC)
6. Skill Enhancement Courses (SEC)
7. Qualifying paper/MOOCs/NPTEL/Mandatory Course/ Value Added Course (VAC)/ Audit Paper
8. Summer Training Project Report *Viva voce* (STPR)
9. General Proficiency (GP)

1. Core Courses Theory (CC-T):

Core courses of B.Sc. Program will provide a holistic approach to biotechnology graduates, giving them an overview of the field, a basis to build and specialize upon. These core courses are the strong foundation to establish technical knowledge and provide broad multi-disciplined knowledge can be studied further in depth during the elective phase.

The core courses will provide more practical-based knowledge. It will train the students to analyze, decide, and lead-rather than merely know-while creating a common student experience that can foster deep understanding of the subject. A wide range of core courses provides groundwork in the field of Animal and Plant Sciences Microbiology, Genetics, Molecular Biology, Biochemistry etc.

We offer core courses in semester I, II, III, IV, V, VI, during the B.Sc. Biotechnology. There will be 4 credits for each core course offered depending upon the course content.

2. Core Courses Practical (CC-P):

These courses includes various laboratories designed to provide the student solid foundation to the domain of Biotechnology. These courses are of 1 credit each.

3. Discipline Specific Elective (DSE):

- i. Elective courses may be offered by the main discipline of study is referred to as Discipline Specific Elective. The University offer discipline related Elective courses of interdisciplinary nature like Recombinant DNA Technology, Biodiversity & Systematics, and Animal Biotechnology etc. There will be 4 credits for each Discipline Specific Elective course offered depending upon the course content.
- ii. Project with a department faculty. It is the exploration of a specific topic within a field by an undergraduate student that makes an original contribution to the discipline

4. Generic Elective (GE):

An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. This can be a core course offered in a discipline/subject which may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective. These courses include science courses from the disciplines of Physics Chemistry and Statistics, Dairy

Microbiology. These courses are of 4 credits each.

5. Ability Enhancement Compulsory Course (AECC):

These courses are actually Ability Enhancement Course (AEC) which is designed to develop the ability of students in communication (especially English) and other related courses where they might find it difficult to communicate at a higher level in their prospective job at a later stage due to lack of practice and exposure in the language etc. Students are motivated to learn the theories, fundamentals and tools of communication which can help them develop and sustain in the corporate environment and culture. These courses are of 4 credits each.

6. Skill Enhancement Courses (SEC):

These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge. Courses like Modern Analytical Techniques, Industrial Biotechnology, IPR in Biotechnology etc. will provide skill based technical knowledge for working in special units in industries and to develop them as entrepreneur. These courses are of 4 credits each

7. Qualifying paper/MOOCs/NPTEL/Mandatory Course/ Value Added Course (VAC)/ Audit Paper:

A Value-Added Course is an on-credit course which is basically meant to enhance general ability of students in areas like soft skills, quantitative aptitude and reasoning ability - required for the overall development of a student and at the same time crucial for industry/corporate demands and requirements. The student possessing these skills will definitely develop acumen to perform well during the recruitment process of any premier organization and will have the desired confidence to face the interview. Moreover, these skills are also essential in day-to-day life of the corporate world. The aim is to nurture every student for making effective communication, developing aptitude and a general reasoning ability for a better performance, as desired in corporate world. This is recommended for every student to take at least one MOOC Course throughout the programme. Every student completing a MOOC course through only NPTEL.

8. Summer Training Project Report *Viva voce* (STPR):

The students, who take up experiential projects in companies, where senior executives with a stake in teaching guide them, drive the learning. All students are encouraged to do some live project other than their regular classes. It is essential to give students hand-on exposure and experience of how things and processes work in industries. This enhances students' exposure to practical learning.

9. General proficiency (GP):

These courses are designed to develop the ability of students in communication and other related courses where they might find it difficult to communicate at a higher level in their prospective job at a later stage due to lack of practice and exposure in the language etc.

Summary of Credits

B.Sc. Biotechnology: Three Years (6 Semester) CBCS Program			
Basic Structure: Distribution of Courses			
S. No.	Types of Course	Credit	Total Credits
1.	Core Course-Theory (CC-T)	14 Courses of 4 Credits each (Total Credit 14X4)	56
	Core Course-Practical (CC-P)	14 Courses of 1 Credit each (Total Credit 14X1)	14
2.	Discipline Specific Elective-Theory (DSE-T)	5 Courses of 4 Credits each (Total Credit 5X4)	20
	Discipline Specific Elective-Practical (DSE-P)	1 Course of 3 Credits (Total Credit 1X3)	3
3.	Generic Elective (GE)	4 Courses of 4 Credits each (Total Credit 4X4)	16
4.	Ability Enhancement Compulsory Course (AECC)	3 Courses of 4 Credits each (Total Credit 3X4)	12
5.	Skill Enhancement Courses (SEC)	4 Courses of 4 Credits each (Total Credit 4X4)	16
6.	Qualifying Paper/MOOCs/ NPTEL / Mandatory Course /Value added courses (VAC)/Audit Paper	1 Course of 0 Credit (Total Credit 1X0)	0
17.	Summer Training Project Report <i>Viva voce</i> (STPR)	1 Course of 3 Credits (Total Credit 1X3)	3
8.	General Proficiency (GP)	6 Courses of 1 Credit (Total Credit 1x1)	6
TOTAL			146

**IFTM UNIVERSITY, MORADABAD
SCHOOL OF BIOTECHNOLOGY**

Year Wise Course Structure

B.Sc. (Biotechnology) First Year

Semester I							
S. No.	Subject Description	Subject Code	Subject Title (Theory/ Practical)	Credits (C) (L+T+P)	Continuous Internal Evaluation (CIE)	University Exam (UE)	Maximum Marks (MM)
1.	Subject -1 (Major) From own faculty	B100101T	Cell Biology & Genetics	04 (03+01+0)	25	75	100
		B100102P	Cell Biology & Genetics Lab	02 (0+0+02)	25	75	100
2.	Subject -2 (Major) From own faculty	B093101T	Animal Science	04 (03+01+0)	25	75	100
		B093101P	Animals Science Lab	02 (0+0+02)	25	75	100
3.	Subject-3 (Major) Any Faculty	B093102T	Plant Science	04 (03+01+0)	25	75	100
		B093102P	Plant Science Lab	02 (0+0+02)	25	75	100
4.	Subject-4 (Minor/ Elective) Other Faculty	B093103T	Chemistry I	04 (03+01+0)	25	75	100
5.	Vocational (Minor) Vocational faculty	A190101T	Foundations of Library and Information Science	03 (03+0+0)	25	75	100
6.	Co-Curricular Course (Minor)	Z010101T	Food, Nutrition and Hygiene	02 (02+0+0)	25	75	100
Total Credits				27	225	675	900

IFTM UNIVERSITY, MORADABAD
SCHOOL OF BIOTECHNOLOGY
Year Wise Course Structure

B.Sc. (Biotechnology) First Year

Semester II							
S. No.	Subject Description	Subject Code	Subject Title (Theory/Practical)	Credits (C) (L+T+P)	Continuous Internal Evaluation (CIE)	University Exam (UE)	Maximum Marks (MM)
1	Subject -1 (Major) From own faculty	B100201T	Molecular Biology & Genetic Engineering	04 (03+01+0)	25	75	100
		B100202P	Genetic Engineering Lab	02 (0+0+02)	25	75	100
2	Subject -2 (Major) From own faculty	B093201T	Elementary Biology	04 (03+01+0)	25	75	100
		B093201P	Experiments in Elementary Biology	02 (0+0+02)	25	75	100
3.	Subject-3 (Major) Any Faculty	B093202T	Chemistry II	04 (03+01+0)	25	75	100
		B093202P	Chemistry II Lab	02 (0+0+02)	25	75	100
4	Subject-4 (Minor/ Elective) Other Faculty	B093203T	Fundamentals of Computers	04 (03+01+0)	25	75	100
5	Vocational (Minor) Vocational faculty	A270101T	Basics of Mass Communication and Journalism	03 (03+0+0)	25	75	100
6	Co-Curricular Course	Z020201	First aid and health	02 (02+0+0)	25	75	100
Total Credits				27	225	675	900

School of Biotechnology
Programme: Bachelor of Science (Biotechnology)
CHOICE BASED CREDIT SYSTEM
Effective from Session 2022-23

Course Code	CBCS BASKET	Credits			
Core Courses- Theory (CC-T)		L	T	P	C
BSB301T	Introduction to Microbiology	3	1	0	4
BSB302T	Enzymology	3	1	0	4
BSB401T	Basics of Immunology	3	1	0	4
BSB402T	Cell & Molecular biology	3	1	0	4
Core Courses-Practical (CC-P)		L	T	P	C
BSB301P	Introduction to Microbiology Lab	0	0	2	1
BSB302P	Enzymology Lab	0	0	2	1
BSB401P	Basics of Immunology Lab	0	0	2	1
BSB402P	Cell & Molecular biology Lab	0	0	2	1
Discipline Specific Elective-Theory (DSE-T)		L	T	P	C
BSB304T	Biodiversity and Systematics	3	1	0	4
BSB303T	Genetics	3	1	0	4
BSB403T	Recombinant DNA Technology	3	1	0	4
Discipline Specific Elective-Practical (DSE-P)		L	T	P	C
Generic Elective (GE)		L	T	P	C
BSB404T	Plant Physiology	3	1	0	4
Ability Enhancement Compulsory Course (AECC)		L	T	P	C
Skill Enhancement Courses (SEC)		L	T	P	C
BSB305T	Modern Analytical Techniques	3	1	0	4
BSB405T	Industrial Biotechnology	3	1	0	4
Qualifying Paper (QP)/MOOCs/NPTEL/VAC/ Audit Paper		L	T	P	C
TEHU-301	Disaster Management (Audit Paper*)	-	-	-	-
Summer Training Project Report Viva voce (STPR)		L	T	P	C
BSB503P	Industrial Training (Evaluation and <i>Viva voce</i>)	0	0	3	3
General Proficiency (GP)		L	T	P	C
GP-301	General Proficiency	-	-	-	1
GP-401	General Proficiency	-	-	-	1

IFTM UNIVERSITY, MORADABAD
COURSE STRUCTURE
(CHOICE BASED CREDIT SYSTEM)
B.Sc. (BIOTECHNOLOGY)

SEMESTER: III

S. No.	Category	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
							Mid Term Exam			External Exam		
				L	T	P	CT	AS +AT	Total			
THEORY												
1.	CC-T	BSB301T	Introduction to Microbiology	3	1	0	20	10	30	70	100	4
2.	CC-T	BSB302T	Enzymology	3	1	0	20	10	30	70	100	4
3.	DSE-T	BSB303T	Genetics	3	1	0	20	10	30	70	100	4
4.	GE	BSB304T	Biodiversity and Systematic	3	1	0	20	10	30	70	100	4
5.	SEC	BSB305T	Modern Analytical Techniques	3	1	0	20	10	30	70	100	4
6.	QP	TEHU-301	Disaster Management (Audit Paper)*	3	1	0	20	10	30	70*	100*	-
PRACTICALS / PROJECT												
7.	CC-P	BSB301P	Introduction to Microbiology Lab	0	0	2	-	-	30	70	100	1
8.	CC-P	BSB302P	Enzymology Lab	0	0	2	-	-	30	70	100	1
9.	GP	GP-301	General Proficiency	-	-	-	-	-	100	-	100	1
TOTAL				18	06	04	-	-	340	560	900	23

* Internal Assessment

The Subject (TEHU-301), Disaster Management will be offered as a compulsory audit course and each student has to pass the subject at the minimum by getting 35 marks out of 100.

SEMESTER: IV

S. No.	Category	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
							Mid Term Exam			External Exam		
				L	T	P	CT	AS +AT	Total			
THEORY												
1.	CC-T	BSB401T	Basics of Immunology	3	1	0	20	10	30	70	100	4
2.	CC-T	BSB402T	Cell & Molecular biology	3	1	0	20	10	30	70	100	4
3.	DSE-T	BSB403T	Recombinant DNA Technology	3	1	0	20	10	30	70	100	4
4.	GE	BSB404T	Introductory Biostatistics	3	1	0	20	10	30	70	100	4

5.	SEC	BSB405T	Industrial Biotechnology	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT												
6.	CC-P	BSB401P	Basics of Immunology Lab	0	0	2	-	-	30	70	100	1
7.	CC-P	BSB402P	Cell & Molecular biology Lab	0	0	2	-	-	30	70	100	1
8.	GP	GP-401	General Proficiency	-	-	-	-	-	100	-	100	1
			TOTAL	15	05	04	-	-	310	490	800	23

Note- Industrial Training needs to be done in summer break after semester IV and will be considered for evaluation in semester V

IFTM UNIVERSITY, MORADABAD
COURSE STRUCTURE
(CHOICE BASED CREDIT SYSTEM)
B.Sc. (BIOTECHNOLOGY)
SEMESTER: V

S. No.	Category	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
							Mid Term Exam			External Exam		
				L	T	P	CT	AS +AT	Total			
THEORY												
1.	CC-T	BSB501T	Introductory Bioinformatics	3	1	0	20	10	30	70	100	4
2.	CC-T	BSB502T	Fermentation Technology	3	1	0	20	10	30	70	100	4
3.	DSE-T	BSB503T	Animal Biotechnology	3	1	0	20	10	30	70	100	4
4.	AECC	BSB504T	Food Biotechnology	3	1	0	20	10	30	70	100	4
5.	SEC	BSB505T	IPR in Biotechnology	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT												
6.	CC-P	BSB501P	Introductory Bioinformatics Lab	0	0	2	-	-	30	70	100	1
7.	CC-P	BSB502P	Fermentation Technology Lab	0	0	2	-	-	30	70	100	1
8.	STPR	BSB503P	Industrial Training (Evaluation & Viva voce)	0	0	3	-	-	100	--	100	3
9.	GP	GP-501	General Proficiency	-	-	-	-	-	100	-	100	1
			TOTAL	15	05	07	-	-	410	490	900	26

SEMESTER: VI

S. No.	Category	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
							Mid Term Exam			External Exam		
				L	T	P	CT	AS +AT	Total			
THEORY												
1.	CC-T	BSB601T	Fundamentals of Bioprocess Engineering	3	1	0	20	10	30	70	100	4
2.	CC-T	BSB602T	Fundamentals of Proteomics and Genomics	3	1	0	20	10	30	70	100	4
3.	DSE-T	BSB603T	Introductory Bioenergetics	3	1	0	20	10	30	70	100	4

4.	GE	BSB604T	Dairy Microbiology	3	1	0	20	10	30	70	100	4
5.	SEC	Departmental Elective*	*Only one paper is to be chosen from the basket of departmental electives having 04 papers provided by the School	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT												
6.	CC	BSB601P	Fundamentals of Bioprocess Engineering Lab	0	0	2	-	-	30	70	100	1
7.	CC	BSB602P	Fundamentals of Proteomics and Genomics Lab	0	0	2	-	-	30	70	100	1
8.	DSE-P	BSB681P	Project	0	0	3	-	-	100	--	100	3
9.	GP	GP-601	General Proficiency	-	-	-	-	-	100	-	100	1
			TOTAL	15	05	07	-	-	410	490	900	26

LIST OF DEPARTMENTAL ELECTIVES*		
S. No.	Course Code	Course Name
1.	BSB605T/ BSB 606T/ BSB 607T/NCC-01	Biomedical Instrumentation/ Plant Tissue Culture/ Developmental Biology/NCC General

Programme/Class: Certificate	Year: First (1)	Semester: First (I)
Subject: Biotechnology		
Course Code: B100101T	Course Title: Cell Biology and Genetics	
Course Outcomes (COs)		
<p>This course introduces the principles of cell biology and genetics. After completion of this course, students will be able to-</p> <p>CO1: Learn contribution of Indian scholars in towards Biotechnological sciences.</p> <p>CO2: Study the salient features, properties and characteristics of cell.</p> <p>CO3: Understand the structure and functions of cell, its organelles such as mitochondria, nucleus etc.</p> <p>CO4: Understand how genetic information is transmitted in organism for skill development.</p> <p>CO5: Understand the regulation of cell cycle, programmed cell death and Cancer for developing the skills of employability.</p> <p>CO6: Understand the laws governing the inheritance, genetic interactions, sex determination and sex linkage.</p> <p>CO7: Conceptualize linkage, crossing over and laws of population genetics for skill enhancement.</p> <p>CO8: Learn different cell biology techniques like karyotyping, chromosome banding, FISH, FACS, centrifugation and microscopy for developing the skills of employability.</p>		
Credits: 4	Core Compulsory	
Maximum Marks: 100 (75(UE)+25 (CIE))	Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week) L-T-P: 4-0-0		
Unit	Topics	N0. of Lectures
I	<ul style="list-style-type: none"> • Introduction and history of Biotechnological science with special reference to contribution of Indian scholars in biological sciences 	2
II	<ul style="list-style-type: none"> • Prototype structure of animal, plant and bacterial cells, Diversity of cell size and shape • Cell theory • C-value paradox • Cell Membrane: Chemical components of biological membranes, organization and Fluid Mosaic Model, and membrane transport. • Cytoskeleton and Extra cellular matrix 	8
III	<p>Structure and Function of Cell organelles:</p> <ul style="list-style-type: none"> • Lysosomes: Vacuoles and micro bodies: Structure and functions • Ribosomes: Structures and function including role in protein synthesis. • Mitochondria: Structure and function, Genomes, biogenesis. • Chloroplasts: Structure and function, genomes, biogenesis • Nucleus: Structure and function, nuclear envelope 	9

IV	<p>Chromosome structure:</p> <ul style="list-style-type: none"> Chromosomes: chromatin and chromosomes organization, euchromatin and heterochromatin, nucleosome, metaphase chromosome, genes and chromosomes. 	9
	<ul style="list-style-type: none"> DNA as genetic material, Structure of DNA Structural and numerical changes in human chromosomes and ploidy in plants. Mutations: Types of mutations, spontaneous and induced mutations, Physical and chemical mutagens 	
V	<p>Cell cycle, Cancer and Cell Signaling:</p> <ul style="list-style-type: none"> Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast and higher organisms Cell senescence and programmed cell death Cancer – chromosomal disorders, oncogenes and tumor suppressor genes <p>Introduction to cell signalling and cell –cell interaction</p>	7
VI	<p>Mendelian and nonmendelian genetics:</p> <ul style="list-style-type: none"> Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance Mendelian genetics: Mendel’s experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy Sex determination and sex linkage: Mechanisms of sex determination, Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory 	8
VII	<p>Linkage, crossing over and population genetics:</p> <ul style="list-style-type: none"> Linkage, crossing-over and chromosome and genetic mapping Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting. Genetic Code: deciphering genetic code; degeneracy, unusual codons in mitochondria Mutations: types, mechanisms <p>Evolution and population genetics: Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, evolutionary genetics, natural selection.</p>	8

VIII	<p>Cytological techniques:</p> <ul style="list-style-type: none"> • Microscopy and staining techniques • Microtomy • Karyotyping • Chromosome banding, • <i>in situ</i> hybridization and FISH • chromosome painting • Fluorescence Activated Cell Sorting 	9
<p>Suggested Reading</p> <ol style="list-style-type: none"> 1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6th Ed.). New York: Garland Science 2. Cooper, G. M., and Hausman, R. E. (2013). The Cell: a Molecular Approach (6th Ed.). Washington: ASM ; Sunderland. 3. Karp, G. Cell and Molecular Biology. Concepts and experiments. John Harris, D., Wiley & sons, New York 4. Iwasa J., Marshal W. Karp's Cell Biology(2018) (8th edition) Wiley & Sons, NY 5. Iwasa J., Marshal W. Karp's Cell and Molecular Biology . Concepts and experiments. (2015) (8th edition) Wiley & sons, New York 6. Watson, J. D. Baker TA, Bell, SP Gann, A. Levine, M. Losick R. (2008). Molecular Biology of the Gene (5th ed.). Pearson 7. Lodish, H F. Berk, A. Kaiser, CA, Krieger, M. Bretscher, A. Ploegh, H. Aman, A. Martin, K. (2016). Molecular Cell Biology (8th Ed.). New York: W.H. Freeman 8. Gupta P.K. Cell and Molecular Biology 2018. 5th edition Rastogi Publication India. 9. Hartl, D. L., & Jones, E. W. (1998). Genetics: Principles and Analysis. Sudbury, MA: Jones and Bartlett. 10. Pierce, B. A. (2005). Genetics: a Conceptual Approach. New York: W.H. Freeman. 11. Tamarin, R. H., & Leavitt, R. W. (1991). Principles of Genetics. Dubuque, IA: Wm. C. Brown. 12. Smith, J. M. (1998). Evolutionary Genetics. Oxford: Oxford University Press Genetics: Principles and Analysis – Hartl and Jones. 13. Gardner EJ, Simmons MJ, Sunstad DP. Principles of Genetics. 8th Edition. John Wiley and Sons. 14. Snustand DP, Simmons MJ. Principles of Genetics. (2016) 7th Edition. John Wiley and Sons. 15. Verma PS, Agarwal VK. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. (2004). S Chand and Company Ltd. 16. Satyanarayana U (2020). Biotechnology. Books and Allied (P) Ltd 17. Singh BD. (2015). Biotechnology: Expanding Horizons (4th edition). Kalyani Publishers 18. Dubey RC. (2014) A Textbook of Biotechnology (5th edition) S Chand and Company Ltd. 19. सिंह बंड (2017) बायोटेक्नोलॉजी Kalyani Publishers 20. पंगपता, कौटिलिका विज्ञान विम अिनंंंं विकं, 2015 2nd edition Rastogi Publications 21. सिंह बंड, आिनं विकं कं आधंर. (2017) Kalyani Publishers 22. ोन कंं, वरकर गंयतरं. आधननक कौटिलिका विंंंं, 2018 CBC <p>Other course books published in Hindi must be prescribed by the University/College</p>		

- <https://ocw.mit.edu/courses/find-by-topic/#cat=science&subcat=biology&spec=genetics>
- <https://nptel.ac.in/courses/102/103/102103012/>
- <https://nptel.ac.in/courses/102/106/102106025/>
- <https://nptel.ac.in/courses/102/103/102103015/>

Suggested Digital platform/Web link

Course prerequisite

The candidate should have passed (10+2) examination in science stream with PCB (Physics, Chemistry, Biology and/or Biotechnology) or PCM (Physics, Chemistry and Maths) or any other science subject.

Suggested Continuous Internal Evaluation (CIE) methodsTotal

marks: 25

10 marks for Test

10 marks for presentation along with assignment 05 marks for Class interactions

Further Suggestions: None

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	2	1	1	2	2
CO2	2	1	2	1	1	1	1	2	2	2
CO3	2	2	1	1	1	1	1	1	2	2
CO4	2	1	1	1	1	1	1	1	2	2
CO5	2	1	1	2	2	1	1	1	1	1
CO6	2	1	1	2	2	1	1	2	1	1
CO7	2	1	2	2	2	1	1	1	1	1
CO8	2	3	2	3	1	1	1	1	1	1

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	1
CO2	3	2	1
CO3	3	1	1
CO4	3	1	1
CO5	3	3	2
CO6	3	2	1
CO7	3	3	2
CO8	3	3	2

Programme/Class: Certificate	Year: First (1)	Semester: First (I)
Subject: Biotechnology		
Course Code: B100102P	Course Title: Cell Biology and Genetics Lab	
Course Outcomes (COs)		
After completion of this course, students will be able to- <ul style="list-style-type: none"> • learn, understand and develop skill and hands on training in basics of cell biology and genetics. • be able to differentiate between plant and animal cells • be analyzed different stages of mitosis and meiosis 		
Credits: 2	Core Compulsory	
Maximum Marks: 100 (75(UE)+25(CIE))	Minimum Passing Marks: As per University norms	
Total Number of Lectures-Tutorials-Practical (in hours per week) L-T-P: 0-0-4		
	Topics	No. of Lectures
	<ol style="list-style-type: none"> 1. Introduction to safety measures in Laboratories 2. Preparation of solutions and buffers 3. Equipment handling and pipetting 4. Study of structure of any Prokaryotic and Eukaryotic cell. 5. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, oesophagus, stomach, pancreas, intestine, kidney etc. 6. Cell division in onion root tip/ insect (grasshopper) gonads. 7. Vital Staining of Mitochondria with Janus green B. 8. Demonstration of diversity of cell types (Muscle, Neuron) 9. Demonstration of Sex chromatin in buccal smear. 10. Karyotype preparation. 11. Preparation of polytene chromosomes from salivary gland of Chironomous larvae. 12. Genetics problems based on : (i) Mendel's law (ii) Gene mapping and (iii) Transposable elements. 13. Ames test for mutagenesis. 14. Genetic experiment – Drosophila model 	60
Suggested Reading		
<ol style="list-style-type: none"> 1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6th Ed.). New York: Garland Science 2. Cooper, G. M., and Hausman, R. E. (2013). The Cell: a Molecular Approach (6th Ed.). Washington: ASM ; Sunderland. 3. Karp, G. Cell and Molecular Biology. Concepts and experiments. John Harris, D., Wiley & sons, New York 4. Iwasa J., Marshal W. Karp's Cell Biology (2018) (8th edition) Wiley & Sons, NY 5. Iwasa J., Marshal W. Karp's Cell and Molecular Biology . Concepts and experiments. (2015) (8th edition) Wiley & sons, New York 		

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6. Watson, J. D. Baker TA, Bell, SP Gann, A. Levine, M. Losick R. (2008). **MolecularBiology of the Gene** (5th ed.). Pearson
7. Lodish, H F. Berk, A. Kaiser, CA, Krieger, M. Bretscher, A. Ploegh, H. Aman, A.Martin, K. (2016). **Molecular Cell Biology** (8th Ed.). New York: W.H. Freeman
8. Gupta P.K. **Cell and Molecular Biology** 2018. 5th edition Rastogi Publication India.
9. Hartl, D. L., & Jones, E. W. (1998). **Genetics: Principles and Analysis**. Sudbury, MA: Jones and Bartlett.
10. Roskam's J. Rodgers L.(2002). **Lab Ref: A Handbook of Recipes, Reagents, and other reference tools for use at the Bench**. Cold Spring Harbor Laboratory Press. USA.
11. Barker K (2004). **At the Bench: A laboratory Navigator**. Cold Spring HarborLaboratory Press. USA

Course books published in Hindi must be prescribed by the University/College

Course prerequisite

The candidate should have passed (10+2) examination in science stream with PCB (Physics, Chemistry, Biology and/or Biotechnology) or PCM (Physics, Chemistry and Maths) or anyother science subject.

Suggested Continuous Internal Evaluation (CIE) methodsTotal

marks: 25

10 marks for Test

10 marks for presentation along with assignment05 marks for Class interactions

Further Suggestions: None

Programme/Class: Certificate	Year: First (1)	Semester: First (I)
Subject: BIOTECHNOLOGY		
Course Code: B093101P	Course Title: Animal Science Lab	
Course Outcomes: The student at the completion of the course will be able to:		
<ul style="list-style-type: none"> • Understand the animal kingdom. • Understand the taxonomic position of Protozoa to Chordates. • Understand the general characteristics of animals belonging to protozoa to Chordates. • Understand the body organization, origin and evolutionary relationship of different phylum. 		
Credits: 2	Core: Compulsory	
Max.Marks: 25+75	Min. Passing marks: As per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week) L-T-P:0-0-2		
S. No.	Objectives	Total No. of Lectures/ Hours (60)
1.	Study of prepared slides of <i>Euglena</i> , <i>Paramecium</i> , <i>Vorticella</i> , <i>Trypanosoma</i> & <i>Noctiluca</i>	7
2.	Identification and study of invertebrate specimens of the following phylum Porifera, Coelentrata, Platyhelminthes, Annelida	7
3.	Study of the L.S of spicules, T.S of Gemmule, Sycon, T.S & L.S of <i>Hydra</i>	7
4.	Identification and study of invertebrate specimens of the following phylum Arthropoda, Mollusca, Echinodermata	7
5.	Identification and study of vertebrate specimens of the following phylum Pisces, Amphibia	8
6	Identification and study of vertebrate specimens of the following phylum Reptilia, Aves, Mammal	8
7.	Study of Histological slides: Tissue & Organ	8
8.	Study of embryological slides: Development of chick embryo whole mounts	8
Suggested Readings:		
<ol style="list-style-type: none"> 1. Practical Zoology Vertebrates by S.S. Lal – 2015. S. Chand. 2. Practical Zoology Invertebrates by S.S. Lal – 2015. S. Chand. 3. A manual of Practical Zoology: Invertebrates: P.S. Verma 4. Advance Practical Zoology 2015 by P.S. Verma & P.C. Shrivastava <p>Lab Virtual links-</p> <ul style="list-style-type: none"> • http://vlabs.iitb.ac.in/vlabs-dev/labs/zoology_lab/index.php • https://www.uwlax.edu/biology/zoo-lab/ • https://www.powershow.com/view1/1ad1bd-ZDc1Z/Zoology_Virtual_Laboratory_experiments_in_the_biological_sciences_powerpoint_ppt_presentation • https://sites.dartmouth.edu/teachremote/remote-lab-activities-and-experiences/ 		
This course can be opted as an elective by the students of following subjects: Open for all		
Course prerequisites: To study this course, a student must have had the subject biology in class12 th		
Suggested Continuous Evaluation Methods:		

Programme/Class: Certificate	Year: First (1)	Semester: First (I)
Subject: BIOTECHNOLGY		
Course Code: B093102T	Course Title: Plant Science	
Course Learning Outcomes: At the end of the course students will be able to: CO1: Gain knowledge about the structure and development of different parts of plants for skill development at global level. CO2: Understand proper metabolic pathways that are signification in physiological functioning for skill development and local employability. CO3: Analyze and apply taxonomy and systematic in plant kingdom for evolutionary classification to enhance knowledge for better skill development and local employability. CO4: Learn the basic concept of Algal classification on basis of common features for effective development of employability skills. CO5: Learn the basic concept of Fungi classification on basis of common features for skill development and employability. CO6: Learn the basic concept of Bryophyte classification on basis of common features to acquire skills for better employability. CO7: Learn the basic concept of Pteridophyta classification on basis of common features for skill development. CO8: Learn the basic concept of Gymno & Angiosperms classification on basis of common features for skill enhancement.		
Credits: 4	Core: Compulsory	
Max. Marks: 25+75	Min. Passing marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0		
Unit	Topics	Total No.of Lectures/ Hours (60)
I	Plant Structure and Development: Structural organization and function of plant cell, Growth and Division of the Cell, Morphogenesis and organogenesis in plants, floral development	6
II	Plant Physiology: Photosynthesis, Respiration and photorespiration, Nitrogen metabolism, Plant hormones, Sensory photobiology, Solute transport and photo assimilate translocation, Stress physiology, Vernalization, Seed dormancy and Germination	12
III	Evolution And Classification of Plants: Principles and methods of taxonomy, Outline classification of plants, Concepts of species and hierarchical taxa, biological nomenclature, classical and quantitative methods of taxonomy of plants	6
IV	Algae: General features, classification, distribution, range of thallus organization, reproduction, economic importance of algae, general characters of <i>Chlamydomonas</i> , Cyanobacteria- heterocyst, general characters of <i>Nostoc</i>	6
V	Fungi: General features, classification, distribution, range of thallus organization, reproduction, parasexual cycle and economic importance fungi, general characters of <i>slime mold</i> , lichens and its types.	6
VI	Bryophyta: General features, classification, distribution, range of thallus organization, reproduction, economic importance of bryophyte, general characters of <i>Riccia</i> , <i>Marchantia</i> and <i>Anthoceros</i> .	8

VII	Pteridophyta: General features, classification, structure, reproduction, stellar evolution, heterospory and seed habit, economic importance of Pteridophytes, general characters of <i>Selaginella</i> .	8
VIII	Gymnosperms & Angiosperms: General features, outline classification, structure, reproduction, Alternation of generation, structure of a flower, life cycle of angiosperm and economic importance.	8

Suggested Readings:

1. V. J. Chapman and D. J. Chapman, The Algae. 2nd edition, Palgrave Macmillan; 1973 edition, January 14, 2014.
2. Ganguli and Kar, College Botany Vol. I and II, 6th revised edition, New Central Book Agency; 1 January, 2011.
3. V. Singh, P.C. Pande & D.K. Jain. A Text Book of Botany, 4th edition, Rastogi Publication, 2008-2009.
4. N.S. Subrahmanyam, Modern Plant Taxonomy, 1st edition Vikas Publishing House, 1997.
5. A Text Book of Botany, V. Singh, P.C. Pande & D.K. Jain, Rastogi Publication.
6. H. D. Kumar. Introductory Phycology, 2nd edition, Affiliated East-west press Pvt Ltd, 1999

Website Sources:

- http://www.brainkart.com/subject/Plant-Biology_229/
- <http://www.plantcell.org/content/teaching-tools-plant-biology>
- <https://www.easybiologyclass.com/plant-physiology-free-lecture-notes-online-tutorials-lecture-notes-ppts-mcqs/>

This course can be opted as an elective by the students of following subjects: Open for all

Course prerequisites: To study this course, a student must have had the subject biology in class 12th.

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 marks

Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks

Class performance/Participate: 5 Marks

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	1	1	2	1	1	1	2	1
CO2	2	1	1	1	2	1	1	1	1	2
CO3	1	1	1	2	1	1	1	1	1	1
CO4	1	1	1	1	1	2	1	2	2	1
CO5	1	1	1	1	1	2	1	3	3	2
CO6	1	1	1	1	1	2	2	3	3	1
CO7	2	1	1	1	1	2	2	3	3	2
CO8	2	1	1	1	1	2	2	3	3	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
C01	2	1	1
C02	2	2	1
C03	2	2	1
C04	2	3	1
C05	2	3	1
C06	3	3	2
C07	3	1	2
C08	3	1	2

Programme/Class: Certificate	Year: First (1)	Semester: First (I)
Subject: BIOTECHNOLOGY		
Course Code: B093102P	Course Title: Plant Science Lab	
Course Outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> ● To understand the plant structure and physiology. ● Provides the basic knowledge of classification and taxonomy in plant kingdom ● Understand distribution, reproduction and their economic importance. ● Identify the distinguishing anatomical features of various parts of plant. ● Ascertain what taxa commonly seen plants belong to. 		
Credits: 2	Core: Compulsory	
Max. Marks: 25+75	Min. Passing marks: As per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week) L-T-P:0-0-2		
S. No.	Objectives	Total No. of Lectures/ Hours (60)
1.	Identification and study of Cyanobacteria- <i>Nostoc</i> .	7
2.	Identification and study of some algal forms: <i>Chlamydomonas</i> , <i>Volvox</i>	7
3.	Identification and study of fungi- <i>Rhizopus</i> , <i>Agaricus</i>	7
4.	Identification and study of lichen	7
5.	Cut the T.S of given plant material (Bryophyta) and identify it with its morphological and anatomical features. (<i>Riccia</i> , <i>Marchantia</i>)	8
6.	Cut the T. S of given plant material (Pteridophyta)and identify it on the basis of its anatomical features. (<i>Marselia</i> , <i>Selaginella</i>)	8
7.	Cut the T.S of given plant material (Gymnosperms)and identify it on the basis of its anatomical features.(<i>Cycas</i> / <i>Pinus</i>)	8
8.	Describe given plant in semi-botanical language and also give the floral structure and formulae of it	8
Suggested Readings: <ol style="list-style-type: none"> 1. A text book of practical Botany 1 by Dr. A. Bendre and Dr. Ashok Kumar (Ed-2009) 2. A text book of practical Botany 2 by Dr. A. Bendre and Dr. Ashok Kumar (Ed-1984) 3. A text book of of practical Botany by Mandeep singh, H. Sahu, S.B. Chaudhry, Daya publishing house. (Ed- 2005) 4. Modern Practical Botany Vol-1 by B.P. Pandey. S. Chand & Company Ed- 2011 5. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultivation, New Age International, New Delhi. 6. Dubey R. C. .and Maheshwari D.K. Textbook of practical microbiology, S Chand Publications. 7. Lab Virtual links- <ul style="list-style-type: none"> ● http://algorithmicbotany.org/virtual_laboratory/ ● http://www1.biologie.uni-hamburg.de/b-online/e00/related.htm ● https://www.ou.edu/cas/botany-micro/www-vl/ ● https://ucmp.berkeley.edu/IB181/HpageIB181.html 		
This course can be opted as an elective by the students of following subjects: Open for all		
Course prerequisites: To study this course, a student must have had the subject biology in class 12 th		
Suggested Continuous Evaluation Methods:		

Programme/Class: Certificate	Year: First (1)	Semester: First (I)
Further Suggestions: None		
Subject: BIOTECHNOLOGY		
Course Code: B093103T	Course Title: Chemistry I	
Course Learning Outcomes:		
At the end of the course students will be able to:		
CO1: Understand the Chemical equilibrium and its relationship on the basis of reversible and irreversible reactions to enhance knowledge for skill development.		
CO2: Solve problems of chemical kinetics by using appropriate mathematical concepts for skill development and local employability.		
CO3: Understand the ideal solution, chemical potential in ideal solution and interprets the colligative properties for better skill development and employability.		
CO4: Understand the concept of acid & base on the basis on different theories for skill development and employability.		
CO5: Understand the role of thermodynamics laws along with concept of free energy for skill development at global level.		
CO6: Understand measurement of reaction rates, representation of rate laws, and applications of chemical kinetics for skill development and employability.		
CO7: Understand the classification, types and properties of colloids for skill development.		
CO8: Understand an idea on different electrochemical cells and electrochemical series to acquire knowledge for better employability skills.		
Credits: 4	Core: Compulsory	
Max. Marks: 25+75	Min. Passing marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0		
Unit	Topics	Total No.of Lectures/ Hours (60)
I	Introduction: Reversible and irreversible reactions, chemical equilibrium, catalysts, law of mass action, Le-Chatelier's principle.	6
II	Mathematical Concepts: Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like Kx , e^x , X^n , $\sin x$, $\log x$; maxima and minima, partial differentiation and reciprocity relations. Integration of some useful/relevant functions.	8
III	Solution: Concentration of solution; normality, equivalent weight, molarity, formality, molality, solutions of gases in liquids, mole fraction, colligative properties, abnormal molecular weights, Van't Hoff factor.	6

IV	Acids & Bases: Ionization, strong and weak electrolytes, concept of acid and bases, dissociation of acid and base in water, strength of acids and bases, Ionic product of water, the pH scale.	8
V	Laws of Thermodynamics: First, second and Zeroth law of thermodynamics, entropy, enthalpy, Gibb's free energy.	8
VI	Reaction kinetics: Order of reactions, first, second and zero order reactions.	8
VII	Colloidal: True solution, colloidal solution and suspension, types of colloidal systems, classification of colloids, properties of colloids, Coagulation, protective colloids	8
VIII	Electrochemistry: Electrolysis, electrochemical cells, electrode potentials, electrochemical series.	8

Suggested Readings:

1. K. J. Laidler, Chemical Kinetics, Pearson Education Society, 1987
2. P. C. Rakshit, Physical Chemistry, Sarat Book House, 2014.
3. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing Company, 2008.
4. P. W. Atkins & J. de Paula, Physical Chemistry, 8th Edn W. H. Freeman Publishing Co., 2006.

Website Sources:

- <https://www.askiitians.com/revision-notes/chemistry>
- <https://ocw.mit.edu/courses/chemistry/5-62-physical-chemistry>
- <http://www.colby.edu/chemistry/PCChem/Lecture1.html>
- https://www.internetchemistry.com/chemistry/physical_chemistry.htm

This course can be opted as an elective by the students of following subjects: Open for all

Course prerequisites: To study this course, a student must have had the subject biology in class 12th.

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 marks

Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks

Class performance/Participate: 5 Marks

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	1	1	1	1	1	2	1	2	1
CO2	2	2	1	1	1	3	1	3	1	1
CO3	2	1	1	2	2	1	1	1	2	1
CO4	2	1	2	1	1	3	2	1	1	2
CO5	1	1	1	2	1	1	1	1	2	1
CO6	1	1	1	1	1	2	1	1	1	1
CO7	1	1	3	1	2	1	1	1	2	1
CO8	1	1	1	2	1	1	2	1	1	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	2	1
CO3	2	2	1
CO4	3	2	1
CO5	3	1	1
CO6	3	3	2
CO7	3	1	2
CO8	3	3	1

Programme/Class: Certificate	Year: First (1)	Semester: First (I)
Subject: BIOTECHNOLOGY		
Course Code: A190101T	Course Title: Foundations of Library and Information Science	
Course Learning Outcomes: After studying this course, the students shall be able to: CO1: Comprehend the concept, objectives and development of libraries and its importance to the society for effective development of employability skills at global level. CO2: Understand the professional ethics of librarianship and the five laws of library science with their implications on various services of the libraries for skill development and local employability. CO3: Understand the importance of library legislation and features of library acts for skill development and employability. CO4: Familiarize with the role of various National and International Library Associations and Organizations to enhance knowledge for skill development and employability.		
Credits: 4	Core: Compulsory	
Max. Marks: 25+75	Min. Passing marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topics	Total No. of Lectures/ Hours (60)
I	Contribution of Indian LIS Professionals in the development of Library Profession-Ranganathan, SR, Kaula, PN, Mangla, PB. Essentials of Library and Information Science Librarianship as a Profession; User Education; Extension Service; Library Building.	15
II	Conceptual Framework and History of Libraries Social foundation of Libraries History of Libraries: Development of libraries in India, U.S.A. And Britain Five Law s of Library science Types of Libraries	15
III	Laws relating to libraries and information centers Library Legislation-Need and essential Features; Library Acts in India; Intellectual Property Right	15
IV	Library Associations Role and contribution of National Organizations such as UGC, ILA, IASLIC; Role and contribution of International Organizations such as LA, ALA, IFLA, FID, UNESCO, ASLIB in the growth and Development of Libraries.	15

Suggested Readings:

1. Krishan Kumar (2001). An Introduction to AACR-2 (Anglo-American Cataloguing Rules). New Delhi: Vikas Publishing.
2. Siddiqui, JA and Husain, Mohd Sabir. Library Cataloguing with AACR-II. New Delhi, Ess Ess Publications, 2018. ISBN 978-93-87698-03-1
3. Mittal, RL: Library and Administration: Theory and practice. New Delhi: Metropolitan Book, 1983.
4. Satyanarayana, NR: A manual of Library Automation and Networking. 2nd ed. Lucknow, New Royal Book, 2003.
5. Dhawan, A: Computers for Beginners. New Delhi, Frank Bros, 1990.
6. Mohammad, Riaz (1989). Advanced Indexing and Abstracting Practices. New Delhi: Atlantic Publishers.
7. Khanna, JK: Documentation and Information Services: systems and techniques. Agra, Y K Publishers, 2000.
8. Dewey, Melvil: Decimal Classification and Relative Index. 19th ed. New York, Lake Placed Club, 1979.
9. Girja Kumar & Krishan Kumar (1975). Theory of cataloguing. New Delhi: Vikas Publishing House
10. Husain, Shabahat (2004). Library Classification: Facets and Analyses. Delhi: B.R. Publishing Corporation.
11. Krishan Kumar (1979). Theory of Classification. New Delhi: Vikas Publishing
12. Khanna, JK: Library and Society. Kurukshetra: Research Publications, 1987.
13. Pandey, SK Sharma: Libraries and Society. New Delhi: Ess Ess, 1992.

Website Sources:

- <https://lisstudymaterials.wordpress.com/>
- <http://egyankosh.ac.in/>
- <http://library-soup.blogspot.com/>

This course can be opted as an elective by the students of following subjects: Open for all

Course prerequisites: To study this course, a student must have passed XII in any discipline

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 marks

Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks

Class performance/Participate: 5 Marks

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	1	1	1	1	1	1	2	2
CO2	1	2	1	1	1	1	2	1	1	1
CO3	2	2	1	2	1	1	2	1	1	1
CO4	3	1	1	1	2	1	1	1	2	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

		Skill Development	Employability	Entrepreneurship Development	
	CO1	2	2	1	
	CO2	2	3	1	
	CO3	3	3	1	
	CO4	3	3	1	

Programme /Class: Certificate	Year: First (1)	Semester: First (I)
Co-Curricular Course		
Course Code: Z010101T	Course Title: Food, Nutrition and Hygiene	
Course outcomes: At the end of the course student will be able to: CO1: Learn the basic concepts of food and nutrition for skill development and employability globally. CO2: Study the nutritional requirement-it's excess and deficiency in the body for effective development of employability skills. CO3: Learn about meal planning and 100 days nutrition concept for skill development and employability. CO4: Study common health issues and special nutritional requirements during common illness to acquire knowledge for better skill development and local employability.		
Credits: 2	Compulsory	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 2-0-0		
Unit	Topics	No. of Lectures Total=30
I	Concept of Food and Nutrition (a) Definition of Food, Nutrients, Nutrition, Health, balanced Diet (b) Types of Nutrition- Optimum Nutrition, under Nutrition, Over Nutrition (c) Meal planning- Concept and factors affecting Meal Planning (d) Food groups and functions of food	8
II	Nutrients: Macro and Micro RDA, Sources, Functions, Deficiency and excess of (a) Carbohydrate (b) Fats (c) Protein (d) Minerals Major: Calcium, Phosphorus, Sodium, Potassium Trace: Iron, Iodine, Fluorine, Zinc (e) Vitamins Water soluble vitamins: Vitamin B, C Fat soluble vitamins: Vitamin A, D, E, K (f) Water (g) Dietary Fibre	7
III	1000 days Nutrition (a) Concept, Requirement, Factors affecting growth of child (b) Prenatal Nutrition (0 - 280 days): Additional Nutrients' Requirement and risk factors during pregnancy (c) Breast / Formula Feeding (Birth – 6 months of age) Complementary and Early Diet (6 months – 2 years of age)	8
	Community Health Concept (a) Causes of common diseases prevalent in the society and Nutrition requirement in the following: Diabetes Hypertension (High Blood Pressure) Obesity	

IV	Constipation Diarrhea Typhoid (b) National and International Program and Policies for improving Dietary Nutrition (c) Immunity Boosting Food	7
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Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	2	2	1	3	3
CO2	1	1	1	1	1	2	1	1	1	2
CO3	1	2	1	1	2	1	1	1	1	1
CO4	2	2	1	2	3	1	2	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	2	1
CO2	2	3	1
CO3	3	3	2
CO4	3	3	2

rogramme/Class: Certificate	Year: First (1)	Semester: Second (II)
Subject: BIOTECHNOLOGY		
Course Code: B100201T	Course Title: Molecular Biology and Genetic Engineering	
<p>Course Outcomes: At the end of the course students will be able to: CO1 : Learn and understand the important discoveries that are made in the field of molecular biology for skill development at global level. CO2 : Learn key molecular events that occur during the DNA replication, transcription,translation and regulation of gene concept for skill development at global level . CO3 : Gain knowledge on the foundation of genetic engineering and their applications in biological research as well as in biotechnology industries for employability at global level. CO4 : Understand gene concept, plasmids, and wide range of techniques, especially modern molecular tools in diagnosis for entrepreneurship development. CO5 : Acquainted with various techniques of genetic engineering and their applications in biological research, diagnostics as well as in biotechnology industries for skill development at global level. CO6: Understand the techniques of DNA manipulation for skill development at global level. CO7: Knowledge of cloning vector for genomic and cDNA library formation. CO8: Gain knowledge of molecular biology techniques like DNA isolation gene cloning and electrophoresis to enhance the employability at global level.</p>		
Credits: 4	Core: Compulsory	
Max. Marks: 25+75	Min. Passing marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topics	Total No. of Lectures/ Hours (60)
I	<p>Gene organization and regulation of gene expression:</p> <ul style="list-style-type: none"> • Structure of DNA, Types of DNA • Gene organization in prokaryotes and eukaryotes, polycistronic genes, split genes promoters, enhancers. <p>Regulation of gene expression: Prokaryotes: lac and trp operons in <i>E. coli</i>.</p>	7
II	<p>DNA Replication and DNA polymerases:</p> <ul style="list-style-type: none"> • Replication of genetic material in prokaryotes and eukaryotes • A brief description of initiation at replication origins and its cell cycle regulation. • Structure and function of prokaryotic and eukaryotic DNA polymerases 	7
III	<p>Transcription and mRNA processing:</p> <ul style="list-style-type: none"> • RNA structure and types of RNA • Mechanism of transcription in prokaryotes and eukaryotes: transcription factors, structure of prokaryotic and eukaryotic RNA polymerases, initiation, elongation and termination. • RNA processing: processing of mRNA (Splicing, capping and polyadenylation) 	8

IV	<p>Prokaryotic and eukaryotic translation:</p> <ul style="list-style-type: none"> • Ribosome structure and assembly, tRNA, aminoacyl tRNA synthetases, • Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation. • Posttranslational modifications of proteins. 	7
V	<p>Vectors:</p> <ul style="list-style-type: none"> • Cloning vectors (plasmids, cosmids, bacterial artificial chromosomes and yeast artificial chromosomes), • shuttle vectors, expression vectors 	7
VI	<p>Enzymes used in DNA manipulating:</p> <ul style="list-style-type: none"> • Restriction endonuclease • Ligases • Polymerases • Kinases • Alkaline phosphatases • Reverse Transcriptase 	8
VII	<p>Genomic Library, PCR, Sequencing etc:</p> <ul style="list-style-type: none"> • Preparation and comparison of Genomic and cDNA library. • PCR and its applications. • DNA Sequencing. • Site directed mutagenesis • Protein engineering concepts and examples (any two). 	8
VIII	<p>Molecular Biology techniques:</p> <ul style="list-style-type: none"> • DNA isolation (Plasmid/ Genomic DNA isolation) • Blotting (Southern, Northern, Western) • Electrophoresis of nucleic acids and proteins • Gene cloning, Screening and characterization of cloned DNA • DNA Fingerprinting RFLP, RAPD 	8

Suggested Reading

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). **Molecular Biology of the Cell** (6th Ed.). New York: Garland Science
2. Cooper, G. M., and Hausman, R. E. (2013). **The Cell: a Molecular Approach** (6th Ed.). Washington: ASM ; Sunderland.
3. Karp, G. **Cell and Molecular Biology. Concepts and experiments**. John Harris, D., Wiley & sons, New York
4. Iwasa J., Marshal W. **Karp's Cell Biology** (2018) (8th edition) Wiley & Sons, NY
5. Iwasa J., Marshal W. **Karp's Cell and Molecular Biology** . Concepts and experiments. (2015) (8th edition) Wiley & sons, New York
6. Watson, J. D. Baker TA, Bell, SP Gann, A. Levine, M. Losick R. (2008). **Molecular Biology of the Gene** (5th ed.). Pearson
7. Lodish, H F. Berk, A. Kaiser, CA, Krieger, M. Bretscher, A. Ploegh, H. Aman, A. Martin, K. (2016). **Molecular Cell Biology** (8th Ed.). New York: W.H. Freeman
8. Gupta P.K. **Cell and Molecular Biology** 2018. 5th edition Rastogi Publication India.
9. Brown TA. **Gene cloning and DNA analysis: An introduction**. (2016) 7th Edition. Wiley-

Blackwell

10. Old, R. W., Primrose, S. B., & Twyman, R. M. (2006). **Principles of Gene Manipulation and Genomics**, 7th Edition: Blackwell Publishing.
11. Krebs JE, Goldstein ES and Kilpatrick ST (2014) **Lewin's Gene XII**, Jones and Barlett Publisher.
12. Brown, T. A. (2018). **Genomes** 4.(4th edition) New York: Garland Science Pub.
13. Green, M. R., & Sambrook, J. (2014) Fourth Edition. **Molecular Cloning: a Laboratory Manual**. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
14. Micklos, DA & Freyer, CA. **DNA Science: A first course in Recombinant DNA Technology**(2nd Edition) –Cold Spring harbor laboratory press, NY
15. Satyanarayana U (2020). Biotechnology. Books and Allied (P) Ltd
16. Singh BD. (2015). Biotechnology: Expanding Horizons (4th edition). Kalyani Publishers
17. Dubey RC. (2014) A Textbook of Biotechnology(5th edition) S Chand and Company Ltd.
18. ए ह बं डं (2017) बायंटेक्नोलॉजी Kalyani Publishers

Course books published in Hindi must be prescribed by the University/College

Suggested link

- <https://ocw.mit.edu/courses/biology/7-01sc-fundamentals-of-biology-fall-2011/molecular-biology/>
- <https://ocw.mit.edu/courses/biology/7-01sc-fundamentals-of-biology-fall-2011/molecular-biology/transcription-translation/>
- <https://ocw.mit.edu/courses/biology/7-01sc-fundamentals-of-biology-fall-2011/molecular-biology/gene-regulation-and-the-lac-operon/>
- <https://ocw.mit.edu/courses/biology/7-01sc-fundamentals-of-biology-fall-2011/recombinant-dna/>
- <https://ocw.mit.edu/courses/biology/7-01sc-fundamentals-of-biology-fall-2011/recombinant-dna/agarose-gel-electrophoresis-dna-sequencing-pcr/>
- <https://ocw.mit.edu/courses/biology/7-01sc-fundamentals-of-biology-fall-2011/recombinant-dna/basic-mechanics-of-cloning/>
- https://ocw.mit.edu/courses/biological-engineering/20-109-laboratory-fundamentals-in-biological-engineering-fall-2007/labs/mod1_3/
<https://nptel.ac.in/courses/102/103/102103045/#>

Suggested Digital platform/Web link

Course prerequisite

To study this course, student must have passed semester I.

Suggested Continuous Internal Evaluation (CIE) methods

Total marks: 25

10 marks for Test

10 marks for presentation along with assignment

05 marks for Class interactions

Further Suggestions: None

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required.

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	1	1	1	1	1	3	3	2
CO2	1	1	3	1	1	1	1	3	1	1
CO3	3	1	1	1	1	1	1	3	1	1
CO4	3	1	1	1	3	1	1	1	3	2
CO5	3	1	1	2	2	2	3	1	1	3
CO6	3	1	1	2	2	2	3	3	1	3
CO7	3	1	1	2	2	2	3	3	2	3
CO8	3	1	1	2	1	1	3	1	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	1
CO2	2	3	1
CO3	2	1	1
CO4	2	2	1
CO5	3	2	1
CO6	3	2	2
CO7	3	3	2
CO8	3	3	2

Programme/Class: Certificate	Year: First (I)	Semester: Second (II)
Subject: BIOTECHNOLOGY		
Course Code: B100202P	Course Title: Genetic Engineering Lab	
After completion of the course, the student shall be able to -		
<ul style="list-style-type: none"> ● prepare different bacterial growth media, ● understand principals and methods of competent cell preparation, restriction digestion, gene ligation, gene cloning, and transformation i. e gene manipulation. ● understand the method of agarose electrophoresis for plasmid and genomic DNA separation ● understand the method of blotting and PCR 		
Credits: 2		Core: Compulsory
Max. Marks: 100 (25+75)		Min. Passing marks: as per rules
Total Number of Lectures-Tutorials-Practical (in hours per week)L-T-P: 0-0-4		
S. No.	Topic	No. of Lectures
	<ol style="list-style-type: none"> 1. Preparation of solutions for Molecular Biology experiments. 2. Preparation of bacterial growth medium (L.B.,2XYT) 3. Competent cell preparation. 4. Transformation of <i>E.coli.</i> cells (color selection of transformants – with or without inserts) X –gal and IPTG. 5. Isolation of Plasmid DNA by alkaline lysis method 6. Isolation of genomic DNA from bacterial cells. 7. Agarose gel electrophoresis of genomic DNA & plasmid DNA 8. Concentration estimation by agarose gel electrophoresis 9. Preparation of restriction enzyme digests of DNA samples 10. Ligation 11. Southern blotting PCR 	8
Suggested Reading		
<ol style="list-style-type: none"> 1. Brown TA. Gene cloning and DNA analysis: An introduction. (2016) 7th Edition. Wiley-Blackwell 2. Old, R. W., Primrose, S. B., & Twyman, R. M. (2006). Principles of Gene Manipulation and Genomics, 7th Edition: Blackwell Publishing. 3. Krebs JE, Goldstein ES and Kilpatrick ST (2014) Lewin’s Gene XII, Jones and Barlett Publisher 4. Brown, T. A. (2018). Genomes 4.(4th edition) New York: Garland Science Pub. 5. Green, M. R., & Sambrook, J. (2014) Fourth Edition. Molecular Cloning: a Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press. Micklos, DA & Freyer, CA. DNA Science: A first course in Recombinant DNA Technology (2nd Edition) –Cold Spring Harbor laboratory press, NY 7. Roskam’s J. Rodgers L.(2002). Lab Ref: A Handbook of Recipes, Reagents, and other reference tools for use at the Bench. Cold Spring Harbor Laboratory Press. USA. 8. Barker K(2004). At the Bench: A laboratory Navigator. Cold Spring Harbor Laboratory 		

Press. USA

6. Course books published in Hindi must be prescribed by the University/College

Course prerequisite

To study this course, student must have passed semester I.

Suggested Continuous Internal Evaluation (CIE) methodsTotal

Marks: 25

10 marks for Test

10 marks for presentation along with assignment

05 marks for Class interactions

Further Suggestions: None

Programme/ Class: Certificate	Year: First (1)	Semester: Second (II)
Subject: BIOTECHNOLOGY		
Course Code: B093201T	Course Title: Elementary Biology	
<p>Course outcomes: At the end of the course students will able to: CO1: Define cell biology and gain some basic concept of functioning of various organelles for skill development at global level. CO2: Understands the Structural Organization and functions of different parts of plants. Students also learn the basic concepts of botanical garden, herbaria, zoological park and museums to enhance knowledge for better skill development and employability. CO3: Understands the concept of animal and plant classification for enhanced skill development and employability. CO4: Develop the knowledge of genes and understands the laws of inheritance for skill development. CO5: Understands the concept of diffusion, osmosis, imbibition in plants and movement of water, food, nutrients and gases in it to acquire better employability skills globally. CO6: Basic construction of a living organism, its metabolism and relation to diseases for skill development and local employability. CO7: Understands the basic structure of mitochondria, cellular respiration and factors affecting respiration for effective development of employability skills. CO8: Understands the basic concepts of immunology and reproductive health and human welfare for skill development at global level.</p>		
Credits: 4	Core: Compulsory	
Max.Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0		
Unit	Topics	Total No. of Lectures/ Hours (60)
I	The Cell: Concept and Cell theory. Structure of prokaryotic cells, eukaryotic cells, plant cells and animal cells. Structure and function cell and cell organelles for skill development.	6
II	Structural Organization: Tissues in animals and plants. Morphology, anatomy and functions of different parts of plants- Root, stem, leaf, inflorescence, flower, fruit and seed. Concepts of botanical garden, herbaria, zoological park and museums to enhance knowledge for better skill development and employability.	8
III	Classification of living organisms: Five kingdom classification, major groups and principles of classification in each kingdom. Systematic and binomial system of nomenclature. Concept of animal and plant classification for enhanced skill development and employability.	8
IV	Concept of alleles and genes: Mendelian Experiments, Cell cycle (Elementary Idea), mitosis and meiosis for skill development.	6
V	Plant Physiology: Concept of diffusion, osmosis, imbibitions. Movement of water, food, nutrients and gases. Plant growth and development to acquire better employability skills.	8

VI	Metabolism: Catabolic & anabolic reactions: enzymes, energy production and carbohydrate metabolism. Lipid & protein catabolism, Energy production mechanism, metabolic diversity & pathways of energy use. Integration of metabolism for skill development and employability.	8
VII	Energy Utilization: Structure of mitochondria, cellular respiration, relationship of carbohydrate metabolism to other compounds, Glycolysis, formation of acetyl co-A, Krebs cycle, Electron Transport System and Oxidative Phosphorylation, ATP, factors affecting respiration for effective development of employability skills.	8
VIII	Reproductive health and human welfare: Population and birth control, sexually transmitted diseases, infertility, Cancer and AIDS, Basic concepts of immunology, vaccines for skill development.	8

Suggested Readings:

1. Biology - Textbook for Class XI, NCERT Publication.
2. Biology - Textbook for Class XII, NCERT Publication.
3. Biology by Peter H Raven, George B Johnson, Kenneth A. Mason, Jonathan Losos, Susan Singer (Macgraw Hill).
4. Concepts in Biology by E.D. Enger & F.C. Ross, 9th Ed Tata McGraw Hill.

Website Sources:

- <https://routledgetextbooks.com/textbooks/9780815345138/lecture-notes.php>
- <https://www.slideshare.net>
- <https://lecturenotes.in/>
- <https://www.shomusbiology.com/>

This course can be opted as an elective by the students of following subjects: Open for all

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Course prerequisites: To study this course, a student must have had the subject General Microbiology in I semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods

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Further Suggestions: None

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1	1	1	1	1	1	1	2
CO2	2	1	2	1	1	1	1	2	1	1
CO3	3	1	1	1	2	3	1	2	1	1
CO4	3	3	2	2	2	1	1	2	3	1
CO5	3	1	2	2	3	1	2	2	3	3
CO6	1	2	1	3	3	3	2	2	3	2
CO7	3	1	2	1	3	2	2	2	3	3
CO8	3	3	3	3	1	2	3	1	2	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	2	1
CO3	2	2	1
CO4	2	1	1
CO5	3	3	2
CO6	3	3	2
CO7	3	3	2
CO8	3	1	2

Programme /Class: Certificate	Year: First (1)	Semester: Second (II)
Subject: BIOTECHNOLOGY		
Course Code: B093201P	Course Title: Experiments in Elementary Biology	
Course outcomes: Upon completion of the practical course in medical microbiology and immunology the students will learn about <ul style="list-style-type: none"> To provide students with a broad conceptual background in the biological sciences. Students will demonstrate an understanding of organismal form, function, and diversity. Students will demonstrate proper and safe laboratory practice, proper use of equipment, and the ability to use basic techniques in several areas and advanced techniques in at least one area. Students will demonstrate the ability to orally communicate the findings of their experiments or the work of others. 		
Credits: 2	Core: Compulsory	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2		
S. No.	Objectives	Total No. of Lectures/ Hours (60)
1	To identify the parts of a flower and distinguish between unisexual and bisexual flowers.	8
2	To study that leaves prepare starch by the process of photosynthesis.	8
3	To study the germinate seeds to observe how plants grow from seeds.	8
4	To test the presence of carbohydrates proteins, fats, in food items.	8
5	To preparation and study mitosis in onion root tip.	8
6	To study the stages of mitosis and meiosis using permanent slides.	8
7	To study the blastula phase of embryonic development in mammals with help of permanent slides, chart model or photograph.	6
8	To analyze living organisms in water and soil sample.	6
Suggested Readings: <ol style="list-style-type: none"> Introduction to Elementary Practical Biology: A Laboratory Guide for High-School and College Students - Primary Source Edition (2014) by Charles Wright Dodge Nabu Press ISBN: 9781293521601, 1293521604 Biology - Textbook for Class XII, NCERT Publication. Biology by Peter H Raven, George B Johnson, Kenneth A. Mason, Jonathan Losos, Susan Singer (Macgraw Hill). Concepts in Biology by E.D. Enger & F.C. Ross, 9th Ed Tata McGraw Hill. Virtual Lab Links- <ul style="list-style-type: none"> http://www.olabs.edu.in/?sub=79&brch=17&sim=205&cnt=4 https://vlab.amrita.edu/?brch=188&cnt=1&sub=3&sim=1102 		
This course can be opted as an elective by the students of following subjects: Open for all		
Course prerequisites: To study this course, a student must have had the subject General Microbiology in I semester of certificate course in Microbial Technology		
Suggested Continuous Evaluation Methods		

Programme/Class: Certificate	Year: First (1)	Semester: Second (II)
Subject: BIOTECHNOLOGY		
Course Code: B093202T	Course Title: Chemistry II	
Course Outcomes:		
At the end of the course students will be able to:		
CO1: Understand the basic concepts of chemical structure, bonding, bond properties and other chemical bond characteristics for skill enhancement at global level.		
CO2: Describe the different types of reagents and reactions such as types of electrophiles and nucleophiles, different types of organic reactions and their mechanisms to acquire employability skills.		
CO3: Learn isomerism in ethane, butane and cyclohexane and different methods of two-dimensional projection of organic molecules for skill development and employability.		
CO4: Explain the stereoisomerism and nomenclature of different isomers for effective development of employability skills globally.		
CO5: Understand the nomenclature, classification, properties and reactions of alkanes to enhance knowledge for skill development and employability.		
CO6: Understand the nomenclature, classification, properties and reactions of cycloalkanes for skill development and employability.		
CO7: Describe the chemical nature, properties, preparation and chemical reactions of alcohols, phenols to acquire knowledge for better skill development and employability.		
CO8: Describe the chemical nature, properties, preparation and chemical reactions of ethers for skill development and employability globally.		
Credits: 4	Core: Compulsory	
Max. Marks: 25+75	Min. Passing marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topics	Total No. of Lectures/Hours (60)
I	Structure and Bonding: Hybridizations, Bond lengths and bond angles, bond energy: Localized and delocalized chemical bond, van-der Waals interactions, inclusion compounds, clathrates, charge transfer complex, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding for skill enhancement.	8
II	Types of Reagents and Reactions: Electrophiles and nucleophiles. Types of organic reactions. Energy consideration. Reactive intermediates-carbocations, carbanions, free radicals and carbenes. Methods of determination of reaction mechanism to acquire employability skills.	6
III	Stereochemistry I: Conformations with respect to ethane, butane and cyclohexane; Interconversion of Wedge Formula; Newman, Sawhorse and Fischer representations; Concept of chirality; Configuration for skill development and employability.	8
IV	Stereochemistry II: Geometrical Isomerism- cis and trans; Optical isomerism- levo and dextrorotatory isomers, specific rotation and method for determination of optical activity; Enantiomerism, Diastereomerism; D and L; cis - trans nomenclature; CIP Rules for effective development of employability skills.	10
V	Alkanes: IUPAC nomenclature, classification, isomerism in alkanes, sources, and methods of preparation (with special reference to Wurtz, Kolbe, Coreyhouse, reactions and decarboxylation of carboxylic acids. Physical	8

	properties and chemical reactions of alkanes. Mechanism of free radical halogenation of alkanes to enhance knowledge for skill development and employability.	
VI	Cycloalkanes: IUPAC nomenclature, classification, isomerism, sources, and methods of preparation of cycloalkanes-, chemical reactions. Bayer's strain theory and its limitations. ring strain in cyclopropane and cyclobutane. Theory of strain in rings for skill development and employability.	6
VII	Alcohols and Phenols: Alcohols- Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters, Reactions-with sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO ₄ , acidic dichromate, conc. HNO ₃). Oppeneauer Oxidation; Diols- Oxidation of diols; Pinacol-Pinacolone rearrangement to acquire knowledge for better skill development and employability.	8
VIII	Ethers: Structure, IUPAC and Common system of Nomenclature, Isomerism, Physical and Chemical properties of Ethers. Methods of preparation of Ethers for skill development and employability.	8

Suggested Readings:

1. R. T. Morrison & R. N. Boyd, Organic Chemistry, 7th Edn, Prentice Hall, 2005.
2. A.I. Vogel, Vogel's Textbook of Practical Organic Chemistry, 5th Edn, Longman Publishers, 1998.
3. A. Bahl, Advanced Organic Chemistry, S Chand & Company Limited, 2010.

Suggestive digital platforms web links-

- <https://ncerthelp.com/>
- <https://ocw.mit.edu/courses/chemistry/>
- <https://www.clearitmedical.com/>
- <https://www.cliffsnotes.com/study-guides/chemistry/>

This course can be opted as an elective by the students of following subjects: Open for all

Course prerequisites: To study this course, a student must have had the subject General Microbiology in I semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 marks

Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks

Class performance/Participate: 5 Marks

Further Suggestions: None

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1	1	1	1	1	1	1	2
CO2	2	1	1	1	2	1	1	1	1	2
CO3	2	3	3	2	3	1	1	1	1	2
CO4	2	1	2	2	1	2	2	2	2	2
CO5	2	1	2	2	2	2	2	2	2	2
CO6	3	3	3	1	3	1	2	1	2	3
CO7	3	1	1	1	3	1	1	1	2	3
CO8	3	3	1	2	3	2	1	2	2	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	2
CO2	2	1	1
CO3	2	2	1
CO4	2	2	1
CO5	3	2	1
CO6	3	3	1
CO7	3	3	2
CO8	3	3	2

Programme/Class: Certificate	Year: First (1)	Semester: Second (II)
Subject: BIOTECHNOLOGY		
Course Code: B093202P	Course Title: Chemistry II Lab	
Course Outcomes:		
The student at the completion of the course will be able to:		
<ul style="list-style-type: none"> • Understand the instruments, microbial techniques and good lab practices for working in chemistry laboratory. • Develop practical skill in the laboratory experiments in chemistry. • Develop skills for identifying melting point, purification and crystallization of compounds. • Handle equipment use in chemistry laboratory. 		
Credits: 2	Core: Compulsory	
Max. Marks: 25+75	Min. Passing marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-2		
S. No.	Objectives	Total No. of Lectures/ Hours (60)
1	To find out the strength in gms/liter of the given solution of sodium hydroxide with the help of standard oxalic acid solution.	10
2	To determine the alkalinity in the given water sample by neutralization titration.	8
3	To determine the melting point of an organic compound containing C, H and O only.	8
4	To determine the melting point of an organic compound containing nitrogen.	8
5	To determine the melting point of an organic compound containing sulphur.	8
6	To decolourise and crystallize the given organic compound using Charcoal.	8
7	To purify the sample of benzoic acid using water as a solvent by recrystallization method.	10
Suggested Readings:		
<ol style="list-style-type: none"> 1. R. T. Morrison & R. N. Boyd, Organic Chemistry, 7th Edn, Prentice Hall, 2005. 2. A.I. Vogel, Vogel's Textbook of Practical Organic Chemistry, 5th Edn, Longman Publishers, 1998. 3. A. Bahl, Advanced Organic Chemistry, S Chand & Company Limited, 2010. 		
Suggestive digital platforms web links-		
<ul style="list-style-type: none"> • https://ncerthelp.com/ • https://ocw.mit.edu/courses/chemistry/ • https://www.clearitmedical.com/ • https://www.cliffsnotes.com/study-guides/chemistry/ 		
This course can be opted as an elective by the students of following subjects: Open for all		
Course prerequisites: To study this course, a student must have had the subject General Microbiology in I semester of certificate course in Microbial Technology		
Suggested Continuous Evaluation Methods		
Further Suggestions: None		

Programme/ Class: Bachelor of Science		Year: First (1)	Semester: Second (II)
Subject: BIOTECHNOLOGY			
Course Code: B093203T		Course Title: Fundamental of Computers	
Course outcomes: On completion of the course students will be able to: CO1: Increases the knowledge of fundamental concepts of computer for skill development at global level. CO2: Ability to know the Input-Output devices to acquire knowledge for better skill development. CO3: Ability to know Number System for skill development and employability. CO4: Ability to know the Memory for effective development of employability skills. CO5: Ability to demonstrate the Software Packages for better employability skills. CO6: Ability to know the CN, OS for skill development and employability. CO7: Ability to know the DBMS to enhance knowledge for skill development and employability globally. CO8: Ability to know the Internet for skill development and employability.			
Credits: 4		Core: Compulsory	
Max.Marks: 25+75		Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0			
Unit	Topics	Total No. of Lectures/ Hours (60)	
I	Introduction to Computer: Definition of computer, characteristics of computer, Applications of computer, Generations of computers, Types of computers, Block diagram of computer, CPU, ALU, Control Unit, Software, Hardware for skill development.	7	
II	Input-Output devices & Number System: Keyboard, Mouse, Scanner, touch screen, MICR, OCR, OMR and Barcode Reader; Monitor, Printer, Speaker, and Projector to acquire knowledge for better skill development.	8	
III	Number System: Positional and non-positional Numbers, requirements of number systems, Binary, Octal, Decimal, Hexadecimal and its conversion. Compliments: 1's compliment, 2's compliment, 9 compliments. BCD. Binary addition, Binary Subtraction for skill development and employability.	8	
IV	Memory: Memory Hierarchy, Main Memory, RAM, ROM (PROM, EPROM, EEPROM), Volatile Memory, Non-Volatile Memory, Flash Memory, Cache memory, hit, miss, Associate memory Magnetic disk, Magnetic tapes, virtual memory for effective development of employability skills.	8	
V	Software Packages: Introduction to software, Type of software, Microsoft Windows Microsoft Word, Microsoft Excel, Microsoft Power Point for better employability skills.	8	
VI	CN and OS: Introduction to Computer Network, types of Computer network, Operating System, objective of Operating System, Structure of operating system, function of operating system for skill development and employability.	8	
VII	DBMS: Introduction to DBMS. Type of DBMS, Application of DBMS, SQL to enhance knowledge for skill development and employability .	7	
VIII	Internet: Concept of Internet, Basics of E-mail, World Wide Web (WWW), web browsers, understanding URL, search engine, E- Commerce,	8	

	Surfing the web for skill development and employability.	
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Suggested Readings:

1. P. K. Sinha, Fundamentals of Computers, BPB Publications
2. E. Balagurusamy (2008), Computing Fundamentals And C Programming, Tata McGraw-Hill
3. Yashwant Kanitkar, Let Us C, BPB Publications
4. Rajeshree R Khande and Manisha Maddel ; Internet Programming & Industrial Law; Vision Publications, Pune.

Website Sources:

- swayam.gov.in
- onlinecourses.nptel.ac.in
- <https://www.geeksforgeeks.org/>
- https://www.tutorialspoint.com/computer_fundamentals/index.htm

This course can be opted as an elective by the students of following subjects: Open for all

Course prerequisites: To study this course, a student must have had the subject General Microbiology in I semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods

Further Suggestions: None

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	3	1	2	2	1	1	2	2	1
CO2	1	1	3	2	2	1	1	2	2	1
CO3	2	2	1	1	2	1	1	2	1	1
CO4	1	3	1	1	2	2	1	2	1	1
CO5	3	3	1	1	3	2	2	2	1	1
CO6	3	1	2	1	1	2	2	1	1	2
CO7	3	1	1	2	1	1	2	1	2	2
CO8	2	3	2	2	1	2	1	1	2	1

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	1	1
CO3	2	2	1
CO4	3	2	2
CO5	3	2	2
CO6	3	3	2
CO7	3	3	2
CO8	3	3	1

Programme/Class Certificate	Year: First (I)	Semester: Second (II)
Subject: Journalism		
Course Code: A270101T	Course Title: Basics of Mass Communication and Journalism	
Course outcomes: The student at the completion of the course will be able to: CO1: Students will get familiar with different types of Communication and Journalism for skill enhancement globally. CO2: Acquaint students with practical knowledge of Media related Computer software's for better skill development. CO3: Explain the need and importance of studying Communication across life span to acquire better employability skills. CO4: Identify the factors affecting Journalism for skill development at global level.		
Credits: 3	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks: 40%	
Total No. of Lectures-60		
Units	Topic	No of Lectures
Part- A: COMMUNICATION		
I	Communication: Meaning and Definition and Nature, Elements, Process, Functions, Types, 7Cs of communication. Communication Games for Ice Breaking for skill	09
II	Indian concepts of communication, Communication in Puranas and other Mythological Books, Narad as a Communicator, Dialogue with Nature, Need & Relevance of Indian Model of communication with special reference to Sadharnikaran Model for better skill development.	06
III	Communication Models: Berlo's Model of SMCR, Osgood model of communication, Laswell model of communication, Shanon-Weaver Model, Schramm Model, Communication flows: one step, two step, multi-step. Barriers in communication to acquire better employability skills.	07
IV	Theories of Mass Communication: Hypodermic needle theory, Agenda setting theory, Uses and gratification theory, Normative media theory, Four Press Theory, Diffusion of Innovation and other Relevant Theories of Communication for skill	08
Part -B: JOURNALISM		
V	Journalism: Meaning, Definition and Function of Communication Journalism Education in India Journalism as a Profession, Types of Journalism	07
VI	Origin and Development of Media: Newspaper, Radio, Television and Digital Media Pioneer Journalist of India	10
VII	Duties and responsibilities of a journalist. Values and Ethics of	04
VIII	Press Council of India, Prasar Bharati Board, RNI, Committees for Journalism	09

Suggested Readings:

- McQuail Denis. Mass Communication Theory, 4th ed., Sage Publication Ltd., London.→
- Wadsworth Julia T , Wood, Communication Mosaics: An Introduction to the Field of Communication. Littlejohn, W. Stephen. Theories of Human Communication, 3rd ed., Belmont, California, 1989→
- Wilbur Schram, Mass Communication, Sage Publication, New Delhi
- Uma Narula, Mass Communication Theory & Practice, Hiranand Publication, New Delhi.
- V.S. Gupta & VirBala Aggarwal, Hand Book of Journalism & Mass Communications, Concept Publishers, New Delhi.
- Marshal McLuhan, Understanding Media, Sage Publication.
- Kumar. J. Keval, 'Mass Communication in India, Jaico Publishing house, Bombay, (NewEd.).
- Schramm, W. & Roberts, D. F., The Process and Effects of Mass Communication, Urbana, IL: University of Illinois Press.
- Rayudu. C.S., Communication, Himalaya Publishing House, Mumbai
- Joshi, P.C., Communication→ & Nation – Building – Perspective and Policy, Publication Division, New Delhi.
- Malhan P.N., Communication Media, Yesterday, Today and Tomorrow, Publication Division, New Delhi.
- Agee, Warren K., Ault Philip H., Introduction to Mass Communication, Oxford & IBH Publishing Company, New Delhi
- **Suggestive digital platforms web links**-ePG-Pathshala, IGNOU & UPRTOU online study material Svayam Portal

This course can be opted as an elective by the students of following subjects: Open for all
The eligibility for this paper is 10+2 with any subject

Suggested Continuous Evaluation Methods:

- Seminar/ Presentation on any topic of the above syllabus
- Test with multiple choice questions/ short and long answer questions Attendance

Course pre requisites: The eligibility for this paper is 10+2 with any subject

Further Suggestions:

It widens the scope for students to join Government and Non-Government organization upskilling the people at different levels.

At the End of the whole syllabus any remarks/ suggestions: Students will be able to work as a reporter, Handling Media related software.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	2	2	2	1	1	2	1	1
CO2	2	1	2	2	2	1	1	1	1	2
CO3	3	2	3	2	2	2	3	1	2	2
CO4	3	2	3	3	3	2	3	1	1	3

**CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	2	1
CO3	3	3	2
CO4	3	2	2

Programme/Class: Certificate	Year: First (1)	Semester: Second (II)
Co-Curricular Course		
Course Code: Z020201	Course Title: First Aid and Health	
Course outcomes: At the end of the course students will able to: CO1: Provide awareness about use of first aid, laws related to first aid, simple hygiene techniques for better skill development at global level. CO2: Learn difference first aid technique used in heart, blood circulation and difference between CPR and recovery positions to enhance knowledge for better skill development. CO3: Get knowledge about first aid technique used in wounds, injuries, fractures and joint injuries for skill development and employability. CO 4: Learn the skills needed to provide first aid during nervous system, GIT conditions for skill enhancement.		
Credits: 2 (1Theory+1 Practical)		Compulsory
Max. Marks: 25+75		Min. Passing Marks: As per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 2-0-0		
Unit	Topics	No. of Lectures Total=15 Theory+3 0 Practical
I	<p>A. Basic First Aid</p> <ul style="list-style-type: none"> • Aims of first aid & First aid and the law. • Dealing with an emergency, Resuscitation (basic CPR). • Recovery position, Initial top to toe assessment. • Hand washing and Hygiene • Types and Content of a First aid Kit <p>B. First AID Technique</p> <ul style="list-style-type: none"> • Dressings and Bandages. • Fast evacuation techniques (single rescuer). • Transport techniques. <p>C. First aid related with respiratory system</p> <ul style="list-style-type: none"> • Basics of Respiration. • No breathing or difficult breathing, Drowning, Choking, Strangulation and hanging, • Swelling within the throat, Suffocation by smoke or gases and Asthma. <p>D. First aid related with Heart, Blood and Circulation</p> <ul style="list-style-type: none"> • Basics of The heart and the blood circulation. • Chest discomfort, bleeding. <p>E. First aid related with Wounds and Injuries</p> <ul style="list-style-type: none"> • Type of wounds, small cuts and abrasions • Head, Chest, Abdominal injuries • Amputation, Crush injuries, Shock 	<p style="text-align: center;">2 (Theory)10 (Practical)</p>
	<p>F. First aid related with Bones, Joints Muscle related injuries</p> <ul style="list-style-type: none"> • Basics of the skeleton, Joints and Muscles. • Fractures (injuries to bones) for better skill development. 	

	<p>G. First aid related with Nervous system and Unconsciousness</p> <ul style="list-style-type: none"> • Basics of the nervous system. • Unconsciousness, Stroke, Fits – convulsions – seizures, Epilepsy. <p>H. First aid related with Gastrointestinal Tract</p> <ul style="list-style-type: none"> • Basics of the gastrointestinal system. • Diarrhea, Food poisoning. <p>I. First aid related with Skin, Burns</p> <ul style="list-style-type: none"> • Basics of the skin. • Burn wounds, Dry burns and scalds (burns from fire, heat and steam). • Electrical and Chemical burns, Sun burns, heat exhaustion and heatstroke. • Frost bites (cold burns), Prevention of burns, Fever and Hypothermia. <p>J. First aid related with Poisoning</p> <ul style="list-style-type: none"> • Poisoning by swallowing, Gases, Injection, Skin <p>K. First aid related with Bites and Stings</p> <ul style="list-style-type: none"> • Animal bites, Snake bites, Insect stings and bites <p>L. First aid related with Sense organs</p> <ul style="list-style-type: none"> • Basic of Sense organ. • Foreign objects in the eye, ear, nose or skin. • Swallowed foreign objects. <p>M. Specific emergency satiation and disaster management to enhance knowledge for better skill development</p> <ul style="list-style-type: none"> • Emergencies at educational institutes and work • Road and traffic accidents. • Emergencies in rural areas. • Disasters and multiple casualty accidents. • Triage. • Emergency Child birth 	<p style="text-align: center;">2 (Theory) 10 (Practical)</p>
<p style="text-align: center;">III</p>	<p>Basic Sex Education</p> <ul style="list-style-type: none"> • Overview, ground rules, and a pre-test • Basics of Urinary system and Reproductive system. • Male puberty — physical and emotional changes • Female puberty — physical and emotional changes • Male-female similarities and differences • Sexual intercourse, pregnancy, and childbirth • Facts, attitudes, and myths about LGBTQ+ issues and identities • Birth control and abortion • Sex without love — harassment, sexual abuse, and rape • Prevention of sexually transmitted diseases for skill development and employability. 	<p style="text-align: center;">9 (Theory)</p>
<p style="text-align: center;">IV</p>	<p>Mental Health and Psychological First Aid</p> <ul style="list-style-type: none"> • What is Mental Health First Aid? • Mental Health Problems in the India • The Mental Health First Aid Action Plan • Understanding Depression and Anxiety Disorders • Crisis First Aid for Suicidal Behavior & Depressive symptoms • What is Non-Suicidal Self-Injury? • Non-crisis First Aid for Depression and Anxiety • Crisis First Aid for Panic Attacks, Traumatic events • Understanding Disorders in Which Psychosis may Occur • Crisis First Aid for Acute Psychosis • Understanding Substance Use Disorder for skill enhancement • Crisis First Aid for Overdose, Withdrawal 	<p style="text-align: center;">2 (Theory) 10 (Practical)</p>

- Using Mental Health First Aid

Suggested Readings:

1. Indian First Aid Manual-<https://www.indianredcross.org/publications/FA-manual.pdf>
2. Red Cross First Aid/CPR/AED Instructor Manual
3. <https://mhfa.com.au/courses/public/types/youthedition4>
4. Finkelhor, D. (2009). The prevention of childhood sexual abuse. Durham, NH: Crimes Against Children Research Center. www.unh.edu/ccrc/pdf/CV192.pdf
5. Kantor L. & Levitz N. (2017). Parents' views on sex education in schools: How much do Democrats and Republicans agree? PLoSONE, 12 (7): e0180250.
6. Orenstein, P. (2016). Girls and sex: Navigating the complicated new landscape. New York, NY: Harper.
7. Schwiengershausen, E. (2015, May 28). The Cut. www.thecut.com/2015/05/most-women-are-catcalled-before-they-turn-17.html
8. Wiggins, G. & McTighe, J. (2008). Understanding by design. Alexandria, VA: ASCD.

Suggested Web links:

- <https://marshallmemo.com/marshall-publications.php#8>

Suggested Continuous Evaluation Methods: Assignments, Presentation, Group Discussion, and MCQ

Suggested equivalent online courses:

- <https://www.redcross.org/take-a-class/first-aid/first-aid-training/first-aid-online>
- <https://www.firstaidforfree.com/>
- <https://www.coursera.org/learn/psychological-first-aid>

<https://www.coursera.org/learn/mental-health>

Further

Suggestions:.....

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	2	1	1	1	1	1	1	1
CO2	3	1	2	2	3	1	1	1	1	2
CO3	2	1	2	2	3	1	2	1	1	2
CO4	2	2	2	2	3	2	2	1	1	2
CO5	3	2	2	2	1	2	3	1	2	2
CO6	3	2	2	2	1	2	3	2	2	3
CO7	3	2	1	1	1	3	1	2	3	3
CO8	3	1	2	3	2	3	1	3	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	1	1
CO3	2	3	1
CO4	2	1	1
CO5	3	3	2
CO6	3	1	2
CO7	3	3	2
CO8	3	3	2

Course prerequisite

To study this course, student must have passed semester II.

Suggested Continuous Internal Evaluation (CIE) methods

Total marks: 25

10 marks for Test

10 marks for presentation along with assignment

05 marks for Class interactions

Further Suggestions: None

IFTM UNIVERSITY, MORADABAD
B.Sc. (BIOTECHNOLOGY)

SYLLABUS
BSB301T INTRODUCTION TO MICROBIOLOGY

Objective(s): The objectives of this course:

- Give a general introduction to the field of microbiology and investigate the amazing diversity of microbial life.
- Learn about the significant roles that microbes play in health, food, and the environment.
- Describe the key differences between the five groups of microbes.
- Explain how microbes replicate and why environmental conditions affect where they live.

UNIT I: **(8 Sessions)**

Introduction to Microbiology: History, scope and development of Microbiology; Applications of Microbiology in human welfare. Development of Microbiology in India & Abroad- Antony van Leeuwenhoek, Alexander Fleming, Edward Jenner, Louis Pasteur, Robert Koch, Selman Waksman, Joseph Lister, M.S. Swaminathan, T.S. Sadasivan and C.V. Subramaniam; Physical and chemical methods of sterilization; Pure Culture Techniques.

UNIT II: **(8 Sessions)**

Diversity of Microbial World A: Classification, general characteristics and structure of Bacteria-(eubacteria & archaebacteria), *Cyanobacteria*, *Actinomycetes*, *Mycoplasma*, *Rickettsia* & *Chlamydia* with emphasis on function of each part & components.

UNIT III: **(8 Sessions)**

Diversity of Microbial World B: Classification, general characteristics, structure with emphasis on *Mucor*, *Rhizopus*, *Puccinia*, *Cercospora*, *Aspergillus*, *Penicillium* *Alternaria* and *Curvularia*, function of each part & components of cell. Reproduction & economic importance of Fungi.

UNIT IV: **(8 Sessions)**

Diversity of Microbial World C: Classification, general characteristics and structure of Viruses (Prions, Virions, Virusoids & Viroids) Virus host, General features of virus reproduction. DNA & RNA Viruses with the example of T4, TMV & Pox Virus.

UNIT V: **(8 Sessions)**

Growth and growth measurement: Definition of growth, mathematical expression of growth. Growth curve, Growth yield, Effect of nutrient concentration on growth. Factors affecting growth: nutrients, temperature, oxygen, pH, osmotic pressure. Measurement of growth by measuring cell number, cell mass and cell activity Cell count, direct and indirect method, turbidometric method. Plate count method, membrane filter count method, dry weight and wet weight method by measurement of cellular activity. synchronous culture, continuous culture and batch culture.

IFTM UNIVERSITY, MORADABAD
B.Sc. (BIOTECHNOLOGY)

Course Outcomes:

At the end of the course students will be able to:

CO1: Understand the scope, application and development of microbiology for skill development, employability and entrepreneurship development.

CO2: Classify the bacteria on the basis of their habitat and function for skill development, employability and entrepreneurship development.

CO3: Distinguish the fungus from the microbial world and its role in product formation for skill development, employability and entrepreneurship development.

CO4: Know the microparticles- virus, and develop an understanding of structural elements and reproduction for skill development, employability and entrepreneurship development.

CO5: Understand the different phases of microbial growth, factors affecting the cell growth and will develop the knowledge to estimate the cell growth for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	2	1	3	1	2
CO2	2	2	1	3	3	2	2	3	2	2
CO3	1	2	2	3	2	1	3	3	3	2
CO4	3	2	2	2	2	1	3	2	2	1
CO5	2	2	2	2	1	1	3	1	2	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	2
CO2	2	2	2
CO3	1	3	1
CO4	2	2	2
CO5	2	1	1

Suggested Readings:

IFTM UNIVERSITY, MORADABAD
B.Sc. (BIOTECHNOLOGY)

1. M. J. Pelczar, E. C. S. Chan & N. R. Krieg, Microbiology, 5th Edn.; Tata McGraw Hill Publishing, 2003.
2. D. R. Harper, Viruses Biology, Applications, and Control, 3rd Edn., Garland Science Tylor & Fransic Group, 2012.
3. P. D. Sharma, 2nd Edn. Microbiology, Rastogi Publications, 2005.
4. R. C. Dubey & D. K. Maheshwari, A Text Book of Microbiology, 1st Edn.; S. Chand and Company Ltd., 2004.
5. H. C. Dubey, A Textbook of Fungi, Vikas Publishing House, 2005.
6. Vashistha, A Textbook of Fungi, S. Chand and Company Ltd., 2003

Website Sources:

- <https://onlinecourses.nptel.ac.in/>
- <https://www.wikipedia.org/>
- <https://library.nitrkl.ac.in/>
- <https://ecoursesonline.iasri.res.in/>

IFTM UNIVERSITY, MORADABAD
B.Sc. (BIOTECHNOLOGY)
SYLLABUS

BSB302T ENZYMOLOGY

Objective(s): The objectives of the course:

- Provide an insight into the fundamentals of enzyme structure, function and kinetics of enzymes.
- Explain how enzymes are able to increase speed of a biochemical reaction in sense of thermodynamics, kinetics and molecular interactions also it deals with current applications and future potential of enzymes.
- This will be helpful in developing concept for fermentation technology and downstream processing.

UNIT I: **(8 Sessions)**

Enzymes as Catalysts: Overview, historical background; Enzyme characteristics and properties; Coenzyme, Cofactor, Apoenzyme, Holoenzyme, Prosthetic group, Enzyme nomenclature & classification; Enzyme Isolation, Purification and Characterization.

UNIT II: **(8 Sessions)**

Mechanism of Enzyme Kinetics: Kinetics of single substrate reactions (Michaelis- Menten equation); Enzyme inhibition (Competitive, Non- competitive, Mixed); Two or more than two substrate kinetics.

UNIT III: **(8 Sessions)**

Enzyme Immobilization: Overview, Types of enzyme immobilization viz adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding - examples; Advantages and disadvantages of different Immobilization techniques; Overview of applications of immobilized enzyme systems

UNIT IV: **(8 Sessions)**

Enzyme Regulation: Methods of enzyme regulation- covalent modification and zymogen activation, Allosteric regulation Partial Proteolysis; Disulphide reduction.

UNIT V: **(8 Sessions)**

Applications of Enzymes: Application of enzyme in industries- Food, Beverages, Detergent, Textile, Leather, Agricultural and pharmaceutical.

Course Outcomes:

At the end of the course students will be able to:

CO1: Understand enzyme nomenclature, classification, and purification techniques for skill development, employability and entrepreneurship development.

CO2: Derive the kinetics expression of enzymatic reactions like Michaelis- Menten Equation for skill development, employability and entrepreneurship development.

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CO3: Understand the immobilization techniques and will learn methods and applications for skill development, employability and entrepreneurship development.

CO4: Identify the regulatory factors of enzymes for skill development, employability and entrepreneurship development.

CO5: Explore the application of enzymes in food, beverages, and agriculture industries for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	2	2	3	2	2	1	1	2
CO2	3	2	3	1	2	3	2	2	2	2
CO3	1	3	2	1	2	2	2	3	3	2
CO4	3	2	3	1	2	2	2	3	2	2
CO5	1	1	1	1	2	2	2	2	2	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	2
CO2	2	2	2
CO3	2	2	1
CO4	1	2	3
CO5	3	1	2

Suggested Readings:

1. A. Fersht, Structure and Mechanism in Protein Science, World Scientific, 2017.
2. N. Price & L. Stevens, Fundamentals of Enzymology, 2nd Edn., Oxford University Press, New York, NY.
3. T. Palmer, Understanding Enzymes, 2nd Edn., John Wiley & Sons, New York.
4. D. Voet & J. G. Voet, Biochemistry, John Wiley & Sons, New York, 2011.
5. G. Zubay, Biochemistry, 3rd Edn., Wm. C. Brown, Oxford, 1993.
6. J. M. Berg, J. L. Tymoczko & L. Stryer, Biochemistry, 7th Edn., W.H.Freeman, 2010.

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- <http://www.odofin.com/enzyme%20technology.htm>
- <https://www.thesciencenotes.com/enzyme-technology/>
- https://application.wiley-vch.de/books/sample/3527329897_c01.pdf

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SYLLABUS

BSB303T GENETICS

Objective: The objectives of this course:

- Is to cover the basics of hereditary.
- To concentrate on two areas of genetics: Mendelian (or transmission) genetics and population/evolutionary genetics.
- To tell that how the genetic material replicates and is passed on, contains information that results in a phenotype, and can change.
- to discuss recent discoveries as well as historical concepts.

UNIT I: **(8 Sessions)**

Introduction to Genetics: Historical perspective and theories (Preformationism, Epigenesis, Pangenesis, Hybrid Experiments); Chromosomes- Polytene, Lampbrush & DNA in Chromosomes; Significance of DNA- Griffith, Harsh & Chase, Avery Macleod and Macarty's Experiments.

UNIT II: **(8 Sessions)**

Mendelian Principles: Mendel's Experiment and terminologies; Law of Segregation; Law of Independent assortment, Segregation-Assortment of Haploids; Punnet Square; Tetrad analysis; Incomplete, Over and Co-dominance, Multiple allelism (ABO blood group); Gene interaction and lethality.

UNIT III: **(8 Sessions)**

Arrangement of genetic material: Sex linkage and maternal effect of cytoplasmic hereditary; Linkage and recombination; Bacterial transformation, transduction and conjugation.

UNIT IV: **(8 Sessions)**

Chromosomal aberrations: Euploidy, polyploidy, aneuploidy; Sex chromosomes number; barr bodies, heterochromatin, trisomy of 21st chromosome and related syndromes; Structural variations- duplication, inversion, breakage; Mutation and repair.

UNIT V: **(8 Sessions)**

Population genetics: Gene frequencies; Gene pool; Population equilibrium; Selection and fitness; Genetic drift and shift; Inbreeding and heterosis- Types and theories.

Course outcomes:

At the end of the course students will be able to:

CO 1: Understand historical perspective and theories related to genetics based on experiments and basic about DNA and chromosomes for skill development and employability.

CO2: Learn about Mendel's Experiment Laws and terminologies and exceptions to classical theories like Incomplete, Over and Co-

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dominance, Multiple allelism, etc for skill development and employability.

CO3: Understand how cytoplasmic inheritance occurs and new combination of genes form; bacterial inheritance in processes for skill development and employability.

CO4: Understand the value of intactness of chromosomes and various syndromes based on mutation or changes in chromosomal number and structure for skill development and employability.

CO5: Understand population genetics, gene frequencies; Gene pool; Population for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	2	3	2	2	2	1	2	2
CO2	3	3	3	3	2	2	2	2	2	2
CO3	3	2	3	3	2	3	2	3	2	3
CO4	2	3	3	3	2	3	2	3	2	3
CO5	3	3	3	3	1	3	2	2	2	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	2	2
CO2	3	2	2
CO3	1	3	2
CO4	2	2	1
CO5	2	3	2

Suggested Readings:

1. Genetics – Classical to modern, 1st Edition. P.K. Gupta. 2013.
2. Principles of Genetics, 7th Edition, Robert H. Tamarin. 2002. Tata- Mc Graw Hill publications.
3. Theory and Problems of Genetics. W. D. Stansfield. 2002. Mc Graw Hill publications.
4. Genetic Maps, 6th edition by O'Brien, S (1993) Book

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5. Genetics, 2nd Edition, by Weaver, R.F. and Hendrick, P.W. (1992). W.C. Brown.
6. Instant notes in Genetics by P.C.Winter, G.I. Hickey and H.L.Fletcher (2003) Viva Books Pvt.Ltd.
7. Principles of Genetics by E.J.Gardener, M.J.Simmons and D.P.Snustad.J.Wiley and Sons pubs (1998).

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- <https://www.edx.org/learn/genetics>
- <https://unlockinglifescode.org/node/976>
- <https://serc.carleton.edu/introgeo/interactive/examples/14297.html>
- <https://educationaladvancement.org/blog-introduction-to-mendelian-genetics/>
- <https://freevidelectures.com/course/4877/nptel-biology-engineers-other-non-biologists/19>

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SYLLABUS
BSB304T BIODIVERSITY AND SYSTEMATICS

Objective(s): The objectives of this course:

- Provide a comprehensive introduction to all areas of systematic biology, from species description to phylogeny reconstruction.
- Develop understanding for ecosystem, its components, role and importance.
- Develop the concept of biodiversity and conservation of ecosystem.
- Let the learners know the importance of museum sciences, and the role of systematic in conservation biology.
- Define different stages of growth, its affect on society and population density are also described to correlate the biological systems.

UNIT I: (8 Sessions)

Biodiversity & Population Dynamics: Biodiversity – Concept of diversity, species, ecosystem; genetic; Population Dynamics- Population density & relative abundance, Population age distribution, Growth forms & carrying capacity.

UNIT II: (8 Sessions)

Ecosystem, Biodiversity & Biogeography: Concept of species, Ecosystem; Habitat & niche, Ecological equivalence, Biological clock, Basic behavioral patterns; Biodiversity & major biomes of world; Biogeography- a comprehensive account of flora and fauna in different bio-geographical region.

UNIT III: (8 Sessions)

Conservation of Biodiversity: Importance,-Conservation strategies; *in situ* and *ex situ* methods- advantages, limitations and applications; Conservation laws, policies and organizations.

UNIT IV: (8 Sessions)

Threats to Biodiversity: Natural and anthropogenic threats to biodiversity; Human-Animal conflict with special reference to elephants and tigers; IUCN Threat Categories-Red Data Book; Wildlife exploitation - Species extinctions. Susceptibility for Extinction, Endangered and endemic species of India; Impact of over-harvesting and Climate change on biodiversity; Causes and Impacts of Invasive species to biodiversity.

UNIT V: (8 Sessions)

Biosystematics: Analysis of Biodiversity- Biodiversity indices, Mathematical modeling for analysis of population variation.

Course Outcomes:

Students will be able to understand:

At the end of the course students will be able to:

CO1: Be aware of concepts related to Biodiversity & Population Dynamics like distribution, diversity of species, population genetics & carrying capacity of the biosphere for skill development, employability and entrepreneurship development.

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CO2: Learn about different ecosystems, biodiversity in the context of Biogeographical region, Biological clock, Basic behavioral patterns; Biodiversity & major biomes of the world for skill development, employability and entrepreneurship development.

CO3: Learn about the conservation of biodiversity and the organizations, laws& policies enforced for environment protection for skill development, employability and entrepreneurship development.

CO4: Learn about various activities that are threats towards Biodiversity, conservation of endangered species; IUCN Threat Categories-Red Data Book; Wildlife exploitation Endangered and endemic species of India for skill development, employability and entrepreneurship development.

CO5: Understand Biosystematics, Analysis of Biodiversity- Biodiversity indices, Mathematical modelling for analysis of population variation for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	2	3	2	2	2	1
CO2	2	2	2	3	2	2	2	3	2	1
CO3	1	1	2	2	2	2	3	2	3	3
CO4	3	1	2	2	2	1	2	3	2	3
CO5	1	2	1	1	1	2	2	2	1	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	1
CO2	2	2	2
CO3	2	2	1
CO4	2	1	1
CO5	1	1	2

Suggested Readings:

1. Albert E, Radford, Gloria May C A dell, Fundamentals of Plant Systematics, First Ed. Harper & Raw, 1986.
2. Naik, V.N. Taxonomy of Angiosperms. Second Ed Tata McGraw Hill, New Delhi.1984.

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3. Thomas M. Smith and Robert Leo Smith. Elements of Ecology, 8th Edition. Benjamin Cummings.2012.
4. Freeman & Herron. Evolutionary Analysis, 3rd Edition.Pearson.2007.
5. M.P. Singh, B.B. Singh, B.S. Singh and Soma Dey. Plant Biodiversity and Taxonomy, First Ed. Daya Publishing House. 2002.

Websites Sources:

- <https://www.environment.gov.au/biodiversity/conservation>
- <https://www.conserve-energy-future.com/biodiversity-conservation-types-importance-methods.php>
- <https://sites.nicholas.duke.edu/ecologyapp/modules/population-dynamics/>
- http://ib.berkeley.edu/courses/ib200a/ib200a_sp2010/lect/ib200a_lect16a_Lindberg_biological_systematics.pdf

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SYLLABUS

BSB305T MODERN ANALYTICAL TECHNIQUES

Objective(s): The objectives of this course:

- Let the student acquire basic concepts, principles, and techniques of modern analytical techniques.
- Empower students with an analytical mind set and the abilities to solve diverse analytical problems in an efficient and quantitative way
- Make student learn the principle behind the basic techniques like chromatography, electrophoresis and their application in diverse fields.

UNIT I: **(8 Sessions)**

Concept of Good Laboratory Practices: Parts of GLP, Good Manufacturing Practices, Quality assurance and Quality Control, Steps of Analysis, Basic Aspects of Qualitative and Quantitative Analysis. Accuracy and Precision.

UNIT II: **(8 Sessions)**

Microscopy & Spectroscopy: Simple and Compound microscope; Overview of Electromagnetic spectrum; Beer-Lambert's Law: UV-Vis spectrophotometer, Colorimeter, Raman Effect, IR Spectroscopy- Their Instrumentation, Principle, Working and application

UNIT III: **(8 Sessions)**

Centrifugation: Theory and Principle of centrifugation, sedimentation, sedimentation rate, sedimentation coefficient. Use and design of different types of rotors, Types of centrifuges, Preparative and analytical centrifugation, Density gradient centrifugation (zonal and isopycnic), differential centrifugation.

UNIT IV: **(8 Sessions)**

Chromatography: Plate and Rate Theory, Principle of Chromatography, Chromatographic performance parameters, High performance liquid chromatography, adsorption chromatography, partition chromatography, Ion-exchange chromatography, molecular exclusion chromatography, affinity chromatography, normal and reverse phase chromatography.

UNIT V: **(8 Sessions)**

Electrophoresis: Theory of electrophoresis, General Principle, Native PAGE, SDS PAGE, Agarose gel electrophoresis, Iso-electric focusing, pulse gel electrophoresis, Capillary Electrophoresis.

Course Outcomes:

At the end of the course students will be able to:

CO1: Understand the concept of GLP and GMP, quality assurance and quality control, and aspects related to their analysis for skill development, employability and entrepreneurship development.

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CO2: Understand the EM spectrum and various spectroscopy- their principle and instrumentation for skill development, employability and entrepreneurship development.

CO3: Learn all the related aspects of centrifugation and sedimentation for skill development, employability and entrepreneurship development.

CO4: Learn the principle of chromatography and its various types for skill development, employability and entrepreneurship development.

CO5: Understand the concept of electrophoresis and its types for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	2	3	2	2	2	1
CO2	2	2	2	3	2	2	2	3	2	1
CO3	1	1	2	2	2	2	3	2	3	3
CO4	3	1	2	2	2	1	2	3	2	3
CO5	3	2	1	1	1	2	2	2	1	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	2
CO2	2	3	2
CO3	2	3	3
CO4	2	3	3
CO5	1	3	3

Suggested Readings:

1. K. Wilson & J. Walker, Principles and Techniques of Biochemistry and Molecular Biology, 7th Edn., Cambridge University Press.
2. S. K. Sawhney & R. Singh, Introductory Practical Biochemistry, 2nd Edn., Alpha Science International, 2005
3. G. R. Chatwal & S. K. Anand, Instrumental Methods of Chemical Analysis, 5th Edn., Himalaya Publishing House, 2019.

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- <https://www.wikipedia.org/>
- <https://library.nitrkl.ac.in/>
- <https://onlinecourses.swayam2.ac.in/>

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SYLLABUS

TEHU-301 DISASTER MANAGEMENT

Objective: The objective of this course is to provide students an understanding to the concepts and aspects of disaster and its relationship with development. To ensure awareness of Disaster Risk Reduction (DRR) approaches among students. To assist students, develop ability to respond to their environment with potential response to disaster.

UNIT I: (12 Sessions)

Introduction to Disasters

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks; Types of disasters – Earthquake, Landslide, Flood, Drought, Fire, campus shooting, bomb threat, terrorist incidence and financial emergency etc.; Causes and Impacts including social, economic, political, environmental, health, psychosocial, etc.; Differential impacts- in terms of caste, class, gender, age, location, disability; Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II: (10 Sessions)

Approaches To Disaster Risk Reduction

Disaster life cycle – its analysis, phases, culture of safety, prevention, mitigation and preparedness; Community based DRR (Disaster Risk Reduction), Structural-nonstructural measures; Roles and responsibilities of community: Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders

UNIT III: (08 Sessions)

Inter-Relationship between Disasters and Development

Factors affecting Vulnerabilities, impact of Development projects such as dams, embankments, changes in Land-use etc.; Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India – Relevance of indigenous knowledge, appropriate technology and local resources; Role of international cooperation's in Disaster Management

UNIT IV: (08 Sessions)

Disaster Risk Management In India

Hazard and Vulnerability profile of India. Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management; Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy – Other related policies, plans, programmes and legislation; Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V: (07 Sessions)

Disaster Management: Applications, Case Studies and Field Works

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The project /fieldwork are meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived creatively based on the geographic location and hazard profile of the region where the college is located.

A few ideas or suggestions are discussed below:

Several governmental initiatives require Urban Local Bodies (ULBs) and Panchayati Raj Institutions (PRIs) to be proactive in preparing DM plans and community-based disaster preparedness plans. Information on these would be available with the district collector or Municipal corporations.

Teachers could ask students to explore and map disaster prone areas, vulnerable sites, vulnerability of people (specific groups) and resources. The students along with teacher could work on ways of addressing these vulnerabilities, preparing plans and consultation with local administration or NGOs.

Students could conduct mock drills in schools, colleges or hospitals. They could also work on school safety, safety of college buildings, training in first aid. Other examples could be- identifying how a large dam, road/ highway or an embankment or the location of an industry affects local environment and resources or how displacement of large sections of people creates severe vulnerabilities may be mapped by student project work.

The suggested topics for Project work for student could be as follows:

- Monitoring and evaluation plan for disaster response
- Low cost Home based water purification methods
- Planning Nutrition intervention programmes
- Safety tips before during and after earthquake, cyclone, floods and fire accidents.
- Mock Drills
- Major disasters in India
- Disaster Management in India
- Flood affected areas and damages in India
- Heat waves in India
- Earth quakes in India
- Historical Tsunamis in India
- Nuclear emergence
- Traffic accidents in India
- Train Accidents
- Major disease outbreak
- Disaster management structure in India
- Precaution, mitigation of disaster in India
- Warning system in India to prevent disaster
- Bhopal gas tragedy
- Kutch earth quake
- Tsunami (2004)

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- Kosi Calamity 2008
- Mayapuri radiation exposure Delhi (2010)
- Mock exercises

Course Outcome:

At the end of the course students will able to:

CO1: Ability to understand major types of disaster in Indian context for skill development

CO2: Understanding of approaches to reduce disaster risks for employability.

CO3: Capable of understanding relationship between development and disaster. Sustainable development for skill development

CO4: Understanding of when an event becomes disaster and the phases to handle the situation for employability

CO5: Ability to analyze how to handle a situation of disaster by taking case studies of events in past for skill development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	3	3	2	2	2	3	2
CO2	3	2	2	2	2	2	2	2	3	2
CO3	2	3	1	2	2	2	2	1	2	2
CO4	1	2	1	2	2	2	2	2	2	2
CO5	2	1	2	2	1	2	2	1	1	1

C CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	2	1
CO2	3	3	3
CO3	1	2	2
CO4	2	1	1
CO5	1	2	1

Suggested Readings:

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2. Alexander David, Introduction in 'Confronting Catastrophe', Oxford University Press
3. Damon P. Coppola, Introduction to International Disaster Management, Butterworth-Heinemann,
4. Singhal J.P. “Disaster Management”, Laxmi Publications. ISBN-10: 9380386427 ISBN-13: 978-9380386423
5. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., . ISBN-10: 1259007367, ISBN-13: 978-1259007361]
6. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi
7. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IAS and Sage Publishers, New Delhi.
8. Cuny, F. Development and Disasters, Oxford University Press. Document on World Summit on Sustainable Development.
9. Special Issue on Psychosocial Aspects of Disasters, Volume 63, Issue 2, April.

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- https://www.physio-pedia.com/Disaster_Management
- <http://www.ifrc.org/en/what-we-do/disaster-management>
- <http://www.wcpt.org/disaster-management/what-is-disaster-management>
- en.wikipedia.org

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SYLLABUS

BSB301P Introduction to Microbiology Lab

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipments and Accessories: Principle and Working	
5.	Microbiology Good Laboratory Practices and Biosafety.	Experiment 1
6.	To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter, micrometer [ocular and stage], haemocytometer) used in the microbiology laboratory.	Experiment 2
7.	Preparation of culture media (Nutrient Broth and Nutrient Agar) for bacterial cultivation.	Experiment 3
8.	Sterilization of medium and Glass ware using Autoclave and Hot Air Oven and assessment for sterility.	Experiment 4
9.	Sampling and quantification of microorganisms in air, soil and water	Experiment 5
10.	Isolation of bacteria [Streak plate, spread plate, pour plate, serial dilution].	Experiment 6
11.	Identification of microorganisms from the habitats [simple staining, differential staining, acid fast staining, capsule staining, spore staining and motility].	Experiment 7
12.	Observation of morphology - shape and arrangement of cells bacteria, phytoplanktons & zooplanktons.	Experiment 8

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SYLLABUS

BSB302P Enzymology Lab

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipments and Accessories: Principle and Working	
5.	Introduction to Enzymology Laboratory.	Experiment 1
6.	Extraction of enzyme from plant source.	Experiment 2
7.	To determine the effect of temperature on the rate of enzyme action.	Experiment 3
8.	To determine the effect of pH on the rate of enzyme action.	Experiment 4
9.	To determine the effect of substrate concentration on the rate of enzyme action.	Experiment 5
10.	To determine the effect of enzyme concentration on the rate of enzyme action.	Experiment 6
11.	Extraction of pure amylase enzyme and its mode of action on substrate (starch).	Experiment 7
12.	Immobilization of amylase enzyme.	Experiment 8

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SYLLABUS

BSB401T BASICS OF IMMUNOLOGY

Objective(s): The objectives of this course:

- Includes a detailed description of the immune response made in humans to foreign antigens including microbial pathogens.
- A description of cells involved in the immune response either innate or acquired.
- Is to teach how the immune system recognizes self from non-self and B and T cell maturation and specific responses.
- Other topics covered will include the genetic basis of diversity of immune responses in mammals.

UNIT I:

(8 Sessions)

Basics of Immunology: History and scope of Immunology, Types of Immunity- Innate and Acquired immunity (Humoral and Cell Mediated Immunity).

UNIT II:

(8 Sessions)

Organization of immune system: Cell and organs of immune system and their functions (Primary and Secondary lymphoid organs); Hematopoiesis; Clonal selection theory.

UNIT III:

(8 Sessions)

Antigens & Antibody: Antigen, Epitope, Haptens, Adjuvant, Factors influencing immunogenicity, Antibodies- Structure, types, and functions of immunoglobulins; Antigen Antibody reaction- Precipitation, Immuno-electrophoresis, Haem-agglutination, RIA and ELISA.

UNIT IV:

(8 Sessions)

Histocompatibility: Structure of MHC class I & II; Antigen processing and presentation; Complement system: Classical and alternate pathways of complement activation.

UNIT V:

(8 Sessions)

Vaccines and Immunization: Passive and Active immunization, Types of Vaccines- Inactivated, Attenuated, Recombinant and Sub Unit Vaccines, Peptide and DNA Vaccines; Hybridoma technology- Production of monoclonal antibodies; Hypersensitivity, Autoimmunity.

Course outcomes:

At the end of the course students will be able to:

CO1: Compare and contrast innate and adaptive immunity for skill development.

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CO2: Understand the cell types and organs present in the immune response for skill development.

CO3: Will gain practical application on the various Immunological techniques viz ELISA, RIA, and western blotting for disease diagnosis for skill development, employability and entrepreneurship development.

CO4: Exemplify the adverse effect of the immune system including Allergy, hypersensitivity and autoimmunity for skill development, employability and entrepreneurship development.

CO5: Elucidate the reasons for immunization and be aware of different vaccination for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	3	3	3	2	3	3	2
CO2	2	2	3	3	3	2	2	3	3	2
CO3	3	1	3	1	2	1	1	2	2	3
CO4	2	3	3	3	2	3	2	1	2	2
CO5	1	2	3	2	2	2	2	2	2	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	2
CO2	2	2	1
CO3	2	2	2
CO4	2	3	3
CO5	2	3	3

Suggested Readings:

1. A. K. Abbas, A. H. H. Lichtman, S. Pillai, Basic Immunology Function and Disorder of Immune System, 6th Edn., Elsevier Publisher, 2019.
2. T. J. Kindt, B. A. Osborne, R. A. Goldsby, Kuby, Immunology, 6th Edn., W. H. Freeman & Co., 2007.
3. P. J. Delves, S. J. Martine, D. R. Burton, I. M. Roitt, Roitt's Immunology, 12th Edn. Wiley-Blackwell, 2011.

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4. F. H. Khan, The Element of Immunology, Pearson Education, 2009.
5. A. Kumar, Textbook of Immunology, Teri Publishers, 2013.

Website Sources:

- <https://microbenotes.com/what-is-immunology/>
- <http://www.helmberg.at/immunology.pdf>
- <https://ocw.mit.edu/courses/health-sciences-and-technology/hst-176-cellular-and-molecular-immunology-fall-2005/lecture-notes/>
- <http://www.roitt.com/mcqlist.asp>

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B.Sc. (BIOTECHNOLOGY)

SYLLABUS

BSB402T CELL & MOLECULAR BIOLOGY

Objective(s): The objectives of this course:

- Is to impart knowledge to students about the cell and its organelles and the signal mechanisms used to transmit the message across the cell.
- Make students learn the importance of the molecular mechanisms present in the cell which functions to ensure the survival and continuity of the organism like DNA replication, transcription etc.
- Students will also have an introduction about the basic molecular techniques like PCR and Blotting techniques.

UNIT I:

(8 Sessions)

Cell and its organization: Eukaryotic and prokaryotic cells; Structure and Function of the Cell and Its Organelles; Cell division- mitosis and meiosis, cell cycle.

UNIT II:

(8 Sessions)

Membrane receptor and Signal Transduction: Cytosolic, nuclear and membrane bound receptors, Signal amplification, different models of signal amplifications, role of cyclic AMP in signal transduction. Transport Across Cell Membranes- Passive & active transport, sodium potassium pump, co transport, symport, antiport, endocytosis and exocytosis.

UNIT III:

(8 Sessions)

DNA Replication and Transcription: Bacterial DNA replication; Structure of bacterial RNA polymerase; Transcription events, and sigma factor cycle; Eukaryotic RNA polymerase; Promoter sequences; TATA box; Enhancers; Upstream activating sequences: RNA processing.

UNIT IV:

(8 Sessions)

Translation and Gene regulation: Prokaryotic and Eukaryotic translation; Mechanisms of initiation; Elongation and termination; Regulation of translation; Post-translational modifications and intracellular proteins transport; Control of gene expression in prokaryotes, Operon model- lac and trp operon.

UNIT V:

(8 Sessions)

Tools in Molecular Biology: Purification of nucleic acid; Molecular Probes-labeling of probes, Southern blotting, Northern blotting, Western blotting, DNA fingerprinting.

Course Outcomes:

At the end of the course students will be able to:

CO1: Describe the cell and its properties, structural components and organelles, types of cell division, and significance of cell cycle for skill

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development and employability.

CO2: Understand the different types of receptors and their mechanism of action, signal amplification, the role of cyclic AMP in signaling, and different types of transport mechanisms for skill development and employability.

CO3: Describe the mechanism of bacterial replication, structure of prokaryotic and eukaryotic RNA Polymerase, mechanism of transcription in prokaryotes, significance of promoter sequences, and RNA processing for skill development, employability and entrepreneurship development.

CO4: Explain the molecular mechanisms of translation in prokaryotes and eukaryotes, post-translational modifications of proteins, and mechanisms of regulation of gene expression in prokaryotes for skill development, employability and entrepreneurship development.

CO5: Define the various molecular tools and techniques like purification of nucleic acid, PCR, and Blotting techniques and the importance of molecular probes for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	3	2	2	3	2	3	2
CO2	2	2	1	2	2	2	3	2	2	2
CO3	2	2	1	2	1	3	2	1	2	3
CO4	2	2	1	3	3	3	2	2	2	3
CO5	2	2	1	2	2	3	1	1	2	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	2
CO2	2	2	2
CO3	2	2	1
CO4	2	2	2
CO5	2	2	2

Suggested Readings:

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1. G. M. Cooper & R. E. Hausman, The Cell: A Molecular Approach, 4th Edn, ASM Press and Sinauer Associates, Inc.,USA, 2007.
2. H. Lodish et al, Molecular Cell Biology, 6th Edn., W. H. Freeman, 2007.
3. T.W. Kimball, Cell Biology, 3rd Edn., Wesley Publishers, 2007.
- J. D. Watson et al, Molecular Biology of the Gene, 7th Edn., Pearson, 2014.
5. De Robertis and De Robertis, Cell and Molecular Biology, 8th Edn., Lippincott Williams, Philadelphia, [B.I Publications Pvt. Ltd. New Delhi], 2005.

Website Sources:

- <https://ocw.mit.edu/courses/chemistry/>
- <https://www.easybiologyclass.com/topic-biochemistry/>
- <https://www.cliffsnotes.com/study-guides/biology/biochemisry>
- <https://ocw.mit.edu/courses/health-sciences-and-technology/>

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SYLLABUS

BSB403T RECOMBINANT DNA TECHNOLOGY

Objective(s): The objectives of this course:

- Is to introduce students to basic molecular biological concepts and techniques used in the fields of biotechnology and genetic engineering.
- Will give students insight into the techniques used to cut up and join together genetic material, especially DNA from different biological species and to introduce the resulting hybrid DNA into an organism in order to form new combinations of heritable genetic material.
- Make the learner understand strategies which help in controlling gene expression, manipulating gene structure and gene containment.

UNIT I: **(8 Sessions)**

Introduction: Concepts of recombinant DNA technology, Tools of r-DNA technology- Adaptors and Linkers, DNA ligase, Modifying enzymes, Restriction enzymes.

UNIT II: **(8 Sessions)**

Vectors in Gene Cloning: Plasmids- Structure and Genomic organization of pBR 322 and pUC 18, Ti plasmid, Cosmids, Phagemids, shuttle vectors, expression vectors- Yeast Artificial Chromosome (YAC).

UNIT III: **(8 Sessions)**

Gene recombination and Gene Transfer: Transformation, Bacterial Conjugation, Transduction, Transfection, Microinjection, Electroporation, Shot-gun method.

UNIT IV: **(8 Sessions)**

In-vitro construction of recombinant DNA molecule: Screening and selection of recombinant host cells; Gene libraries- Genomic DNA and cDNA library.

UNIT V: **(8 Sessions)**

Techniques: Polymerase chain reaction (PCR), Types of PCR-Nested PCR, Hot-start PCR, Reverse transcriptase PCR, Real time PCR, anchored PCR, Site directed mutagenesis, Application of r-DNA technology.

Course Outcomes:

At the end of the course students will be able to:

CO1: Familiarize the basic concepts of recombinant DNA technology such as tools of rDNA technology, different types of commonly employed enzymes, and their use in r-DNA techniques for skill development, employability and entrepreneurship development.

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CO2: Understand the vectors used in gene cloning such as Plasmids, Ti plasmid, Cosmids, Phagemids, shuttle vectors, expression vectors like YAC for skill development, employability and entrepreneurship development.

CO3: Understand the different mechanisms of gene recombination like transformation, bacterial conjugation and methods of gene transfer such as transfection, microinjection, electroporation, shot-gun method for skill development, employability and entrepreneurship development.

CO4: Describe the technique of construction of recombinant DNA molecule and gene libraries, screening, and selection of recombinant host cells for skill development, employability and entrepreneurship development.

CO5: Define the concept of PCR technique, principle and procedure of PCR, components of PCR, and different types of PCR techniques and identify the applications of rDNA technology for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	3	2	3	3	3	3	3	3	2
CO2	2	3	3	2	3	3	2	2	2	2
CO3	3	2	3	2	2	2	2	2	3	3
CO4	2	2	2	3	2	2	2	2	2	3
CO5	2	2	2	3	2	1	2	2	2	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	3
CO2	3	2	2
CO3	3	2	2
CO4	3	2	2
CO5	2	2	2

Suggested Readings:

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1. B. R. Glick, J. J. Pasternak, C. L. Patten, Molecular Biotechnology: Principles and Applications of Recombinant DNA, 2010.
2. T. A. Brown. Gene Cloning and DNA Analysis: An Introduction, 2020.
3. Harvey Lodish, David Baltimore, Arnold Berk. Molecular Cell Biology, W H Freeman & Co (Sd), 2008.
4. Benjamin Lewin – Genes VIII, 2004.

Website Sources:

- <https://onlinecourses.nptel.ac.in/>
- <https://www.wikipedia.org/>
- <https://www.ncbi.nlm.nih.gov/books>

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SYLLABUS

BSB404T INTRODUCTORY BIOSTATISTICS

Objective(s): The objectives of the course:

- To learn Biostatistics for designing data collection plans, analyze data appropriately and interpret and draw conclusions from those analyses.
- Is to help in learning advance statistical science and its application in problems of human health and disease.
- Is advancing statistics and analyzing data for research problems

UNIT I:

(8 Sessions)

Introduction to Biostatistics: Definition, Statistical method biology measurement, Kinds of biological data, Function of statistics and limitation of statistics, Application of biostatistics, Role of biostatistics in modern research, Parametric and non-parametric methods (Tests).

UNIT II:

(6 Sessions)

Collection of data: Presentation of data classification and tabulation, Type of representation (graphic-bar diagram, pie-diagram, Curves and basic concept of calculus), Sampling and sampling design.

UNIT III:

(6 Sessions)

Measures of central tendencies: Mean, Median, Mode, Geometric mean, Measure of dispersion, Variability and changes, Deviation- Quartile deviation, Mean deviation, Standard deviation, Standard error, Coefficient of variations.

UNIT IV:

(8 Sessions)

Different Test: Test of hypothesis, Test of significance, t-test, Chi-square test, F-test and ANOVA with numerical.

UNIT V:

(12 Sessions)

Probability theory: Probability theory of random experiment and associated sample space, Events, Definition of probability, Algebra of events, Addition and multiplication theorems on probability (without proof), Probability distribution, Binomial distribution, Poisson distribution and Normal distribution and their applications in biostatistics.

Course Outcomes:

At the end of the course students will be able to:

CO1: Demonstrate knowledge of the properties of parametric, semi-parametric and non-parametric testing procedures in Biostatistics for skill development.

CO2: Remember restate the principal concepts about biostatistics and collect data relating to variable which will be examined for skill development.

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CO3: Understand and interpret the concepts of descriptive statistics from these data for skill development.

CO4: Understand and be able to address ethical, regulatory and practical aspects of human subject's research including human subjects protections for skill development.

CO5: Be capable of self-directed learning of unfamiliar statistical methods and written and oral presentation of results/findings. for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	3	3	3	3	2	3	3	3
CO2	3	3	3	2	3	3	2	2	2	2
CO3	3	2	2	2	3	2	2	3	3	3
CO4	3	2	2	2	3	2	2	3	3	3
CO5	2	1	2	2	3	1	1	3	2	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	2
CO2	3	3	2
CO3	2	2	1
CO4	3	2	2
CO5	2	1	1

Suggested Readings:

1. George W and Willian G., Statistical Methods, IBH Publication
2. Zar J. Biostatistics, Prenticw Hall, London.
3. R. Rangaswami, A Text Book of Agricultural Statistics, New Age International Publication, New Delhi.
4. B. K. Mahajan: Methods in Biostatistics.

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5. S.C. Gupta & V.K. Kapoor: Fundamentals of Applied Statistics: Sultan Chand & Sons, New Delhi.

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- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

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SYLLABUS

BSB405T INDUSTRIAL BIOTECHNOLOGY

Objective(s): The objectives of this course:

- To understand the use of living cells such as bacteria, yeast, algae or component of cells like enzymes, plants and animals to generate industrial products and processes.
- To study techniques for genetic improvement of micro-organisms to improve yield of byproducts.

UNIT I: **(8 Sessions)**

Introduction to Industrial Biotechnology: Brief history, developments and application of Industrial Biotechnology; Techniques of microbial culture, growth media, sources of nutrition.

UNIT II: **(8 Sessions)**

Strain improvement and preservation: Mutation; Protoplast fusion; Genetic engineering techniques; Preservation of cultures-storage on agar slants, soil culture; maintenance of microbial culture and strain preservation- Lyophilization; Cryopreservation- Storage in liquid nitrogen.

UNIT III: **(8 Sessions)**

Microbial production of amino acids and organic acids: Production of Amino Acids-Glutamic acid, Tryptophan; Production of organic acids-Citric acid and acetic acid; Production of Ethanol.

UNIT IV: **(8 Sessions)**

Microbial production of enzymes, vitamins and antibiotics: Production of amylase, lipase and protease; Production of Vitamin B12; Production of Penicillin.

UNIT V: **(8 Sessions)**

General concept of recovery: Recovery process-biomass separation, centrifugation, cell disruption, liquid-liquid extraction.

Course Outcomes:

At the end of the course students will be able to:

CO1: Understand the history and application and of Industrial Biotechnology. Learn the techniques of microbial culture for skill development, employability and entrepreneurship development.

CO2: Explain the strain improvement and preservation techniques for skill development, employability and entrepreneurship development.

CO3: Understand the microbial production of amino acid and organic acid for skill development, employability and entrepreneurship

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development.

CO4: Understand the microbial production of enzymes, vitamin and amino acid for skill development, employability and entrepreneurship development.

CO5: Describe the importance and general concept of recovery of metabolites for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	2	2	3	3	3	3	2	3
CO2	2	2	2	2	3	2	2	2	2	2
CO3	1	1	2	2	2	2	2	2	2	2
CO4	3	2	2	2	2	2	2	1	2	2
CO5	2	2	2	3	2	1	1	2	1	1

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	1
CO2	2	1	2
CO3	2	1	2
CO4	2	1	2
CO5	1	2	1

Suggested Readings:

1. M. M. Young, Comprehensive Biotechnology, 3rd Edn., Elsevier Science, 2019.
2. D. B. Wilson, H. Sahn, K. P. Stahmann, M. Koffas, Industrial Microbiology, Wiley Publication, 2019.
3. G. Reed, S. C. Prescott, C. Gordon, D. Prescott, Dunn's Industrial Microbiology, 4th Edn., CBS Publishers & Distributors, 2006.

Website Sources:

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- <https://onlinecourses.nptel.ac.in/>
- <https://www.wikipedia.org/>
- <https://library.nitrkl.ac.in/>
- <https://www.edx.org/>
- <https://www.coursera.org/>

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SYLLABUS

BSB401P Basics of Immunology Lab

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipment's and Accessories: Principle and Working	
5.	Identification of blood group by simple agglutination method.	Experiment 1
6.	To collect the serum from Blood.	Experiment 2
7.	To enumerate the total number of RBCs in the blood sample.	Experiment 3
8.	To enumerate the total number of WBCs in the blood sample	Experiment 4
9.	Estimation of specific antibodies present in serum by rapid slide test (WIDAL test)	Experiment 5
10.	<i>In vitro</i> detection of Rheumatoid Factor (RF) in serum by qualitative Slide test.	Experiment 6
11.	To learn the techniques of Radial immunodiffusion – Precipitation Reaction.	Experiment 7
12.	To determine the presence of specific antigen by sandwich ELISA method (Dot ELISA).	Experiment 8

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SYLLABUS

BSB402P Cell and Molecular Biology Lab

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipments and Accessories: Principle and Working	
5.	Identification of plant, fungi, bacteria and animal cells	Experiment 1
6.	Preparation of different stages of Mitosis and Meiosis	Experiment 2
7.	Study of sex chromatin through preparation of Barr body from buccal epithelium.	Experiment 3
8.	Isolation of DNA from plant, animal/bacterial cells (According to availability)	Experiment 4
9.	Isolation of plasmid DNA	Experiment 5
10.	Estimation of DNA by diphenylamine method	Experiment 6
11.	Analysis of DNA by agarose gel electrophoresis	Experiment 7
12.	Estimation of RNA by orcinol method	Experiment 8

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SYLLABUS
BSB-501 IPR in Biotechnology

Unit I: IPR: Introduction, History and evolution, Various form of IPR: Trade Secret, Patent, Copy right, Trade mark, Industrial Design, Geographical indication, Choice of IPR Protection, Indian Patent Act 1970 (amendment 2000) knowledge for betteremployability in industry

Unit II: International Harmonization of Patent Laws: Paris convention Treaty, WIPO, European Patent Convention, TRIPs, Protection of Biotechnological Inventions, Plant Breeder's Rights (PBR): Historical, requirement for PBR, The Extent of Protection by PBR, Management of IPR, Benefit and Problem from IPR to inculcate skill, provide employability and entrepreneurial skills

Unit III: Rights/protection, infringement or violation, remedies against infringement- civil and criminal for skill development

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Unit IV: Biosafety: Introduction, Historical background, Definition, Objective of safety guidelines, Risk Assessment, Containment, Planned introduction of genetically modified organism (GMOs): Budapest treaty; Biosafety guidelines in India for skill development

Unit V: Biotechnology Products Food and Drugs; Bioethical issues for employability and entrepreneurship.

Recommended Text/ Reference Books

1. H. Jackson Knight, Patent Strategy For Researches & Research Managers, Third ed., Wiley-Blackwell Publications, 2013.
2. V. Santaniello and R.E. Evenson, Agriculture and Intellectual Property Rights: Economic, Institutional and Implementation Issues in Biotechnology, CABI publishing, First ed., 2000.
3. Phillippe Cullet, Intellectual Property Protection & Sustainable Development, Lexis Nexis Butterworths.
4. John A. Thomas and Roy L. Fuchs, Biotechnology and Safety Assessment, Third Edition, Academic publishers, 2002.
5. Gerhard Fuchs, Biotechnology in Comparative Perspective, Routledge, 2003.
6. Deepa Goel, IPR, Biosafety and Bioethics, First ed., Pearson, 2013

Course Outcomes:

At the end of the course students will be able to:

CO1: Identify different types of Intellectual Properties (IPs), the right of ownership as well as the scope of protection .Outline the process of patenting and development for skill development globally.

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CO2: Understand the roles of different organizations and conventions related to IP knowledge for better employability in local industry

CO3: Identify activities and constitute IP infringements and the remedies available to the IP owner for better skill development globally.

CO4: Recognize the importance of GLP, Understand the levels of Biosafety and biosafety guidelines in India bioethics to inculcate skill, provide local employability and entrepreneurship

CO5: Understand the ethical issues in biotechnological products and NGO for bioethics understanding for entrepreneurial skill

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	2	2	3	1	3	2	2
CO2	2	2	2	2	1	2	2	3	2	2
CO3	1	2	2	2	2	2	2	2	2	2
CO4	2	2	2	2	2	1	2	2	3	2
CO5	1	2	2	2	2	1	1	2	2	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	2
CO2	2	2	2
CO3	2	1	2
CO4	2	2	2
CO5	1	1	2

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SYLLABUS
BSB-502 Fundamentals of Bioprocess Engineering

Unit I: Introduction to Bioprocess: Steps in Bioprocess Development: A typical New Product From Recombinant DNA, Media Preparation and formulation, Inoculation preparation of bacterial, yeast, fungus. to inculcate skill, provide employability and entrepreneurial skills

Unit II: Sterilization: Sterilization and kinetics of sterilization, Sterilization of media: Batch Sterilization, Continuous Sterilization. Sterilization of air, theory of depth filter for skill development

Unit III: Material Balances: Material Balance equation, Law of Conservation of Mass, Steady State material balance, Stoichiometric of growth and product formation for employability and entrepreneurship

Unit IV: Bioreactors: Basics of bioreactors for microbial or animal cell culture, Aseptic operation of bioreactors, Aeration and Agitation in bioreactor knowledge for better employability in industry

Unit V: Cultivation system: Batch and Continuous cultivation system- Washout phenomenon, chemostat and turbidostat, Fed batch cultivation system to develop skill and provide employability.

Recommended Text/ Reference Books

- 1.Peter F. Stanbury, Allan Whitaker and Stephen J. Hal , Principles of Fermentation Technology, Second ed., Pergamon, 1995.
- 2.Pauline M. Doran, Bioprocess Engineering Principles, Second ed., Academic press, 2012.
- 3.Henry C. Vogel, Fermentation & Biochemical Engineering Handbook, Second ed., William Andrews, 2004.

Course Outcomes:

At the end of the course students will be able to:

CO1: Understand the concept of bioprocess engineering in biotechnology, medium preparation and inoculum development providing local employability and entrepreneurship

CO2: Know the different types of microbial cultivation techniques, Biomass, and product yield identification for skill development globally.

CO3: Sterilize the fermentation medium, fermenter, vessel, and air for better skill development.

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CO4: Utilize the element and material balance to design the stoichiometry of growth and product formation understanding for entrepreneurial skill

CO5: Use the different types of bioreactors in industrial fermentation, Role of aeration and agitation in product optimization for better employability in industry globally.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	1	2	1	2	2	1	2	2
CO2	2	3	2	2	2	2	2	1	2	1
CO3	2	2	2	2	3	1	1	2	1	1
CO4	2	2	2	2	2	1	2	1	2	1
CO5	3	1	1	2	1	1	3	1	2	1

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	2
CO2	3	1	2
CO3	1	3	2
CO4	2	1	2
CO5	2	2	1

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SYLLABUS

BSB-503 Protein & Enzyme Technology

Unit I: Architecture of Protein: Primary, Secondary, Tertiary, Quaternary Structure of protein; Various methods for estimation and characterization of Protein; Factors affecting protein configuration to inculcate skill, provide employability and entrepreneurial skills

Unit II: Introduction of Enzyme: Enzyme nomenclature; Enzyme commission numbers, and classification of enzymes; Isolation and purification of enzymes from microbes; Enzyme activity; Specific activity and turn over number to develop skill and provide employability

Unit III: Factor Affecting Enzyme Activity and Catalysis: pH, substrate and enzyme concentration, temperature, coenzyme and cofactors; Ping pong mechanism for skill development

Unit IV: Structure and Function of Enzymes: Lysozyme, chymotrypsin, DNA polymerase, RNase, proteases; Enzyme regulation (T form, R form); Isozymes and abzymes to provide employability

Unit V: Enzyme Technology: Industrial applications of enzymes knowledge for better employability in industry in pulp, leather, textile and food industry to develop skill and provide employability

Recommended Text/ Reference Books

1. David L. Nelson, Albert L. Lehninger, and Michael M. Cox. Lehninger principles of biochemistry. Macmillan, 2008.
2. Dixon & Webb, Enzymes, Second ed., Academic Press, 1964.
3. Walsh, Protein Biotechnology & Biochemistry, Second Edition, Wiley Publications.
4. Wangs and Humphrey, Fermentation and Enzymes Technology, Wiley International.
5. B.D. Singh, Introduction to Biotechnology, Kalyani Publishers, 2014.

Course Outcomes:

CO1: Understand protein structure, factors affecting protein structure, protein assays to inculcate skill, provide local employability and entrepreneurship

CO2: Explain enzyme classification, nomenclature, technique for isolation and purification of enzymes to provide local employability and entrepreneurship

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CO3: Understand the enzyme rate kinetics, factors affecting reaction rate and catalysis for skill development globally.

CO4: Understand chemical properties, mechanism and functions of important biological enzymes for better employability globally.

CO5: Explain and understand the various applications of enzymes in industries for better skill development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	3	3	3	3	2	3	3	3
CO2	3	3	3	2	3	3	2	2	2	2
CO3	3	2	2	2	3	2	2	3	3	3
CO4	3	2	2	2	3	2	2	3	3	3
CO5	2	1	2	2	3	1	1	3	2	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	2
CO2	3	3	2
CO3	2	2	1
CO4	3	2	2
CO5	2	1	1

IFTM UNIVERSITY, MORADABAD
B.Sc. (BIOTECHNOLOGY)
SYLLABUS
BSB–504 Food Biotechnology

Unit-I: Food fermentation- production of culture for food fermentation, beer, bread ,wines ,vinegar , fermented vegetables pickles , sauerkraut, dill pickles. Fermentation of dairy products (cheese), tea, coffee, cacao, Oriental fermented foods, soy sauce, soy bean cheese, idly to inculcate skill, provide employability and entrepreneurial skills.

Unit II: Food spoilage-general principles of food spoilage, contamination, spoilage of sugars, Vegetables and fruits, meat and meat products , fish and other sea foods , eggs, milk and milk products to develop skill and provide employability

Unit III: Food preservation-general principles of food preservation, Asepsis and removal, by use of high temperature, by use of low temperature, by drying, by food additives, by radiation, by use nitrogen Canned foods for skill development

Unit IV: Food additives: Introduction, Need of food additives in food processing, Characteristics and classification of food additives (Sweeteners, Coloring agents, Preservatives, Flavoring agents, Emulsifiers) to provide employability

Unit V: Food laws and standard– Codex, HACCP, BIS, AGMARK, ISO, FSSAI, food sanitation and inspection.

Recommended Text/ Reference Books

1. William S. Frazier and Dennis C. Westhoff, Food Microbiology, Fourth sub ed., Tata McGraw hill publications,1988.
2. N.A. Michael Eskin, Biochemistry of Foods, Third ed., Academic press, 2008.
3. Srinivasan Damodaran, Kirk L. Parkin, and Owen R. Fennema, eds., Fennema's food chemistry, Fourth ed., CRC press, 2007.
4. D G Rao, Fundamentals of Food Engineering, PHI Learning Private Limited, 2010.

Course Outcomes:

At the end of the course students will be able to:

CO 1: Understand the basic characteristics of microbes that affect microbial growth for skill development

CO 2: Understand the basic characteristics of microbes that are important in the food industry and methods that are employed for the reservation of food knowledge for better employability in industry globally.

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CO 3: Understand the basics of production of several industrially important fermented products like wine, cheese, and vinegar provide local employability and entrepreneurship

CO 4: Understand the characteristics and classification of food additives understanding for entrepreneurial skill

CO 5: Understand the different Food laws and standards for better skill development at global level.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	1	2	2	2	2	2
CO2	2	2	3	3	2	2	1	3	2	2
CO3	3	2	3	3	3	2	2	2	3	3
CO4	2	3	3	3	3	3	3	2	2	3
CO5	3	3	2	2	2	3	2	2	3	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	1
CO2	3	2	3
CO3	2	2	2
CO4	2	3	2
CO5	3	3	2

IFTM UNIVERSITY, MORADABAD
B.Sc. (BIOTECHNOLOGY)
SYLLABUS
BSB-505 Animal Biotechnology

Unit I: Historical perspectives, early experiments and scope of Animal Tissue Culture; Requirements for Animal Cell Culture; Media: Natural, Semi-synthetic and Synthetic; Role of ingredients in Animal Culture Media to inculcate skill, provide employability and entrepreneurial skills

Unit II: Basic techniques of mammalian cell culture; Disaggregation of animal tissue; Primary culture; Evolution of cell line; Organ culture; Stem Cell Culture; Embryo culture; Embryonic stem cells and their application; Maintenance of cell culture to provide employability

Unit III: Hybridoma Technology; Production of vaccines; Interferons; Baculoviruses as animal viral vectors; Hormones in ATC; Gene therapy; Ethical values in Animal Biotechnology knowledge for better employability in industry.

Unit IV: Embryo technology: *In vitro* fertilization; Embryo transfer; ICSI; Embryo splitting; Test tube babies; Cell cloning gene transfer to animals -chemical and physical transfection techniques, transgenic animals- Sheep, goat, cow, fishes; Animal breeding to develop skill and provide employability

Unit V: Sericulture; Commercial production of silk; Silkworm as bioreactor; Aquaculture; Apiculture to develop skill and provide employability

Recommended Text/ Reference Books

1. R. Ian Whitney, Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, Sixth ed., Wiley Blackwell, 2010.
2. A. Puhler, Genetic Engineering of Animal, VCH Publishers, Weinheim New York Basel Cambridge, 1993
3. M.M. Ranga, Animal Biotechnology, Agrobios India Publishers, 2007.
4. R. Sasidhara, Animal Biotechnology, MJP Publishers, 2009.
5. U. Satyanarayana, Biotechnology, Books and Allied (P) Ltd, 2008.

Course Outcomes:

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At the end of the course students will be able to:

CO1: Understand the requirement for animal cell culture for skill development globally.

CO2: Understand the techniques and procedures involved in the development of cell clines

CO3: Apply the applications of gene therapy for the treatment of various diseases to provide local employability and entrepreneurship

.CO4: Understand the various gene transfer techniques and the concept of in-vitro fertilization for Better skill development globally.

CO5: Get insight into applications or recombinant DNA technology in sericulture, aquaculture, and apiculture understanding for entrepreneurial skill

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	3	3	3	3	2	3	3	3
CO2	3	3	3	2	3	3	2	2	2	2
CO3	3	2	2	2	3	2	2	3	3	3
CO4	3	2	2	2	3	2	2	3	3	3
CO5	2	1	2	2	3	1	1	3	2	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	2
CO2	3	3	2
CO3	2	2	1
CO4	3	2	2
CO5	2	1	1

IFTM UNIVERSITY, MORADABAD
B.Sc. (BIOTECHNOLOGY)
SYLLABUS
BSB-504 I FOOD STORAGE

UNIT I: Principles of Food Preservation a, Meaning, mode of action and changes in food knowledge for better employability in industry

UNIT II: Use of High temperature (Heat preservation) : a) Moist and Dry heat methods b) Blanching c) Dehydration d) Concentration e) Canning f) Commercial sterilization g) Pasteurization knowledge for better employability in industry

UNIT III: Use of Low Temperatures: a) Cold Preservation: Freezing and Refrigeration- Air freezing b) Indirect contact freezing c) Immersion freezing d) Dehydro-freezing e) Cryo-freezing f) Changes in foods during refrigeration and frozen storage for entrepreneurial skill development knowledge for better employability in industry

UNIT IV: Dry storage: Definition, types, functions, food items that can stored. Cost of storage knowledge for better employability in industry

UNIT V: Low temperature storage: Definition, type, function – Refrigerated storage, Cold Storage, Freezer storage. Types of food items that can be stored in each of them, and cost of storage. for skill development. And knowledge for better employability in industry. knowledge for better employability in industry

Recommended Text Books/References:

1. Mahindru, S.N. “Food Additives: Characteristics, Detection and Estimation”. Tata McGraw-Hill, 2000
2. Stanbury, P.E. and Whitaker A., Principles of Fermentation Technology (1984) Pergamon Press
3. B. Srilakshmi- Dietetics, 7th ed
4. Indian Council of Medical Research : Nutrient Requirements and Recommended Dietary Allowance for Indians, New Delhi
5. Textbook of Nutrition-Ravinder Chadha & Pulkit Mathur, Orient Blackswan Pvt. Ltd. Telangana

Course Outcomes:

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At the end of the course students will be able to:

CO1: Understand the principles and mode of action of food preservation for local employability.

CO2: Gain knowledge about the use of high temperature to preserve the food for employability in global industry.

CO3: Understand the concept about the use of low temperature of preservation for local employability in global industry.

CO4: Understand the principle and importance of dry storage of food for skill development as well as local employability in global industry.

CO5: Understand the principles and type the use of low temperature storage to preserve the food for local employability in industry.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	1	2	2	2	2	2
CO2	2	2	3	3	2	2	1	3	2	2
CO3	3	2	3	3	3	2	2	2	3	3
CO4	2	3	3	3	3	3	3	2	2	3
CO5	3	3	2	2	2	3	2	2	3	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	1
CO2	3	2	3
CO3	2	2	2
CO4	2	3	2
CO5	3	3	2

IFTM UNIVERSITY, MORADABAD
B.Sc. (BIOTECHNOLOGY)
SYLLABUS

BSB-504 II NUTRACEUTICALS

UNIT I: Introduction, Classification of nutraceuticals, Introduction of Balanced Diet, Basic Five Food Groups, Food Pyramid, Classification of Nutrients, Dietary Fibre, Components, physiological effects, potential health benefits knowledge for better employability in industry. Nutrition related diseases and disorders - Diseases and disorders related to Excess and deficiency of Carbohydrates, Protein, Fat Metabolic disorders, Metabolic disorders, Concept of antioxidants, Role of nutraceuticals in the prevention and treatment of disease and disorders knowledge for better employability in industry.

UNIT II: Nutraceuticals of plant and animal origin, Classification, recover and application of alkaloids, phenols, terpenoids with special reference to skin, hair, eye, bone, muscle, heart, brain, liver, kidney, general health and stimulants knowledge for better employability in industry. Microbial and algal nutraceuticals, Concept of prebiotics and probiotics -principle, mechanism, production and technology involved, applications-examples of bacteria used as probiotics, use of prebiotics in maintaining the useful microflora-extraction from plant sources knowledge for better employability in industry.

UNIT III: Symbiotics for maintaining good health.,Algae as source of omega-3 fatty acids, antioxidants and minerals-extraction and enrichment, Phytonutraceutical biotechnology and pre-clinical and clinical trials involved knowledge for better employability in industry.

UNIT IV: Functional Foods ,Cereal and cereal products, Milk and milk products, egg, oils, meat and products, sea foods, nuts and oilseeds, functional fruits and vegetables, herbs and spices, beverages such as tea and wine knowledge for better employability in industry.

UNIT V: Scope of functional foods and nutraceuticals, Future prospects of functional foods and nutraceuticals and their potential for use in improving healths for skill development.

Recommended Text Books/References

1. Wildman REC, Handbook of Nutraceutical and Functional Foods, CRC Press 2001.

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2. Ghosh D et al, Innovations in Healthy and Functional Foods, CRC Press 2012.
3. Pathak YV, Handbook of nutraceuticals Volume 2, CRC Press 2011.
4. Hotchkiss JH, Potter NN, Food Science (5thEd.), CBS Publishers & Distributors, 2007.

Course Outcomes:

At the end of the course students will be able to:

CO1: Understand the classification of nutraceuticals and nutrition related diseases and disorders for local employability in global industry.

CO2: Gain knowledge about the use nutraceuticals of plant and animal origin, Microbial and algal nutraceuticals for local employability in industry.

CO3: Understand the concept Phytonutraceutical biotechnology and pre-clinical and clinical trials for local employability in global industry.

CO4: Understand the Functional Foods, Cereal and cereal products, Milk and milk products for local employability in industry.

CO5: Understand the Scope of functional foods and nutraceuticals, Future prospects of functional foods for local employability and skill development at global level.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	1	2	2	2	2	2
CO2	2	2	3	3	2	2	1	3	2	2
CO3	3	2	3	3	3	2	2	2	3	3
CO4	2	3	3	3	3	3	3	2	2	3
CO5	3	3	2	2	2	3	2	2	3	2

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CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
C01	3	3	1
C02	3	2	3
C03	2	2	2
C04	2	3	2
C05	3	3	2

IFTM UNIVERSITY, MORADABAD
B.Sc. (BIOTECHNOLOGY)
SYLLABUS
BSB-504 III Stem Cell Biology

Unit I: 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 *for generating skills to develop employability.*

Unit II: 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 *to develop employability.*

Unit III: Stem cell and founder zones in plants –particularly their roots – stem cells of shoot meristems of higher plants. Skeletal muscle stem cell – Mammary stem cells – intestinal stem cells – keratinocyte stem cells of cornea – skin and hair follicles –tumour stem cells *to enhance skills for employability.*

Unit IV: 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 *to enhance skills for employability..*

Unit V: 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 to develop skills *for generating employability and entrepreneurship development.*

Recommended Text / Reference Books

1. Stem Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold Spring Harbour Laboratory Press
2. Stem cell biology and gene therapy, Booth C., Cell Biology International, Academic Press.
3. Stem cells by C.S Potten., Elsevier, 2006.
4. Essentials of Stem Cell Biology by Robert Lanza., fourth edition. Elsevier 2014.

Course Outcomes:

At the end of the course students will be able to:

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CO1: Understand the properties, proliferation, and culture of stem cells, medical applications of stem cells, ethical and legal issues in use of stem cells for employability in industry.

CO2: Gain knowledge about the Types of stem cells for employability in industry.

CO3: Understand the concept of Stem cell and founder zones in plants for employability in industry.

CO4: Understand the Therapeutic applications of stem cells Gene Therapy for skill development in industry.

CO5: Understand the Ethical Issues associated with stem cell-based regenerative medicine field Regulatory and Ethical Considerations of stem cell and Gene Therapy for employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	1	2	2	2	2	2
CO2	2	2	3	3	2	2	1	3	2	2
CO3	3	2	3	3	3	2	2	2	3	3
CO4	2	3	3	3	3	3	3	2	2	3
CO5	3	3	2	2	2	3	2	2	3	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	1
CO2	3	2	3
CO3	2	2	2
CO4	2	3	2
CO5	3	3	2

IFTM UNIVERSITY, MORADABAD
B.Sc. (BIOTECHNOLOGY)
SYLLABUS

BSB-505 I NORMAL THERAPEUTIC NUTRITION

UNIT I: INTRODUCTION TO COMMUNITY NUTRITION- Community nutrition as a field, public health nutrition, goals of nutrition programme, dietary guidelines, present trends and focus on community nutrition. knowledge for better employability in industry

UNIT II: DIRECT NUTRITIONAL STATUS- Direct nutritional assessment of human groups: Diet survey methods, nutritional anthropometry, clinical signs knowledge for better employability in industry.

UNIT III: INDIRECT NUTRITIONAL STATUS - Vital statistics, indicators and their use; health policy indicators, social and economic indicators; indicators of the provision of health care; coverage by primary health care; basic health status indicators knowledge for better employability in industry. And skill development and for better employability

UNIT IV: NATIONAL COMMUNITY NUTRITION PROGRAMMES - Introduction to national nutrition programmes and policies. Programmes for improving nutritional status at national level:- Integrated Child Development Services(ICDS); National Rural Development Programme(NRDP); National Rural Employment Programme (NREP); miscellaneous monofocal programmes for better employability

UNIT V: NUTRITIONAL PROBLEM IN INDIA - Magnitude of nutritional problems in India: Protein energy malnutrition, anaemia, vitamin A deficiency, Iodine deficiency disorder; over nutrition and chronic degenerative diseases. Strategies for the control of malnutrition for better employability

Recommended Text Books/References:

1. Bamji, M.S Rao, NP and Reddy V. 1996. Text book of Human Nutrition
2. Bagchi, K. 1990. Guidelines for the management of nutrition programmes- a manual for nutrition officers. WHO EMRO Technical Publication no. 15, WHO, Geneva
3. Bendich, A and Deckelbaum, RJ, 1997. Preventive Nutrition. The Comprehensive guide for health professional.

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4. Marshall, Rice Science and Technology. 1994. Wadsworth Ed., Marcel Dekker, New York.
5. Manay, S. and Sharaswamy, M. 1987. Food Facts and Principles. Wiley Eastern Limited

Course Outcomes:

At the end of the course students will be able to:

CO1: Understand the Community nutrition as a field, public health nutrition, goals of nutrition programme for employability in global industry.

CO2: Gain knowledge about the direct nutritional assessment of human groups for employability in industry.

CO3: Understand the concept of Vital statistics, indicators and their use; health policy indicators, social and economic indicators for employability in industry.

CO4: Understand the national nutrition programmes and policies and Programmes for improving nutritional status at national level for employability in industry.

CO5: Understand the Magnitude of nutritional problems in India for local employability in industry.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	1	2	2	2	2	2
CO2	2	2	3	3	2	2	1	3	2	2
CO3	3	2	3	3	3	2	2	2	3	3
CO4	2	3	3	3	3	3	3	2	2	3
CO5	3	3	2	2	2	3	2	2	3	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	1
CO2	3	2	3
CO3	2	2	2
CO4	2	3	2
CO5	3	3	2

IFTM UNIVERSITY, MORADABAD
B.Sc. (BIOTECHNOLOGY)
SYLLABUS
BSB-505 II DIET THERAPY AND COUNSELLING

UNIT I: Objectives of diet therapy: Role of a dietitian. Principles of diet preparation and counselling. Normal diet in the hospitals –, liquid ,semi liquid, light , soft diet, bland diet and regular diet Different types of Feeding - Basic concepts of oral feeding, tube feeding, IV feeding, gastrostomy feeding. . knowledge for better employability in industry

UNIT II: Therapeutic diets for the following disorders: a) Under weight - definition, etiology, treatment. B) Obesity - definition, etiology, treatment. C) Diseases of the gastro intestinal tract- ulcer, constipation &diarrhea .knowledge for better employability in industry

UNIT III: Diseases of the liver and gall bladder (risk factors and diet therapy). a) jaundice b) hepatitis c) cirrhosis d) fatty liver and diet therapy Diseases of the cardio vascular system (risk factors and diet therapy) a) atherosclerosis b) arteriosclerosis c) hypertension d) congestive heart failure .knowledge for better employability in industry and skill development

UNIT IV: Diabetes mellitus :Types,causes, symptoms, bio-chemical changes, insulin, hypo-glycemic drugs, types only, food exchange list, dietary management. Diseases of the kidney and urinary tract- Acute and chronic nephritis, Nephrotic syndrome, Renal failure, Urinary calculi. Causes and dietary treatment of kidney diseases and dialysis, ESRD (End Stage Renal Dialysis). Nutrition andcancer Dietary guidelines for management. .knowledge for better employability in industry and skill development

UNIT V: Diet in Allergy: Definition, classification, common food allergy, test of allergy, diet therapy. Diet in febrile conditions - Short duration e.g. Typhoid, Long duration e.g. Tuberculosis. Diet in relation to deficiency diseases-Protein calorie deficiency, vitamin A deficiency and anemia. .knowledge for better employability in industry and skill development

Recommended Text Books/References:

1. Krause and Mahan – Food ,Nutrition and Diet therapy, 6th Edition W.B. Saunders company, London
2. Normal and therapeutic nutrition –17th Edition, Robinson et. al ., Mac Millan Pub.Co., New York

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3. ICMR(1989) Nutrient Requirements and recommended dietary allowances for Indians.
4. Antia FP (1987) Clinical Dietetics and Nutrition, Oxford University Press, New Delhi
5. Srilakshmi (2002) Dietetics, IVth Edition. New Age International (P) Limited, Publishers, New Delhi

Course Outcomes:

At the end of the course students will be able to:

CO1: Understand the role of a dietician, Principles of diet preparation and counselling for employability in global industry.

CO2: Gain knowledge about the therapeutic diets for the several disorders for employability in industry.

CO3: Understand the diseases of the liver, gall bladder and cardio vascular system for employability in industry and skill development.

CO4: Understand the Causes and dietary treatment of kidney diseases and dialysis for employability in industry and skill development.

CO5: Understand the Diet in Allergy and Diet in relation to deficiency diseases for employability in global industry.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	1	2	2	2	2	2
CO2	2	2	3	3	2	2	1	3	2	2
CO3	3	2	3	3	3	2	2	2	3	3
CO4	2	3	3	3	3	3	3	2	2	3
CO5	3	3	2	2	2	3	2	2	3	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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			Development
C01	3	3	1
C02	3	2	3
C03	2	2	2
C04	2	3	2
C05	3	3	2

IFTM UNIVERSITY, MORADABAD
B.Sc. (BIOTECHNOLOGY)
SYLLABUS
BSB-505 III Fermented Milk Products

UNIT I: Technology of Fermented Milk Products Credit Origin and history of development of fermented products, status and scope in Dairy Industry for skill development, employability and entrepreneurship development.

UNIT II: Definition, standard and classification of milk. Additives and preservatives. Milk quality, treatment of milk for cheese making. Role of starter culture in relation to cheese quality Rennet preparation and properties. Rennet substitutes. Role of milk constituents and changes during ripening. Action of rennet on milk for skill development, employability and entrepreneurship development.

UNIT III: Production and practice of fermented Foods: Yoghurt, Dahi, Lassi, Acidophilus Milk, Kefir, Koumiss , for better skilling of entrepreneurship.

UNIT IV: Production and practice of different varieties of Cultured Butter-Milk, Bulgarian milk, Leben and Yakult , for better skilling of entrepreneurship.

UNIT V: Standardization , neutralization, pasteurization and cooling of cream. . Preparation of sterilized cream. Preparation of cooking butter by the hand operated churn. Preparation of desi butter. Manufacture of table butter using the power - driven churn . Preparation of Low-fat spread. Preparation of ghee from cream and butter for entrepreneurship development.

Recommended Text Books/References

1. Sukumar De, 2002 Outlines of Dairy Technology.
2. A H Varnam and J P Sutherland, 1994 , Milk and Milk Products Technology Chemistry and Microbiology.
3. Yadav, J.S , A Comprehensive Dairy Microbiology

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Course Outcomes:

At the end of the course students will be able to:

CO1: Understand the technology of fermented milk products, status and scope in dairy industry for employability in global industry.

CO2: Gain knowledge about the standard and classification of milk for employability in industry.

CO3: Understand the Production and practice of fermented Foods for local employability in industry and skill development.

CO4: Understand the Production and practice of different varieties of Cultured Butter-Milk for employability in industry and skill development at global level.

CO5: Understand the standardization, neutralization, pasteurization and cooling of cream for entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	1	2	2	2	2	2
CO2	2	2	3	3	2	2	1	3	2	2
CO3	3	2	3	3	3	2	2	2	3	3
CO4	2	3	3	3	3	3	3	2	2	3
CO5	3	3	2	2	2	3	2	2	3	2

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CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	1
CO2	3	2	3
CO3	2	2	2
CO4	2	3	2
CO5	3	3	2

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SYLLABUS
BSB-601 Fermentation Technology

Unit I: Basic Introduction of fermentation process; Basic function of a fermenter for microbial or animal cell culture, Design of fermenter; Body Construction: Aeration, Agitation, Stirrer glands, Baffles, sparger to inculcate skill, provide employability and entrepreneurial skills.

Unit II: Raw material availability, Pretreatment of raw materials; Media for microbial fermentation: Carbon sources, Nitrogen sources, Inducers, Minerals, sterilization of media and fermenter to develop skill and provide employability

Unit III: Methods and types of fermentation: Solid state fermentation, Submerged Fermentation, Dual and multiple fermentation to provide employability.

Unit IV: Fermentation process in dairy and other food products knowledge for better employability in industry. Production of Organic Acid- Acetic Acid, Amino acid- L-lysine to provide employability.

Unit V: Production of Antibiotics: Penicillin, Tetracycline, Streptomycin.. Production of alcoholic beverages-beer, wine and whisky to provide entrepreneurial skill development.

Recommended Text/ Reference Books

1. A.Cruger. A text of Industrial microbiology, Sinaeur Associates, 1990.
2. P.F. Stanbury, S. Hall, A. Whitaker. Principle of Fermentation Technology, II ed.
3. Y. H. Hui, LisbethMeunier-Goddik, JytteJosephsen, Wai-Kit Nip, Peggy S. Stanfield.Handbook of Food and Beverages Fermentation Technology, , CRC Press, New York/London, 2004.
4. A.R. Allman, Mansi El-Mansi, C.F.A. Bryce, Arnold L. Demain.Fermentation Microbiology and Biotechnology, , , III Ed., CRC Press, New York/London, 2011.
5. Linda Harvey.Practical Fermentation Technology, Brain McNeil (Ed.), ISBN: 978-0-470-01434-9, John Wiley & Sons, Ltd., 2008.
6. Greed, Prescott, Dunn. Industrial Microbiology,IVEdition, CBS Publishers, 1987.

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Course Outcomes:

At the end of the course students will be able to:

CO1: Understand the basic concepts of fermentation, Isolation, screening and maintenance of microbes for skill development

CO2: Know the fermentation medium and its components, pretreatment process for Better skill development at global level.

CO3: Develop the design and construction and types of bioreactors to provide local employability and entrepreneurship

CO4: Develop the understanding of the production of industrially important products like alcohol, amino acids, etc. knowledge for better employability in global industry.

CO5: Understand the techniques of antibiotics and vitamins production to inculcate skill, provide employability and entrepreneurship

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	1	2	1	1	1	2	2	2
CO2	1	2	1	1	1	3	2	1	2	2
CO3	1	2	1	3	2	3	2	2	2	1
CO4	3	1	1	2	1	2	2	2	2	3
CO5	1	1	1	1	1	2	1	2	2	1

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	2
CO2	2	3	2
CO3	3	2	2
CO4	2	2	2
CO5	2	2	2

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SYLLABUS
BSB-602 Introductory Bioenergetics

Unit I: Energy, energy flow cycle, energy conversion, Structure and properties of ATP, High energy compounds, Thermodynamic considerations, coupling reactions of ATP and NDP (nucleotide diphosphate) to inculcate skill, provide employability and entrepreneurial skills.

Unit II: Biological membrane: structure, permeability, properties, passive transport and active transport, facilitated transport, energy requirement, mechanism of Na⁺/ K⁺ ATPase pump, glucose and amino acid transport, Organization of transport activity in cell, Active potentials, Signal Transduction-Role of transport to develop skill and provide employability

Unit III: Metabolism and bioenergetics: Generation and utilization of ATP, skill based study of Metabolism of Nitrogen containing compounds: nitrogen fixation, amino acids and nucleotides.

Unit IV: Energetics of Metabolic Pathways: ATP, GTP, FADH, NADH; Concept of maintenance energy; Oxygen consumption and heat evolution in aerobic cultures knowledge for better employability in industry.

Unit V: Sites of Phosphorylation: Substrate level and oxidative phosphorylation- Mechanism and control, ATP synthetase provide entrepreneurial skill development

Recommended Text/ Reference Books

1. Conn and Stumpf. Outlines of Biochemistry, V Ed., John Wiley & Sons, 2009.
2. **David L. Nelson; Michael M. Cox. Lehninger Principles of Biochemistry, Fourth Edition. W. H. Freeman, 2004,**
3. Jeremy M. Berg; John L. Tymoczko; Gregory J. Gatto Jr.; Lubert Stryer. Biochemistry 8th. Edition Freeman & Company, W. H. (2015).
4. R C Srivastava, Subit K. Saha & Abhay K Jain. Thermodynamics: A Core Course, III Ed., PHI Learning Private Limited, New Delhi, 2010.

Course Outcomes:

At the end of the course students will be able to:

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CO1: Learn about the applicability of laws of thermodynamics in biological systems, about high energy compounds, and related reactions to inculcate skill, provide local employability and entrepreneurship

CO2: Understand the structure and function of the biological membrane in transport activity of cells and signal transduction and response towards the internal and external factors for skill development

CO3: Understand generation and utilization of ATP, Metabolism of Nitrogen-containing compounds, Nitrogen cycle.

CO4: Know about Metabolic Pathways of high-energy compounds ATP, GTP, FADH, NADH, maintenance energy; energy involvement in aerobic processes for better local employability in global industry.

CO5: Understand the concept of Substrate level and oxidative phosphorylation for better skill development

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
3	3	2	2	1	1	1	2	3	1	3
2	2	3	2	1	2	2	3	2	1	2
2	1	2	2	1	2	3	2	2	1	2
2	1	2	2	3	2	3	2	2	3	2
1	2	2	2	2	1	3	2	2	2	1

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	1
CO2	2	2	2
CO3	1	2	1
CO4	2	3	3
CO5	2	3	2

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SYLLABUS
BSB 603 Immunoinformatics

Unit I: Immune system: Innate and specific immunity, Immunoglobulins- structure, sequence and function, classes and subclasses, Hybridoma technology- Production of monoclonal antibodies to inculcate skill, provide employability and entrepreneurial skills.

Unit II: Epitopes; Membrane receptors for antigen- B cell surface receptor for antigen (BCR), The T cell surface receptor for antigen (TCR), Major histocompatibility complex (MHC), HLA; Antigen processing and presentation, Autoimmune disease, to develop skill and provide employability

Unit III: Introduction to immunoinformatics: basics, categories of vaccines, therapeutic vaccine, polytope vaccine, introduction to vaccine design, Outline of computer aided vaccine design knowledge for better employability in industry.

Unit IV Immunoinformatics tools: BIMAS, SVMHC, ProPed, databases of epitopes- B-cell epitope database, T-cell epitope database for skill development.

Unit V: Prediction of 3D structure using homology modeling, Introduction to molecular docking, MHC polymorphism, causes of MHC polymorphism provide entrepreneurial skill development

Recommended Text/ Reference Books

1. R. A.Goldsby,Thomas J.Kindt,B. A. Osborn, J.Kuby.Immunology,, VII Ed., 2000
2. Ole Lund, Morten Nielsen, Claus Lundegaard, Can Kesmir, and SorenBrnak.Immunological Bioinformatics, MIT Press, USA,2005.
3. Immunoinformatics: Bioinformatics Strategies for Better Understanding of Immune Function, I Ed., Wiley Publishers, 2003.
4. I.M. Roitt, P.J. Delves. Essential Immunology,XII Ed., Wiley-Blackwell- Science, 2011.
5. Ashim K. Chakravarty. Immunology and Immunotechnology, I Ed., Oxford, 2006.

Course Outcomes:

At the end of the course students will able to:

CO1: Study the immune system and its types. To explain the structure, types and functions of Immunoglobulins and Hybridoma technology to inculcate skill, provide local employability and entrepreneurial skills.

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CO2: Understand the structure of BCR and TCR. To explain the mechanism of Antigen processing and presentation To familiarize the students with autoimmune disease to inculcate skill, provide local employability and entrepreneurial skills.

CO3: familiarize the students with the concept of vaccine types and its designing. To explain the immunoinformatic based approach to designing of vaccines for skill development at global level.

CO4: Understand the Immunoinformatic tools like BIMAS, SVMHC and databases of epitopes for better employability.

CO5: Explain the methodology of Predicting 3D structure using homology modeling and molecular docking. To describe the concept of MHC polymorphism for better development of skills.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
3	3	2	2	1	1	1	2	3	1	3
2	2	3	2	1	2	2	3	2	1	2
2	1	2	2	1	2	3	2	2	1	2
2	1	2	2	3	2	3	2	2	3	2
1	2	2	2	2	1	3	2	2	2	1

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	1
CO2	2	2	2
CO3	1	2	1
CO4	2	3	3
CO5	2	3	2

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SYLLABUS

BSB-604 Fundamentals of Proteomics and Genomics

Unit I: Organization and structure of genomes in prokaryotes and eukaryotes: chloroplast, mitochondrial and nuclear genomes. Tandem repeated sequences: minisatellites and microsatellites, Introduction to transposons and its types to inculcate skill, provide employability and entrepreneurial skills.

Unit II: Mapping: RFLPs, Sequence tags, SNPs, AFLPs; Sequencing Genomes, Shotgun sequencing, provide entrepreneurial skill development

Unit III: Comparative genomics: Orthologs and paralogs in gene evolution, Identification of genes and regulatory elements, Generation of new gene structure, Genome resources on web, Human Genome Project to develop skill and provide employability.

Unit IV: Expression analysis and characterization of proteins: Luciferase assay, SDS PAGE, IEF, and 2D electrophoresis, knowledge for better employability in industry

Unit V: Analysis of protein structures: Protein structure databases and structure visualization tools providing skill, classification approaches.

Recommended Text/ Reference Books

1. S.B. Primrose, R.Twyman. Principles of Gene Manipulation and Genomics, VII Ed., Wiley-Blackwell, 2006.
2. J. Pevsner. Bioinformatics and Functional Genomics, III Ed., Wiley-Blackwell, 2015.
3. David W.Mount. Bioinformatics: Sequence and Genome Analysis, II Ed., University of Arizona, Tucson, 2004.
4. D.L. Nelson, M.M. Cox. Lehninger Principles of Biochemistry, V Ed., 2016.
5. Z. Ghoshm B. Mallick. Bioinformatics: Principles and Applications, Oxford University Press, 2012.
6. S.C.Rastogi. Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery, III Ed., PHI Learning Pvt. Ltd., 2008.

Course Outcomes:

At the end of the course students will able to:

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CO1: Understand the type, structure, properties and organization of genome in prokaryotes and eukaryotes for skill development.

CO2: Understand the different techniques of mapping and genome sequencing for entrepreneurial skill development at global level.

CO3: familiarize the students with the concept of gene evolution and identification of regulatory elements and human genome project for better employability globally.

CO4: Understand the methods and techniques for determination of expression and characterization of proteins for skill development

CO5: Explain the protein structure databases and structure visualization tools for skill development

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
3	3	2	2	1	1	1	2	3	1	3
2	2	3	2	1	2	2	3	2	1	2
2	1	2	2	1	2	3	2	2	1	2
2	1	2	2	3	2	3	2	2	3	2
1	2	2	2	2	1	3	2	2	2	1

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	1
CO2	2	2	2
CO3	1	2	1
CO4	2	3	3
CO5	2	3	2

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SYLLABUS
BSB-605 Biomedical Instrumentation

Unit I: Introduction to biomedical instrumentation, Basic transducer principles, Sources of bioelectric potentials, Electrodes to inculcate skill, provide employability and entrepreneurial skills.

Unit II: The Cardiovascular system, Cardiovascular measurements, Patient care and monitoring, Measurements in the respiratory system provide entrepreneurial skill development

Unit III: Noninvasive diagnostic instrumentation, Nervous system, Instrumentation for sensory measurements and the study of behaviors, Biotelemetry to develop skill and provide employability

Unit IV: Instrumentation for the clinical laboratory, X-ray and radioisotope instrumentation knowledge for better employability in industry

Unit V: The computer in biomedical instrumentation, Electrical safety of medical equipment for better skilling of entrepreneurial skills

Recommended Text/ Reference Books

1. L. Cromwell, F.J. Weibell, E.A. Pfeiffer. Biomedical Instrumentation and Measurement, Prentice Hall Of India, 2001
2. R.B. Northrop. Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation, II Ed., CRC Press, 2012.
3. C.D. Ferris. Introduction to Bioinstrumentation: With Biological, Environmental, and Medical Application, Humana Press, 2013.
4. R. Singh. Biomedical Instrumentation: Technology and Applications, Blacklick, Ohio, U.S.A.: McGraw-Hill, 2004.

Course Outcomes:

At the end of the course students will able to:

CO1: Understand the biomedical instrumentation, transducers and bioelectric potentials for skill development.

CO2: Understand the CVS and its measurement, patient care and respiratory measurement for entrepreneurial skill development

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CO3: familiarize the students with the instrumentation for sensory measurements for better employability

CO4: Understand the instrumentation for X-ray and radioisotope for skill development

CO5: Explain the computational tools and electrical safety of instruments for skill development

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
3	3	2	2	1	1	1	2	3	1	3
2	2	3	2	1	2	2	3	2	1	2
2	1	2	2	1	2	3	2	2	1	2
2	1	2	2	3	2	3	2	2	3	2
1	2	2	2	2	1	3	2	2	2	1

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	1
CO2	2	2	2
CO3	1	2	1
CO4	2	3	3
CO5	2	3	2

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SYLLABUS
BSB-604 I Microbial Diversity

Unit-I: General characteristics, Classification, Morphology, Culturing, Re production and Significance of:-i. Fungi – Type study of Aspergillus, Rhizopus, Agaricus, Penicillium, *Saccharomyces cerevisiae* ii. Cyanobacteria – Type study of Anabaena, Spirulina iii. Protozoa – Type study of Giardia, Balantidium iv. Viruses – General characters, ICTV system of classification, Study of viruses - bacteriophages (T4, Lambda), plant viruses (TMV), animal viruses (foot and mouth disease virus, Rotavirus), Prions and viroids v. Bacteria - Spirochetes, Rickettsia, Chlamydia, Mycoplasma, Actinomycetes *for skill development*.

Unit-II: Nutritional requirements and growth of microorganisms: Macronutrients – Carbon, Nitrogen, Phosphorous, Sulphur, Potassium, Magnesium, Calcium, Sodium, Iron. Micronutrients (trace elements) – Cobalt, Zinc, Molybdenum, Copper, Manganese, Nickel, Tungsten, Selenium. Growth factors – Vitamins, Amino acids, Purines, Pyrimidines. Physical factors required for growth – pH, Temperature, Oxygen, Osmotic pressure, etc.. Nutritional classification of microorganisms – Autotrophs, Heterotrophs, Phototrophs and Chemotrophs *for skill development*.

Unit-III: Bacterial growth: a) Bacterial growth curve, factors affecting bacterial growth b) Continuous cultivation – Chemostat and Turbidostat c) Counting of bacteria: Total – DMC, Turbidity estimation, Nitrogen content estimation; Viable – SPC, MPN, Membrane filtration method *for skill development and employability*.

Unit-IV: Isolation, culturing and maintenance of pure culture: i. Media preparation – definition of medium, solid and liquid medium (use of plate, slant, butt and broth), preparation and types of media – preparation of general and special purpose medium ii. Concept of aseptic zone, aseptic transfer of media and microbes (inoculation) *for generating skills to develop employability*.

Unit-V: Natural microbial population (mixed culture), selection methods, concepts of pure culture techniques, study of cultural characteristics iv. Anaerobic cultivation of microorganisms v. Maintenance of pure cultures, Culture collection centers - Indian and International *for generating skills to develop employability*.

Recommended Text / Reference Books

1. Microbial Diversity: Form and Function in Prokaryotes by Oladele Ogunseitan
2. Principles of Microbial Diversity (ASM Books) by James W. Brown
3. Microbial Genetics by Maloy and Freifelder.
4. Principles of Biochemistry by Lehninger.

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5. Microbiology by Pelczar.

Course Outcomes:

At the end of the course students will be able to:

CO1: Gain Knowledge about basics of microbial world, their types, morphology examples, reproduction etc. of bacteria, virus, fungus and molds *for skill development at global level.*

CO2: Learn about Nutritional requirements and growth of microorganisms, role of macro and micro nutrients *for skill development*

CO3: Learn the skill of Bacterial Growth, its cultivation and bacterial count *for skill development and local employability.*

CO4: Learn the skill of Isolation, culturing and maintenance of pure culture, media preparation *for skill development and local employability*

CO5: Understand selection methods, concepts of pure culture Indian and International collection centres.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	3	3	3	3	2	3	3
CO2	3	3	2	2	3	1	1	3	3	3
CO3	3	3	3	3	2	2	2	1	3	3
CO4	2	2	2	2	3	2	3	3	3	3
CO5	1	3	2	2	2	3	3	3	2	2

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CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	2
CO2	3	2	2
CO3	3	2	3
CO4	3	2	2
CO5	3	2	2

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Syllabus

BSB-604 III ECONOMIC ZOOLOGY

UNIT I: Apiculture & Lac Culture: Types of honey bees – Diseases and pests of bees – Harvesting and processing of honey –Types of Honey, Maintenance of Apiary, Instruments used in Apiculture.Lac Culture: Types of Lac; Life cycle of Lac insect, Harvesting and Extraction of Lac; Uses and Enemies of Lac. Economic Importance *for development of entrepreneurship and to generate employability*

UNIT II: Poultry: Types of birds for poultry – Bio-security measures followed in Poultry farms, Diseases and pests – Egg and meat production – Types of breeds rearing in animal husbandry (Cow, Sheep and Goats, Pigs) – Disease and parasites of animal husbandry, Economic importance *for development of entrepreneurship and to generate employability.*

UNIT III: Aquaculture: Aqua culture- Site selection and Construction, Pre stocking and post stocking management of Nursery, rearing and stocking ponds, Fish byproducts. Prawn culture - Methods of prawn fishing, Preservation - Fish and Prawn, Marketing of Prawn *for development of entrepreneurship and to generate employability*

UNIT IV: Vermiculture: Species of earthworm used in vermiculture- Raw materials for vermiculture- Compost Production. Natural enemies and their control measures-Harvesting of vermicompost and worms-Role of vermicompost in agriculture *for development of entrepreneurship and to generate employability*

UNIT V: Pharmaceuticals: Sericulture–Types of Silk worms, Rearing techniques, Diseases – Bacterial, Fungal and Protozoan - their managements, reeling and Byproducts *for development of entrepreneurship and to generate employability*

Recommended Text/ Reference Books

1. Shukla, G.S. &Upadhyay, V.B.: Economic Zoology, 4e, 2002, Rastogi.
2. Singh, S. : Bee keeping in India, ICAR.
3. Srivastava, C.B.L. : Fishery Science and Indian Fisheries, 2002, Kitab Mahal.
4. B.K. Tikadar. Threatened Animals of India, ZSI Publication, Calcutta
5. Kehimkar ID. (2008).Book of Indian butterflies. Oxford University Press.

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Course Outcomes:

At the end of the course students will be able to:

CO1: Know and Learn about Apiculture & Lac Culture *for development of entrepreneurship and to generate local employability*

CO2: Understand about Poultry- Types of birds for poultry – Bio-security measures followed in Poultry farms, Diseases and pests *for development of entrepreneurship and to generate local employability*

CO3: Learn about Aqua culture- Site selection and Construction, fishing methods, diseases *for development of entrepreneurship and to generate local employability*

CO4: Understand the concept of Vermiculture: Species of earthworm used in vermiculture, production, economy associated *for development of entrepreneurship and to generate local employability*

CO5: Understand the concept of Pharmaceuticals: Sericulture–Types of Silk worms, Rearing techniques, Diseases

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	2	3	3	3	2	3	3	2
CO2	3	2	3	2	3	2	1	2	3	2
CO3	3	3	3	2	2	3	2	3	3	2
CO4	2	3	2	3	1	3	3	1	2	3
CO5	2	3	3	1	3	2	2	2	2	1

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CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	2
CO2	3	2	2
CO3	3	3	2
CO4	3	3	2
CO5	2	3	2

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Syllabus

BSB-604 II WILDLIFE SCIENCE

UNIT I: Scope And Importance Of Wildlife Of India: Definition of Wildlife: Causes of wildlife depletion; Economic importance of wildlife; need for wildlife conservation; rare, endangered, threatened and endemic species of fishes, amphibians, reptiles, birds and mammals in India- India as a mega wildlife diversity country *for development of entrepreneurship*.

UNIT II: Forestry, Silviculture And Forest Entomology: Forest types in India- identification, dendrology; Deforestation & Impacts; Forest Inventory; Natural and artificial regeneration of forests; Silvicultural systems, Agro forestry systems, Social/Urban Forestry- Joint Forest Management-Indian Forest Act 1927, Forest Conservation Act 1980, Harmful Insects and their role in forest economy, Beneficial Insects and their role in forest economy *for development of entrepreneurship and to generate employability*.

UNIT III: Behaviour Of Wildlife: Instinctive behaviour-classical and modern concepts-fixed action pattern and ritualization; Learning- Imprinting-habituation. Biological rhythms and bird migration; Types of animal communications; Courtship, display, sexual selection and parental care in mammals and birds; Social behaviour in animals - Honey bees, Elephants *for enhancement of skills*

UNIT IV: Wildlife Management and Census Techniques: Vegetative analyses Quadrat, Strip transect; GIS and Remote sensing in wildlife habitat surveys-Habitat manipulation, Making observations and records: field notes, datasheets; Wildlife Photography, Planning census basic concepts and applications -Direct count, Indirect count Identifying animals based on indirect signs; Capture- recapture techniques *to generate employability*.

UNIT V: Human Wildlife Conflicts health care and Conservation of Wildlife: Basic concepts, reasons for conflicts, Identification of damages caused by wild animals and control measures, Translocation of Wild animals – Principles, Methods and applications. Infectious wildlife diseases- Viral, Bacterial, Protozoan. Helminth and Non-infectious diseases of wild animals.in-situ and ex-situ conservation: Wildlife and Zoological Parks, Role of Government and Non-Governmental organizations in conservation; Administrative set up - Advisory bodies- National Board for Wildlife –Wildlife (Protection) Act, 1972 and its Amendments; Wildlife trade and regulations; Biodiversity Act 2000 *for enhancement of skills and entrepreneurship*.

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Recommended Text/ Reference Books

1. E.O. Wilson. Biodiversity, Academic Press, Washington.
2. B.K. Tikadar. Threatened Animals of India, ZSI Publication, Calcutta
3. Caughley G, Sinclair AR. Wildlife ecology and management. Blackwell Science
4. Lawmann . (2017). Wildlife Protection Act 1972, Kamal Publishers, New Delhi.
5. Majumdar AB (Author), Nandy D, Mukherjee S. (2013). Environment and Wildlife Laws in India, LexisNexis Publishers.

Course Outcomes:

At the end of the course students will be able to:

CO1: Learn about Definition of Wildlife, Causes of wildlife depletion, Economic importance *for global development of entrepreneurship*

CO2: Know about various types of forests in India, deforestation and its impact, silviculture, aquaculture etc *for enhancement of skills*

CO3: Understand the different behaviours of wildlife animals, classical and modern concepts behaviour *for enhancement of skills*

CO4: Learn the methods of Wildlife Census Techniques, Vegetative analyses Quadrat, Strip transect, Wildlife Photography, Capture-recapture techniques *to generate local employability*

CO5: Learn about Human Wildlife Conflicts health care and Conservation of Wildlife, Translocation of Wild animals etc. Biodiversity Act 2000 *for enhancement of local skills and entrepreneurship.*

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Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	2	3	2	3	3	2	2	3
CO2	3	2	3	3	3	2	1	2	3	2
CO3	3	3	2	2	2	3	3	1	2	3

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CO4	2	3	2	3	1	3	3	1	3	3
CO5	3	3	3	1	3	2	2	3	1	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	2
CO2	3	2	2
CO3	3	2	3
CO4	3	2	2
CO5	3	2	2

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Syllabus

BSB-605 I BEHAVIOURAL SCIENCE

UNIT I: Introduction: An introduction to the principles of behavioral sciences and their application to problems facing contemporary societies (e.g., autism, public health, education, juvenile delinquency, substance abuse) human behavior, careers in the behavioral sciences and how to pursue them *for skill enhancement*.

UNIT II: Scientific inquiry in applied behavioral science: Objectivity, definitions, observation, reliability, validity, correlation and its limitations, causation, experimental design and analysis, and the interpretation of data in the context of solving individual and societal problems *for development of entrepreneurship and to generate employability*.

UNIT III: Introduction to Child Behavior and Development. Child behavior and development normal developmental range of growth, intelligence, cognition, emotion, language, and social skills from birth to adolescence *to generate employability*.

UNIT IV: Human Development, Adult Development and Aging: Psychological, social, and physical development of humans across the lifespan from conception through infancy, childhood, adolescence, adulthood and death An overview of environmental, cultural, and biological influences of adult development. Development-including cognitive, emotional, social, neurological, physical, genetic *for enhancing the skills*.

UNIT V: Ethical, Legal and Professional Issues in Applied Behavioral Science: Ethical and legal issues in the responsible conduct of basic, applied, intervention and prevention research inclusion of underrepresented groups, participatory action research; bias, fraud, and plagiarism, conflict of interest; reporting misconduct; authorship conflict. professional issues in behavioral consultation and training, behavior-analytic skills, client-centered responsibilities *for development of entrepreneurship and to generate employability*.

Recommended Text/ Reference Books

1. Bates, A. P. and Julian, J.: Sociology - Understanding Social Behaviour Dressler, David and Cans, Donald: The Study of Human Interaction
2. Lapiere, Richard. T – Social Change

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3. Lindzey, G. and Borgatta, E: Sociometric Measurement in the Handbook of Social Psychology, Addison – Welsley, US. Rose, G.: Oxford Textbook of Public Health, Vol.4, 1985.
4. LaFasto and Larson: When Teams Work Best, 2001, Response Books (Sage), New Delhi
5. J William Pfeiffer (ed.) Theories and Models in Applied Behavioural Science, Vol 2, Group (1996);Pfeiffer& Company
6. Smither Robert D.; The Psychology of Work and Human Performance, 1994, Harper Collins College Publishers

Course Outcomes:

At the end of the course students will be able to:

CO1: Understand the principles of behavioral sciences and their application to problems facing societies *for skill enhancement*

CO2: Understand Scientific inquiry in applied behavioral science: Objectivity, definitions, observation, reliability for *development of entrepreneurship and to generate local employability*

CO3: Understand Child behavior and developmental stages, growth, intelligence etc.

CO4: Understand Psychological, social, and physical development of humans across the lifespan *for enhancing the skills at global level.*

CO5: Understand Ethical, Legal and Professional Issues in Applied Behavioral Science for *development of entrepreneurship and to generate local employability*

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	3	3	3	3	2	3	3
CO2	3	3	2	2	3	1	1	3	3	3
CO3	3	3	3	3	2	2	2	1	3	3
CO4	2	2	2	2	3	2	3	3	3	3
CO5	1	3	2	2	2	3	3	3	2	2

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CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	2
CO2	3	2	2
CO3	3	2	3
CO4	3	2	2
CO5	3	2	2

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SYLLABUS
BSB-605 III Plant Pathology

Unit-I: Importance, definitions and concepts of diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases for skill development.

Unit-II: Growth, Reproduction, Survival and dispersal of important plant pathogens, role of environment and host nutrition and disease development knowledge to inculcate skills.

Unit-III: Host parasite interaction, recognition concept and infection, symptomatology, disease, development, role of enzymes, toxins, growth regulators, defense strategies- oxidative burst, phenolics, phytoalexin, PR proteins, Elicitors. Altered plant metabolism as affected by plant pathogens knowledge to inculcate skill for better employability.

Unit-IV: Genetics of resistance, 'R' genes, mechanism of genetic variation in pathogens, molecular basis for resistance basics, Chemical nature and classification of fungicides and antibiotics: their bioassay and compatibility with other agricultural chemicals; resistance to fungicides/ antibiotics for skill development.

Unit-V: Disease management strategies: General principles of plant quarantine. Exotic pathogens and pathogens introduced into India. Sanitary and phytosanitary issues under WTO, TRIPS and PRA. Genetic basis of disease resistance and pathogenicity: gene for gene hypothesis; breeding for disease resistance. Production of disease-free seeds and planting materials. Seed certification. effect on environment. Spraying and dusting equipments, their care and maintenances. Important cultural practices and their role in disease management, solarization, integrated disease management. Biotechnology for crop disease management. knowledge for skill development and employability.

Recommended Text / Reference Books

1. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
2. Lucas JA. (1998). Plant Pathology and Plant Pathogens. 3rd edition. Blackwell Science, Oxford.
3. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited

Course Outcomes:

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At the end of the course students will be able to:

CO1: Learn about definitions and concepts, history and importance of Plant pathology for skill development.

CO2: Understand about Growth, Reproduction, Survival and dispersal of important plant pathogens for skill development.

CO3: Learn Host - parasite interaction, recognition concept and infection Altered plant metabolism as affected by plant pathogens knowledge to inculcate skill for better employability globally.

CO4: Understand Genetics of resistance, mechanism of genetic variation in pathogens, for skill development.

CO5: Understand Disease management strategies, Seed certification, Biotechnology for crop disease management .knowledge for skill development and local employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	2	2	1	3	2	2	3	1
CO2	2	2	2	3	2	2	2	3	2	2
CO3	2	2	2	3	3	3	3	2	1	3
CO4	2	3	3	3	3	3	3	2	2	3
CO5	3	2	2	3	2	3	3	2	3	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	3
CO2	2	3	3
CO3	2	2	3
CO4	3	2	3
CO5	3	3	3

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SYLLABUS
BSB-605 II Food Toxicology

UNIT I: Principles of Toxicology: classification of toxic agents; characteristics of exposure; spectrum of undesirable effects; interaction and tolerance; biotransformation and mechanisms of toxicity. Evaluation of toxicity: risk vs. benefit: experimental design and evaluation: prospective and retrospective studies to inculcate skill, provide employability & entrepreneurial skills.

UNIT II: Natural toxins in food: natural toxins of importance in food-toxins of plant and animal origin; microbial toxins (e.g., bacterial toxins, fungal toxins and Algal toxins), natural occurrence, toxicity and significance, determination of toxicants in foods and their management for entrepreneurial skills.

Unit III: Food allergies and sensitivities: natural sources and chemistry of food allergens; true/untrue food allergies; handling of food allergies; food sensitivities (anaphylactoid reactions, metabolic food disorders and idiosyncratic reactions); Safety of genetically modified food: potential toxicity and allergenicity of GM foods. Safety of children consumables understanding for entrepreneurial skills.

Unit IV: Environmental contaminants and drug residues in food: fungicide and pesticide residues in foods; heavy metal and their health impacts; use of veterinary drugs (e.g. Malachite green in fish and β -agonists in pork); other contaminants in food, radioactive contamination of food, Food adulteration and potential toxicity of food adulterants for skill development and employability.

Unit V: Food additives and toxicants added or formed during food processing: safety of food additives; toxicological evaluation of food additives; food processing generated toxicants: nitroso-compounds, heterocyclic amines, dietary Supplements and toxicity related to dose: common dietary supplements; relevance of the dose; possible toxic effects for better skilling of entrepreneurship.

Recommended Text Books/References

1. Microbial Biotechnology by Glazer AN & Nikaido H., 2nd Ed., Cambridge University Press, 2007

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2. Molecular Biotechnology by Glick BR, Pasternak JJ & Patten CL, Ed. IV, ASM Press, 2010
3. Biotechnology: A text Book of Industrial Microbiology by Crueger W, Crueger A, 2nd Ed., Sinauer associates, Inc.1990

Course Outcomes:

At the end of the course students will be able to:

CO1: Understand the Principles of Toxicology, toxic agents, characteristics, tolerance and interactions to inculcate skill, provide local employability & entrepreneurial skills globally.

CO2: Learn about Toxins in food, importance and causative agents, determinants and their management in food.to inculcate skill, provide local employability & entrepreneurial skills

CO3: Understand Food allergies and sensitivities, source and their management understanding for entrepreneurial skill globally.

CO4: Learn about Environmental contaminants and drug residues in food: fungicide and pesticide etc. for skill development and local employability.

CO5: Understand about Food additives and toxicants added or formed during food processing, safety and evaluation to inculcate skill, provide local employability & entrepreneurial skills

Mapping Course Outcomes leading for the achievement of Programme Outcomes

Please write 3,2,1 wherever required

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	3	3	3	3	2	3	3
CO2	3	3	2	2	3	1	1	3	3	3
CO3	3	3	3	3	2	2	2	1	3	3
CO4	2	2	2	2	3	2	3	3	3	3
CO5	1	3	2	2	2	3	3	3	2	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	2
CO2	3	2	2
CO3	3	2	3
CO4	3	2	2
CO5	3	2	2