

**IFTM UNIVERSITY, MORADABAD
SCHOOL OF BIOTECHNOLOGY
YEAR WISE COURSE STRUCTURE**

B.SC. (MICROBIOLOGY) 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	B080101T	General Microbiology	04 (03+01+0)	25	75	100
		B080102P	Experiments in Basic Microbiology	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

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B.SC. (MICROBIOLOGY) 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	B080201T	Agriculture and Environmental Microbiology	04 (03+01+0)	25	75	100
		B080202P	Experiments in Agriculture and Environmental Microbiology	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

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B.SC. (MICROBIOLOGY) SECOND YEAR

Semester III							
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	B080301T	Basic Biochemistry and Microbial Physiology	04 (03+01+0)	25	75	100
		B080302P	Experiments in Basic Biochemistry and Microbial Physiology	02 (0+0+02)	25	75	100
2.	Subject -2 (Major) From own faculty	B094301T	Bioinformatics	04 (03+01+0)	25	75	100
		B094301P	Bioinformatics Lab	02 (0+0+02)	25	75	100
3.	Subject-3 (Major) Any Faculty	B094302T	Bioinstrumentation	04 (03+01+0)	25	75	100
		B094302P	Biotechnical lab	02 (0+0+02)	25	75	100
4.	Subject-4 (Minor/ Elective) Other Faculty	B094303T	Introductory Bioprocess	04 (03+01+0)	25	75	100
5.	Vocational (Minor) Vocational faculty	B093304T	Quality Assurance	03 (03+0+0)	25	75	100
6.	Co-Curricular Course	Z030301	Human Values and Environment studies	02 (02+0+0)	25	75	100
Total Credits				27	225	675	900

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YEAR WISE COURSE STRUCTURE**

B.SC. (MICROBIOLOGY) SECOND YEAR

Semester IV							
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	B080401T	Molecular Biology and Microbial Genetics	04 (03+01+0)	25	75	100
		B080402P	Experiments in Molecular Biology and Microbial Genetics	02 (0+0+02)	25	75	100
2.	Subject -2 (Major) From own faculty	B094401T	Recombinant DNA Technology	04 (03+01+0)	25	75	100
		B094401P	Recombinant DNA Technology Lab	02 (0+0+02)	25	75	100
3.	Subject-3 (Major) Any Faculty	B094402T	Proteomics and Genomics	04 (03+01+0)	25	75	100
		B094402P	Proteomics and Genomics Lab	02 (0+0+02)	25	75	100
4.	Subject-4 (Minor/ Elective) Other Faculty	B093404T	Project Management and Entrepreneurship	04 (03+01+0)	25	75	100
5.	Vocational (Minor) Vocational faculty	B093405T	Mushroom culture technology	03 (03+0+0)	25	75	100
6.	Co-Curricular Course	Z040401	Physical education and yoga	02 (02+0+0)	25	75	100
Total Credits				27	225	675	900

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
SCHOOL OF BIOTECHNOLOGY
YEAR WISE COURSE STRUCTURE
B.SC. (MICROBIOLOGY) THIRD YEAR
Fifth Semester

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME			End Sem Exam	Course Total	Credits
			L	T	P	Mid Sem Exam	AS +AT	Total			
THEORY											
1.	BSB-501	IPR in Biotechnology	3	1	0	20	10	30	70	100	4
2.	BSB-502	Fundamentals of Bioprocess Engineering	3	1	0	20	10	30	70	100	4
3.	BSB-503	Protein & Enzyme Technology	3	1	0	20	10	30	70	100	4
4.	BMB-501/ 501 I-III	Departmental Elective	3	1	0	20	10	30	70	100	4
5.	BMB-502/502 I-III	Departmental Elective	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
6.	BSB-551	Bioprocess Lab	0	0	2	20	10	30	70	100	1
7.	BMB-552	Industrial Training (Evaluation and <i>Viva voce</i>)	0	0	2	20	10	100	-	100	1
8.	GP-501	General Proficiency	0	0	0	-	-	100	-	100	1
		Total Credit	15	5	4			380	420	800	23

LIST OF DEPARTMENT ELECTIVES		
S.No.	Course Code	Course Name
1	BMB-501/501 I/ 501 II/ 501 III	Food Microbiology/ Principle of Human Nutrition /Food Science and Nutrition/Technology of Beverages
2	BMB-502/502 I/ 502 II/ 502 III	Microbial Biotechnology/ Cloning Strategies and Nano microbiology/ Clinical Operations & Clinical Data Management/ Substitute and Food Evaluation

IFTM UNIVERSITY, MORADABAD
SCHOOL OF BIOTECHNOLOGY
YEAR WISE COURSE STRUCTURE
B.SC. (MICROBIOLOGY) THIRD YEAR
Sixth Semester

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
						Mid Sem Exam	AS +AT	Total	End Sem Exam		
			L	T	P						
THEORY											
1.	BSB-601	Fermentation Technology	3	1	0	20	10	30	70	100	4
2.	BSB-602	Introductory Bioenergetics	3	1	0	20	10	30	70	100	4
3.	BMB-601	Advanced Virology	3	1	0	20	10	30	70	100	4
4.	BMB-603/ 603 I-III	Departmental Elective	3	1	0	20	10	30	70	100	4
5.	BMB-602/602 I-III	Departmental Elective	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
6.	BSB-651	Fermentation Technology	0	0	2	20	10	30	70	100	1
7.	BMB-651	Dairy Microbiology	0	0	2	20	10	30	70	100	1
8.	GP-601	General Proficiency	0	0	0	-	-	100	-	100	1
		Total Credit	15	5	4	-	-	310	490	800	23

LIST OF DEPARTMENT ELECTIVES		
S.No.	Course Code	Course Name
1	BMB-602/602 I/ 602 II/ 602 III	Clinical Parasitology/ Microbial quality control in Food and pharmaceutical industries/ Microbial diagnosis in health clinic/ Economic Botany
2	BMB-603/603 I/ 603 II/ 603 III	Dairy Microbiology/ Biofertilizers Technology/ Plant and Algal Physiology /Clinical Pharmacokinetics

Subject prerequisite

To study MICROBIOLOGY at undergraduate, a student must have Biology in Class 12.

Programme Objectives (POs)

1. The Programme has been designed in such a way so that the students get exposed to strong theoretical and practical background on various domains of Microbiology.
2. The Programme includes details of important microorganisms of agricultural, medical and industrial importance, biomolecules, tools and techniques, enzymes, immunology, cell biology, molecular biology genetic engineering to make the study of microbiology for sustainable development of human society.
3. The practical courses have been designed to equip the students with the laboratory skills in microbiology. Students will be able to design and conduct experiments, as well as to analyze and interpret scientific data
4. The Programme will provide students with the knowledge and skill base that would enable them to undertake further studies in microbiology and related areas or in multidisciplinary areas that involve microbiology, biochemistry, biotechnology and molecular biology and help develop a range of generic skills that are relevant in enhancing entrepreneurship skills among students
5. The students will be exposed to a wide range of careers that combine microbiology, environment, industry and medical.

PROGRAM OUTCOMES (PO):

The Program Aims to achieve the following objectives:

PO1. Conceptual Knowledge: The programme has been designed to impart the knowledge of subjects in such a way that the students have strong theoretical background on various domains of Microbiology.

PO2. Microbial Technology: Recognize the role of important microorganisms in agricultural, medical and industries. Demonstrate knowledge of biomolecules, tools and techniques, enzymes, immunology, cell biology, molecular biology genetic engineering to make the study of microbiology for sustainable development of human society.

PO3. Practical Application: Demonstrate the practical applications of microorganisms in pharma, agriculture, dairy, food, beverage and nutraceutical industries.

PO4. Communication Skills: Enhanced communication skills cultivated through reading, listening, speaking, etc., which are prerequisite for expressing views clearly and confidently.

PO5. Problem Analysis & Critical Thinking: The programme aims to improve the students at problem solving, logical reasoning, rational analysis and critical thinking of the students as required in solving scientific problems.

PO6. Ethics & Morals: The programme would help students equip with high ethical, moral and social values in professional and social life leading to a responsible citizen.

PO7. Sustainable Environment: Understanding the techniques for cleaner environment utilizing resources in a sustainable manner producing less waste and toxicity in environment. The programme will impart the knowledge related to role of microorganisms in bioremediation and bioprospecting, role of microorganisms in Agriculture.

PO8. Biodiversity: Appreciation of biological diversity in organisms and microorganisms, their relation with each other and with the surrounding environment.

PO9. Self-learning: Facilitate students to acquire ability to engage in self-learning process to overcome the challenges faced in professional studies and careers.

PO10. Technical ability: Familiarization with the advanced and newer techniques along with the underlying principle for research and analytical applications.

Certificate Course in Microbial Techniques	
B. Sc. I Programme Specific Outcomes (PSOs)	
PSO1	Students will be able to acquire, articulate, retain, and apply specialized skills and knowledge relevant to microbiology.
PSO2	Students will be able to appreciate the diversity of microorganisms and microbial communities inhabiting a multitude of habitats, understand their pathogenic as well beneficial significance to man, and nature.
PSO3	Students will acquire and demonstrate proficiency in good laboratory practices in a microbiological laboratory and be able to explain the theoretical basis and practical skills of the tools/technologies commonly used to study this field.
PSO4	Students will gain fundamental knowledge about the various scopes on agricultural and environmental microbiology and their concepts.
PSO5	The certificate course will enable students to apply for technical positions in government and private labs/institutes.

Diploma in Microbial Technology	
B.Sc. II Programme based outcomes	
PSO 1	Students will develop familiarity and understanding of the microbiology concepts as relevant to various areas such as biochemistry, microbial physiology, molecular biology and genetics.
PSO 2	Students will exhibit reasonable abilities in the utilization of instruments, advances and techniques common to microbiology, and apply the logical strategy and theory testing in the plan and execution of examinations.
PSO3	Students will be adequately capable to utilize microbiology information and abilities to analyze problems involving microorganisms, articulate these with peers and undertake remedial measures.
PSO4	Students will be able to describe how microorganisms obtain energy, metabolism, reproduction, survival, and interactions with their environment, hosts, and host populations.
PSO5	Students will be able to work in a variety of fields, including biological and medical science in higher education institutions, public health, environmental organizations, and the food, dairy, pharmaceutical, and biotechnology industries.

Degree in Bachelor of Science	
B.Sc. III Programme Specific Outcomes (PSOs)	
PSO1	Students of B.Sc. Microbiology Programme will learn to use scientific logic as they investigate a broad variety of contemporary subjects covering different areas of basic microbiology such as Bacteriology, Virology, Biochemistry, Microbial Physiology, Immunology, Cell Biology, Molecular Biology, Genetics, Immunology, and Microbial Genetics, as well as becoming aware of the importance of environmental microbiology.
PSO2	Students will learn about various biotechnological applications of microorganisms as well as industrially relevant substances developed by microorganisms. They'll learn about the special role microbes play in genetic modification technologies.
PSO3	Students will learn and develop good laboratory practices in a microbiological laboratory, as well as be able to explain the theoretical foundations and practical skills of the tools and technologies widely used in this area. Students can gain proficiency in the quantitative skills needed to analyze biological problems.
PSO4	Students will learn about experimental methods, hypothesis creation and testing, and experiment design and execution. Students can develop their critical thinking skills as well as their ability to read and interpret scientific literature. Via successful presentation of experimental findings as well as workshops, students can acquire good oral and written communication skills.

PSO5	The Degree courses will enable students to go for higher studies in Microbiology and Allied subjects leading to Post Graduation and Ph.D. degrees.
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Detail Syllabus of

B.Sc. I Year

or

Certificate in Microbial Technology

Programme/Class: Certificate	Year: First	Semester: First
Subject: MICROBIOLOGY		
Course Code: B080101T	Course Title: General Microbiology	
Course Outcomes:		
At the end of the course students will be able to:		
CO1: Understand the historical concept, scope of microbiology. It will also clear the concept of microbial classification for skill development .		
CO2: Understand about structure, characteristics, classification and reproduction of various members of microbial world including virus, fungi and protozoa for skill development and employability.		
CO3: Gain the knowledge about the various microscopy techniques used in microbiology for skill development and employability.		
CO4: Gain the knowledge about the various techniques and instruments used in laboratory for skill development and employability.		
CO5: Learn about the methods and techniques for sterilization and asepsis for skill development and employability.		
CO6: Understand the concept of isolation, cultivation, maintenance and preservation of microorganism to acquire knowledge for employability.		
CO7: Clear the concept of various staining techniques used in microbiology laboratory to develop employability skills.		
CO8: Understand biostatistics that helps to create the analytic ability for skill enhancement 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, history and scope of Microbiology History, scope, branches of microbiology and relevance of microbiology; Contribution of Antony Van Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Ivanowsky, Waksman, Subba Rao, Sambhunath De; Position of microorganisms in the living world. 5 kingdom classification of Whittaker and 3 kingdom classifications, comparison of the 3 domain of microorganisms- bacteria, archaea, eukarya; Bergey's manual and introduction to classification of bacteria for skill development .	8
II	Bacterial morphology Ultrastructure of bacterial cell, cell wall, plasma membrane, capsule, flagella, nucleoid, and reserve material. Differences between archaebacterial and eubacterial cell. General features of Rickettsia, Chlamydia, Mollicutes, Actinomycetes and Cynobacteria. The viruses General properties and structure of animal viruses: Influenza, HIV; plant viruses: TMV; bacterial viruses: Lambda Phage and T4 bacteriophage; general features of Prions and Viroids. Fungi General characteristics, classification & reproduction of Saccharomyces, Aspergillus. Protozoa General characteristics, classification & reproduction of Giardia, Entamoeba for skill development and employability.	10

III	<p>Techniques in microbiology I Principles of microscopy, construction and application of- Compound Microscope (monocular and binocular), Bright field Microscopy, Dark field Microscopy, Phase Contrast Microscopy, Fluorescence Microscopy, Electron Microscopy- TEM and SEM for skill development and employability.</p>	6
IV	<p>Techniques in microbiology II Principles, construction and application of centrifuge; bacteriological Incubator & Incubator Shaker; Laminar flow; Colourimeter & Spectrophotometer (UV-Vis) for skill development and employability.</p>	6
V	<p>Sterilization techniques and control of microorganisms Definitions of terms- sterilization and disinfection; Sterilization by Physical methods- Use of moist heat- heat under pressure, autoclave, boiling, pasteurization, fractional sterilization, tyndallization; Use of dry heat- hot air oven, incineration; Filtration- Seitz filter, membrane filter, HEPA filter; Radiation- Ionizing and non- ionizing; for skill development and employability. Chemical methods- Alcohols, aldehydes, phenols, halogens, metallic salts, ethylene oxide</p>	7
VI	<p>Isolation, cultivation and preservation of microorganisms Culture media and its types; Methods for enumeration & isolation of microorganisms using pour plate, spread plate technique, and streak plate; Isolation of anaerobic microorganisms; Maintenance and preservation of pure Culture to acquire knowledge for employability.</p>	8
VII	<p>Stains and staining techniques Staining techniques, principles, procedures and applications of Simple staining, negative staining; Differential staining- Gram's staining, acid fast staining, Leishman's staining, Giemsa's staining, Ziehl Neelsen staining; Structural staining- cell wall, capsule, endospore and flagella staining to develop employability skills.</p>	7
VIII	<p>Biostatistics Introduction to biostatistics – definition statistical methods, biological measurement, kinds of biological data; Measure of central tendency – Mean, median, mode, standard deviation; Collection of data, sampling and sampling design, classification and tabulation, types of representation, graphic biodiagrams for skill enhancement and employability.</p>	8

Suggested Readings:

1. Alexopoulos C.J. and Mims C.W., Introductory Mycology, New Age International, New Delhi.
2. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi.
3. Atlas R.M., Microbiology- Fundamentals and applications, Macmillan Publishing Company, New York.
4. Benson Harold J., Microbiological Applications, WCB Mcgraw-Hill, New York.
5. Bold H.C. and Wynne M.J., Introduction to Algae, Prentice Hall of India Private Limited, New Delhi.
6. Baveja C.P., Textbook of microbiology APC 6th edition.
7. Dubey R.C., and Maheshwari D.K., Textbook of microbiology, S Chand Publications.
8. Pelczar M.J., Chan E.C.S and Kreig N.R., Microbiology, Mcgraw-Hill Book Company, New York.
9. Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB Mcgraw- Hill, New York.

10. Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.
11. Sharma P.D., Microbiology, Rastogi Publications.
12. Tortora G.J., Funke B.R. and Case C.L., Microbiology: An introduction, 9th edition, Pearson Education.
13. Suggestive digital platforms web links-
 - <https://www.classcentral.com/tag/microbiology>
 - <https://cmp.berkeley.edu/bacteria/bacteria.html>
 - <https://www.livescience.com/53272-what-is-a-virus.html>
 - <https://www.slideshare.net/sardar1109/algae-notes-1>
 - <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy>
 - https://onlinecourses.swayam2.ac.in/cec19_bt11/preview
 - <https://microbenotes.com/laminar-flow-hood>
 - <https://physics.fe.uni-lj.si/students/predavanja/MicroscopyKulkarni.pdf>

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

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	1	1	1
CO2	2	1	1	1	1	1	1	1	1	2
CO3	1	1	1	1	1	1	1	1	1	2
CO4	1	2	1	1	1	1	1	1	1	3
CO5	3	1	1	1	1	1	2	3	2	3
CO6	2	1	1	1	1	1	1	1	2	3
CO7	3	1	1	1	1	1	1	1	1	3
CO8	1	1	1	1	3	1	1	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	1	2	1
CO5	1	2	1

	C06	2	3	1	
	C07	2	3	1	
	C08	3	3	1	

Programme/Class: Certificate	Year: First	Semester: First
Subject: MICROBIOLOGY		
Course Code: B080102P	Course Title: Experiments in Basic Microbiology	
Course Outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> • To understand the instruments, microbial techniques and good lab practices for working in a microbiology laboratory. • Practical skills in the laboratory experiments in microbiology. • Develop skills for identifying microbes and using them for industrial, agricultural and environmental purpose. • To prepare slides and stain to see the microbial cell. 		
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.	<ul style="list-style-type: none"> • Good laboratory practice in Microbiology and safety measures. • Cleaning and sterilization of glassware and equipments. • Study of aseptic technique- preparation of cotton plug, wrapping of glassware, transfer of media and Inoculum. 	12
2.	<ul style="list-style-type: none"> • Study of instruments- Microscope, autoclave, hot air oven, laminar airflow, inoculation loop and needle, incubator, B.O.D incubator, centrifuge machine, pH meter, colony counter, seitz filter, membrane filter, colourimeter, spectrophotometer. 	12
3.	<ul style="list-style-type: none"> • Preparation of different culture media- nutrient agar/nutrient broth for bacterial culture, PDA for fungal culture. • Enumeration of bacteria using spread plate and pour plate techniques. • Isolation of bacteria by pour plate, spread plate and streak plate method. 	12
4.	<ul style="list-style-type: none"> • Staining of bacteria- <ol style="list-style-type: none"> 1. Simple staining- methylene blue 2. Gram's staining 3. Acid fast staining 4. Ziehl Neelsen staining 5. Giemsa staining 6. Structural staining- capsule, endospore. 7. Staining of fungi using lactophenol and cotton blue. 	12
5.	Study of permanent slide and life materials <ul style="list-style-type: none"> • Bacteria- Staphylococci, Streptococci, Bacillus sp., Vibrio, Azospirillum • Protozoans- <i>Amoeba</i>, <i>Paramecium</i>, <i>Trypanosoma</i>, <i>Plasmodium</i>, <i>Entamoeba histolytica</i>. • Helminths- <i>Fasciola</i>, <i>Taeniasolium</i>, <i>Ascaris</i> 	12

	<ul style="list-style-type: none"> ● Fungi- <i>Mucor, Rhizopus, Penicillium, Aspergillus, Alternaria.</i> ● Cyanobacteria- <i>Chlorella, Spirulina, Nostoc, Anabaena.</i> 	
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Microbiology: A laboratory manual by J. Cappucino and C.T. Welsh. 11th edition, Pearson education, USA. 2016 2. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultivation, New Age International, New Delhi. 3. Dubey R.C. and Maheshwari D.K., Textbook of practical microbiology, S Chand Publications. 4. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology, 5th edition McMillan. 5. Lab Virtual links- <ul style="list-style-type: none"> ● https://www.classcentral.com/course/basic-concepts-in-microbiology-and-clinical-pharm-32196 ● https://www.labster.com/microbiology-virtual-labs/ ● https://www.futurelearn.com/courses/basic-concepts-in-microbiology-and-clinical-pharmacology-of-antimicrobials 		
<p>This course can be opted as an elective by the students of following subjects: Open for all </p>		
<p>Course prerequisites: To study this course, a student must have had the subject biology in class 12th</p>		
<p>Suggested Continuous Evaluation Methods: </p>		
<p>Further Suggestions: None</p>		

Programme/Class: Certificate	Year: First	Semester: First
Subject: MICROBIOLOGY		
Course Code: B093101T	Course Title: Animal Science	
Course Learning Outcomes: Upon successful completion of the course, the student: CO1: Describe general taxonomic rules of animal classification to acquire knowledge for skill enhancement. CO2: Classify Protozoan on basis of features and examples from parasitic adaptation for skill development. CO3: Classify Phylum Porifera with taxonomic keys using examples from parasitic adaptation for skill development and employability. CO4: Describe Phylum Annelids with their type study for effective development of skills. CO5: Understand general characteristics of Echinodermata and Arthropoda for skill development and employability. CO6: Identify, classify, and characterize phylum Chordata & class Mammalia for skill development. CO7: Describe the Human physiology including the digestive system, circulatory system, respiratory system, excretory system, and endocrine system for skill development. CO8: Understand the human physiology including the Nervous system, muscular and reproductive systems for skill development and better 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	Taxonomy & Classification: General principle of taxonomy and animal classification. Salient features and outline classification of invertebrates and vertebrates to acquire knowledge for skill enhancement.	6
II	Invertebrates: General characteristic of protozoa. Study of Euglena, Amoeba and Paramecium. Life cycle and pathogenicity of Plasmodium vivax and Entamoeba histolytica. Locomotion and Reproduction in Protista Evolution of symmetry and segmentation of Metazoa for skill development.	8
III	Porifera: General characters of Porifera; General characters of Coelentrata; General characters of Platyhelminthes, type study of Taenia and their parasitic adaptations; Canal system in sponges for skill development and employability.	8
IV	Annelid: General character of phylum Annelids, type study of Leech; General characters of Mollusk, type study of <i>Pila globose</i> for effective development of skills.	7
V	Arthropoda and Echinodermata: General character of Arthropoda and Echinodermata, external features of star fish for skill development and employability.	7
VI	Vertebrates: Outline classification and characteristic features of phylum Chordata and class Mammalia for skill development.	8
VII	Human Physiology I: Digestive System, Respiratory system, excretory system, Circulatory system- activity of the heart, Blood- composition and function, blood clotting mechanism; Endocrine system for skill development.	8

VIII	Human Physiology II: Nervous system- Structure of a typical neuron, conduction of nerve impulse, resting potential; Muscular system- ultrastructure and chemical composition of skeletal muscle, mechanism of muscle contraction. Human reproductive system for skill development and better employability.	8
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Suggested Readings:

1. R. L. Kotpal. Modern Textbook of Zoology Invertebrate, 11th Edn., Rastogi Publications, 2014.
2. R. L. Kotpal. Modern Textbook of Zoology Vertebrate. 4th Edn., Rastogi Publications, 2015.
3. Dhama & Dhama, Invertebrate Zoology, 5th Edn., S. Chand Publication, 2006.
4. Dhama & Dhama, Chordata Zoology, R. Chand Publication, 2006.
5. Jordan & Verma, Invertebrate Zoology, S. Chand Publication, 2008.
6. Jordan & Verma, Chordate Zoology, S. Chand Publication, 2007.
7. R. A. Agarwal, Animal Physiology, S. Chand Publication, 2014.

Website Sources:

- <https://www.shapeoflife.org/>
- <https://animalsmart.org/animal-science>
- <http://www.animal.org/content/teaching-tools-animal-biology>
- <https://study.com/academy/course/animal-science-study-guide.html>
- <https://www.britannica.com/animal/animal/>

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	2	1	1	2	1	1	3	1	1
CO2	2	2	2	1	2	1	2	3	1	2
CO3	2	1	2	2	2	1	2	3	1	2
CO4	2	1	2	2	2	1	2	3	2	2
CO5	1	1	2	2	2	2	1	2	2	3
CO6	1	1	2	2	2	2	1	2	2	3
CO7	1	2	2	1	1	2	1	2	3	3
CO8	1	2	1	1	1	2	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
CO1	2	2	1
CO2	2	1	1
CO3	2	1	1
CO4	1	2	1
CO5	1	3	1
CO6	3	1	1
CO7	3	1	1
CO8	3	1	1

Programme/Class: Certificate	Year: First	Semester: First
Subject: MICROBIOLOGY		
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 		
Lab Virtual links- <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:		
Further Suggestions: None		

Programme/Class: Certificate	Year: First	Semester: First
Subject: MICROBIOLOGY		
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.		
CO2: Understand proper metabolic pathways that are signification in physiological functioning for skill development and employability.		
CO3: Analyze and apply taxonomy and systematic in plant kingdom for evolutionary classification to enhance knowledge for better skill development and 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 for skill development.	6
II	Plant Physiology: Photosynthesis, Respiration and photorespiration, Nitrogen metabolism, Plant hormones, Sensory photobiology, Solute transport and photoassimilate translocation, Stress physiology, Vernalization, Seed dormancy and Germination for skill development and employability.	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 to enhance knowledge for better skill development and employability.	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> for effective development of employability skills.	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 for skill development and employability.	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> to acquire skills for better employability.	8
VII	Pteridophyta: General features, classification, structure, reproduction, stellar evolution, heterospory and seed habit, economic importance of Pteridophytes, general characters of <i>Selaginella</i> for skill development.	8
VIII	Gymnosperms & Angiosperms: General features, outline classification, structure, reproduction, Alternation of generation, structure of a flower, life cycle of angiosperm and economic importance for skill enhancement.	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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
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wherever required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

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
CO1	2	1	1
CO2	2	2	1
CO3	2	2	1
CO4	2	3	1
CO5	2	3	1
CO6	3	3	2
CO7	3	1	2
CO8	3	1	2

Programme/Class: Certificate	Year: First	Semester: First
Subject: MICROBIOLOGY		
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 biologyinclass12 th		
Suggested Continuous Evaluation Methods:		
Further Suggestions: None		

Programme/Class: Certificate	Year: First	Semester: First
Subject: MICROBIOLOGY		
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 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.		
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 to enhance knowledge for skill development.	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 for skill development and employability.	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 for better skill development and employability.	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 for skill development and employability.	8
V	Laws of Thermodynamics: First, second and Zeroth law of thermodynamics, entropy, enthalpy, Gibb's free energy for skill development.	8
VI	Reaction kinetics: Order of reactions, first, second and zero order reactions for skill development and employability.	8

VII	Colloidal: True solution, colloidal solution and suspension, types of colloidal systems, classification of colloids, properties of colloids, Coagulation, protective colloids for skill development.	8
VIII	Electrochemistry: Electrolysis, electrochemical cells, electrode potentials, electrochemical series to acquire knowledge for better employability skills.	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/PChem/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
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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	2	1	2	1	1
CO2	2	1	1	1	3	1	3	1	1	2
CO3	1	1	2	2	1	1	1	2	1	1
CO4	1	2	1	1	3	2	1	1	2	2
CO5	1	1	2	1	1	1	1	2	1	3
CO6	1	1	1	1	2	1	1	1	1	1
CO7	1	3	1	2	1	1	1	2	1	3
CO8	1	1	2	1	1	2	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	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	Semester: First
Subject: MICROBIOLOGY		
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. 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 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 for effective development of employability skills.	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 for skill development and employability.	15
III	Laws relating to libraries and information centers Library Legislation-Need and essential Features; Library Acts in India; Intellectual Property Right for skill development and employability.	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 to enhance knowledge for skill development and employability.	15
Suggested Readings:		
<ol style="list-style-type: none"> 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	Semester: First
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. 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 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 for skill development and employability		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 for effective development of employability skills. (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) for skill development and employability		8
IV	Community Health Concept (a) Causes of common diseases prevalent in the society and Nutrition requirement in the following: Diabetes Hypertension (High Blood Pressure) Obesity Constipation Diarrhea Typhoid (b) National and International Program and Policies for improving Dietary Nutrition		7

(c) Immunity Boosting Food to acquire knowledge for better 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	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

Programme/Class: Certificate	Year: First	Semester: Second
Subject: MICROBIOLOGY		
Course Code: B080201T	Course Title: Agriculture and Environmental Microbiology	
<p>Course Outcomes: At the end of the course students will be able to: CO1: Get the knowledge of natural and extreme habitats of microbes for skill development and employability. CO2: Learn the interaction among themselves and with plant and animals to acquire knowledge for skill development and employability. CO3: Learn about different biogeochemical cycles running in ecosystem and role of microbes within it for skill development. CO4: Get knowledge about different types of waste and their management to enhance knowledge for skill development and employability. CO5: Learn the management of pollutants and the activities of microbes within it for skill development and employability. CO6: Learn about safety measures of water and it's treatment method for development of employability skills. CO7: Gain knowledge of bio-fertilizers and their types for effective skill development and employability. CO8: Study about bio-pesticides-it's types, applications, advantages and disadvantages for skill development and employability.</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>Microorganisms and their habitats Structure and function of ecosystem; Terrestrial environment: soil profile and soil microflora; Aquatic Environment: microflora of fresh water and marine habitats; Atmosphere: Aero micro flora and dispersion of microbes; Animal Environment: Microbes in/on human body (microbiomes) & animal (Ruminants) body; Extreme habitats: Extremophiles: Microbes thriving at high & low temperature, pH. High hydrostatic & osmotic pressures, salinity and low nutrient level for skill development and employability; Microbial succession in decomposition of plant organic matter.</p>	8
II	<p>Microbial Interactions Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation; Microbe-Plant interaction: positive-negative interaction; Microbe-Animal interaction: positive-negative interaction; Microorganism of rhizosphere, rhizoplane and phylloplane, mycorrhiza (types and its applications) to acquire knowledge for skill development and employability.</p>	8

III	Biogeochemical cycling Carbon cycle: Microbial degradation of cellulose, hemicellulase, lignin and chitin; Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction; Phosphorous cycle: Phosphate Immobilisation and solubilisation; Sulphur cycle: Microbes involved in sulphur cycle for skill development.	8
IV	Waste management Solid waste management: Source and type of solid waste, method of solid waste disposal (composting and sanitary landfill), Liquid waste management: composition and strength of sewage (BOD & COD), primary, secondary, (oxidation pond, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment to enhance knowledge for skill development and employability.	8
V	Microbial Bioremediation Principle and degradation of common pesticides, organic (hydrocarbon, oilspills) and inorganic matter, biosurfactants for skill development and employability.	6
VI	Water potability Treatment and safety of drinking water; Methods to detect potability of water sample: Standard qualitative procedure- MPN test/Presumptive test, confirmed and completed test for faecal-coliforms Membrane filter technique, Presence/Absence test fecal coliform for development of employability skills.	6
VII	Biofertilizer Definition, Types- Bacterial, Fungal, Phosphate solubilizer, BGA & associative; Mode of application; Advantages and Disadvantages for effective skill development and employability.	8
VIII	Biopesticides Introduction and definition; Types of biopesticides; Integrated pest management (IPM); Mode of action; Factor influencing; Applications, advantages & disadvantages for skill development and employability.	8

Suggested Readings:

1. Alexander M., Introduction to soil microbiology, Wiley Eastern limited, New Delhi.
2. Alexopoulos C.J. and MIMS C.W., Introductory Mycology, New age international, New Delhi.
3. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi
4. Hurst, C.J., Environmental Microbiology, ASM press, Washington D.C.
5. Mehrotra A.S., Plant Pathology, Tata Mcgraw Hill Publications limited, New Delhi.
6. Pelczar M.J., Chan E.C.S and Kreig N.R., Microbiology, Mcgraw-Hill Book Company, New York.
7. Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB Mcgraw- Hill, New York.
8. Salle A.J., Fundamental Principles of Bacteriology, Tata Mcgraw-Hill Publishing Company Limited, New Delhi.
9. Stacey R.H. and Evans H.J., Biological Nitrogen Fixation, Chapman and Hall limited, London.
10. Stanier R. Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.
11. Subbarao N.S., Soil Microorganisms and Plant Growth, Oxford and IBH Publishing Company, New Delhi.
12. Steward W.D.P., Nitrogen Fixation in Plants, The Athlone Press, London.

Suggestive digital platforms web links-

- <https://www.classcentral.com/tag/microbiology>
- <https://www.mooc-list.com/tags/biotechnology>
- <https://asm.org/articles/2020/december/virtual-resources-to-teach-microbiology-techniques>
- <https://www.futuredirections.org.au/publication/living-soils-role-microorganisms-soil-health>

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	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	Semester: Second
Subject: MICROBIOLOGY		
Course Code: B080202P	Course Title: Experiments in Agriculture and Environmental Microbiology	
Course Outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> ● To understand the instruments, microbial techniques and good lab practices for working in a microbiology laboratory. ● Practical skill in the laboratory experiments in microbiology. ● Develop skills for identifying microbes and using them for industrial, agricultural and environmental purpose. ● To prepare slides and stain to see the microbial cell. 		
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	<ul style="list-style-type: none"> ● To analyse soil- pH, moisture, water holding capacity. 	8
2	<ul style="list-style-type: none"> ● Isolation of microorganisms (Bacteria & Fungi) from soil sample at different temperature (28° C & 45° C) ● Isolation of bacteria and fungi from rhizosphere and rhizoplane. ● Isolation of bacteria & fungi from air environment by exposure plate method. ● Isolation of Rhizobium sp. from leguminous root nodule. 	16
3	<ul style="list-style-type: none"> ● To determine BOD of waste water sample. ● Bacteriological examination of water by MPN test, presumptive coliform, confirmed coliform and completed coliform test. 	12
4	<ul style="list-style-type: none"> ● Specimen study of plant pathogens. <ol style="list-style-type: none"> 1. Black rust of wheat 2. White rust of crucifer 3. Leaf curl of tomato 4. Downy mildew 5. Red rot of sugarcane 	10
5	<ul style="list-style-type: none"> ● Study of permanent slide and life materials <ol style="list-style-type: none"> 1. <i>Cladosporium</i> 2. <i>Helmithosporium</i> 3. <i>Mucor</i> 4. <i>Curvularia</i> 5. <i>Alternaria</i> 6. <i>Geotrichurn</i> 7. <i>Trichoderma</i> 8. <i>Rhizopus</i> 	14

Suggested Readings:

1. Agrios A.G. Plant Pathology, Elsevier Academic Press, New Delhi, 2006.
2. Atlas RM and Batha R (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
3. Maier RM, Pepper IL and Gerba Cp (2009). Environmental Microbiology. 2nd edition, Academic Press.
4. Subba Rao NS. (1999). Soil Microbiology, 4th edition. Oxford & IBH Publishing Co. New Delhi.

Virtual Lab Links-

- <https://vlab.amrita.edu/?sub=3&brch=73>
- <https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering>
- <https://opentextbc.ca/virtualscienceresources/chapter/environmental-science/>

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

Programme/ Class: Certificate	Year: First	Semester: Second
Subject: Microbiology		
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. 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. CO6: Basic construction of a living organism, its metabolism and relation to diseases for skill development and 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.</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

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	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	Semester: Second
Subject: Microbiology		
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

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Further Suggestions: None

Programme/Class: Certificate	Year: First	Semester: Second
Subject: MICROBIOLOGY		
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.		
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.		
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.		
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 properties and chemical reactions of alkanes. Mechanism of free radical halogenation of alkanes to enhance knowledge for skill development and employability.	8
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 stainless 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	Semester: Second
Subject: MICROBIOLOGY		
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: Certificate		Year: First	Semester: Second
Subject: Microbiology			
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. 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. 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, Surfing the web for skill development and employability.	8	

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: 1	Semester: Second
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. 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.			
Credits: 4		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 enhancement.		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 development		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 Journalism		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	Semester: Second
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.		
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.		
CO 5: Provide awareness for various accidental poison consumption, bites, stings, basic sense organs and steps taken during any disastrous condition to acquire knowledge for better employability skills.		
CO 6: Learn about basic reproductive, urinary system for skill development and employability.		
CO7: Awareness about the concept of sex education, LGBTQ issues and most importantly prevention of STDs for effective skill development and employability.		
CO8: Know about mental health issues, understanding depression, disorders and first aid use mental health aid to acquire better for employability skills.		
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+30 Practical
	A. First aid related with Bones, Joints Muscle related injuries <ul style="list-style-type: none"> • Basics of the skeleton, Joints and Muscles. Fractures (injuries to bones) for better skill development.	
II	B. First aid related with Nervous system and Unconsciousness <ul style="list-style-type: none"> • Basics of the nervous system. • Unconsciousness, Stroke, Fits – convulsions – seizures, Epilepsy. C. First aid related with Gastrointestinal Tract <ul style="list-style-type: none"> • Basics of the gastrointestinal system. • Diarrhea, Food poisoning. D. First aid related with Skin, Burns <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. E. First aid related with Poisoning <ul style="list-style-type: none"> • Poisoning by swallowing, Gases, Injection, Skin F. First aid related with Bites and Stings <ul style="list-style-type: none"> • Animal bites, Snake bites, Insect stings and bites G. First aid related with Sense organs <ul style="list-style-type: none"> • Basic of Sense organ. • Foreign objects in the eye, ear, nose or skin. 	2 (Theory)10 (Practical)

	<ul style="list-style-type: none"> Swallowed foreign objects. <p>H. 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. <ul style="list-style-type: none"> Emergency Child birth 	
III	<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 <p>Prevention of sexually transmitted diseases for skill development and employability.</p>	9 (Theory)
IV	<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 Using Mental Health First Aid 	2 (Theory)10 (Practical)
<p>Suggested Readings:</p> <ol style="list-style-type: none"> Indian First Aid Manual-https://www.indianredcross.org/publications/FA-manual.pdf Red Cross First Aid/CPR/AED Instructor Manual https://mhfa.com.au/courses/public/types/youthedition4 Finkelhor, D. (2009). The prevention of childhood sexual abuse. Durham, NH: Crimes Against Children Research Center. www.unh.edu/ccrc/pdf/CV192.pdf Kantor L. & Levitz N. (2017). Parents’ views on sex education in schools: How much do Democrats and Republicans agree? PLoS ONE, 12 (7): e0180250. Orenstein, P. (2016). Girls and sex: Navigating the complicated new landscape. New York, NY: Harper. Schwiegershausen, E. (2015, May 28). The Cut. www.thecut.com/2015/05/most-women-are-catcalled-before-they-turn-17.html Wiggins, G. & McTighe, J. (2008). Understanding by design. Alexandria, VA: ASCD. <p>Suggested Web links:</p> <ul style="list-style-type: none"> 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

Detail Syllabus of

B.Sc. II Year

or

Diploma in Microbial Technology

Programme/Class: Diploma	Year: Second	Semester: Third
Subject: MICROBIOLOGY		
Course Code: B080301T	Course Title: Basic Biochemistry and Microbial Physiology	
Course Learning Outcomes:		
At the end of the course students will able to:		
CO1: Explain the basic principles of thermodynamics applied to biological systems and its related terms for better skill development and employability.		
CO2: Comprehend the structure & properties of water and carbohydrates to acquire knowledge for better skill development and employability.		
CO3: Know about various levels of protein structure and the forces involved in protein folding for enhanced employability skills.		
CO4: Explain the structure, classification and metabolism of lipids and nucleotides for skill development and employability.		
CO5: Comprehend the basic concepts of enzyme including enzyme kinetics, inhibition and their classification to acquire employability skills.		
CO6: Understand the classification of microbes on the basis of nutrition and energy source, along with various modes of transports for effective development employability skills.		
CO7: Understand the patterns of bacterial growth, bacterial growth curve, calculation of generation time, specific growth rate as well as the various operational modes for skill development and employability.		
CO8: Know about the physiology of nitrogen fixation by bacteria and effect of environmental stress on microbial adaptation 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	Overview of thermodynamics and bioenergetic Basics of thermodynamics- First and second laws, concept of enthalpy, entropy, free energy change, standard free energy change, equilibrium constant and spontaneous reactions and coupled reactions for better skill development and employability.	6
II	Water & Carbohydrates Structure and properties of water, Handerson Hasselbalch equation, Ionic product of water, pH and buffers. Structure & classification of carbohydrates, carbohydrates metabolism: glycolysis, fermentation, Pentose phosphate pathway (PPP), Entner Doudoroff pathway, Krebs Cycle, Electron transport chain (ETC)- Chemiosmotic hypothesis, oxidative phosphorylation and ATP generation, Gluconeogenesis to acquire knowledge for better skill development and employability.	12
III	Proteins Structure & Classification- Protein structure: primary, secondary-peptide unit salient features, α helix, β sheet, β turn, tertiary and quaternary-human hemoglobin as an example. Forces involved in protein folding for enhanced employability skills.	6

IV	Lipids & Nucleic acids Structure and classification of lipids. Metabolism of lipids- Alpha and beta oxidation of lipids; Nucleic acids Structures, Double helical structure of DNA. Types of DNA: A, B, Z. Physic-chemical properties of DNA. RNA types- rRNA, mRNA, tRNA for skill development and employability.	6
V	Enzymology concepts: Concepts of holozymes, apoenzyme, cofactors, prosthetic group, coenzyme, metal cofactors; Classification of enzymes; Active site and activation energy; Lock and key hypothesis, induced fit hypothesis; enzyme kinetics; Allosteric enzymes-cooperativity; Enzyme inhibition: competitive and noncompetitive to acquire employability skills.	6
VI	Microbial nutrient uptake and transport: Microbial classification based on nutrient and energy source; Nutrient uptake mechanisms-passive and facilitated diffusion; Primary and secondary active transport; Concept of uniport, symport, antiport, group translocation; Iron uptake for effective development employability skills.	8
VII	Microbial growth and effect of environmental factors on growth Bacterial growth curve and kinetics-Generation time and specific growth rate; Diauxic growth and synchronous growth; Batch, Fed batch and continuous cultures; Chemostat and turbidostat for better skill development and employability.	8
VIII	Stress physiology and Nitrogen metabolism Effect of oxygen, pH, osmotic pressure, heat shock on bacteria; Microbial adaptation to Environment-Temperature, pH, Oxygen, Pressure, Salt, Water activity; Extremophiles application in industry; Dissimilatory nitrate reduction, Nitrogen fixation for better skill development and employability.	8

Suggested Readings:

1. Moat A.G., Foster J.W. and Spector M.P. 2002. *Microbial Physiology*, 4th edition. A Johan Wiley and sons inc., publication.
2. Kim B.H. and Gadd G.M. 2008. *Bacterial physiology and metabolism*. Cambridge University Press, Cambridge.
3. Gilbert H.F. 2000. *Basic concepts in biochemistry: A student's survival guide*. Second Edition. Mc-Graw-Hill Companies, health professions Division, New York.
4. Madigan M.T., Martinko J.M., Stahl D.A. and Calrk D.P. 2012. *Brock Biology of Microorganisms*. 13th ed. Pearson Education Inc.
5. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto Jr., Lubert Stryer. 2015. *Biochemistry* 8th edition. W. H. Freeman.

Suggestive digital platforms web links-

- <https://lipidnanostructuresgroup.weebly.com>
- <https://www.labster.com/microbiology-virtual-labs>
- <https://www.microbiologybook.org>
- <https://www.cpe.rutgers.edu/courses/current/lf0401wa.html>
- <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy>
- <https://www.futurelearn.com/courses/introduction-to-microbiology>

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 “Agriculture and Environmental Microbiology” in II Semester of certificate course in Microbial Technology

Suggested Continuous Evaluation MethodsHouse 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	1	1	1	1	1	1	1	1	1
CO2	2	1	1	1	1	1	1	1	1	1
CO3	2	1	1	1	1	1	1	1	1	1
CO4	2	1	1	1	2	1	2	2	2	1
CO5	3	2	2	2	3	2	2	2	2	2
CO6	3	2	2	2	2	2	2	2	2	2
CO7	3	2	2	2	3	2	2	2	1	2
CO8	3	2	2	2	2	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	2	1	1
CO2	2	2	1
CO3	2	2	1
CO4	2	2	1
CO5	3	3	2
CO6	3	3	2
CO7	3	3	2
CO8	3	3	2

Programme/Class: Diploma	Year: Second	Semester: Third
Subject: MICROBIOLOGY		
Course Code: B080302P	Course Title: Experiment in Basic Biochemistry and Microbial Physiology	
Course Outcomes: After completing the course, the student will be able to: <ul style="list-style-type: none"> • Understand the structures of carbohydrates and their main properties, as well as conduct chemical tests to detect their presence in samples. • Would have acquired practical knowledge of biochemical techniques for proteins and will be familiar with the use of a spectrophotometer. • Understand the fundamental principles of enzyme biochemistry, including enzyme kinetics, at the end of the course. • Will have a thorough understanding of bacterial growth patterns, bacterial growth curves, generation time and basic growth rate calculations, and the impact of the environment on growth. • Will learn about the fermentation process in microbes. 		
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	Use and calibration of pH meter and preparation of buffers. Preparation of stock and working solutions. Handling of pipettes and micropipettes and checking their accuracy.	4
2	Qualitative tests Carbohydrates: Molisch's Test, Fehling's Test, Benedict's Test, Iodine Test) Amino acids and Proteins: Ninhydrin test, Biuret test, Lowry test. Lipids: Solubility Test, Translucent Spot Test, Emulsification Test.	20
3	<ul style="list-style-type: none"> • Quantitative estimation of carbohydrate by anthrone method. • Quantitative estimation of proteins by Lowry's method • Determination of the acid value of a fat 	10
4	Extraction of enzyme (Catalase) from plant source and its mode of actions on substrate. Urease production test, IMViC test	10
5	Effect of temperature and pH on growth of E. coli, Effect of carbon and nitrogen on microbial growth.	8
6	Demonstration of carbohydrate fermentation, indole production, catalase test, oxidase test.	8
Suggested readings: <ol style="list-style-type: none"> 1. Daniel M. Bollag, Stuart J. Edelstein, Protein Methods, Volume 1, 1991, Wiley. 2. S. K. Sawhney, Randhir Singh, Introductory Practical Biochemistry, 2000, Narosa. 3. Sambrook J and Russell DW., Molecular Cloning: A Laboratory Manual. 4th Edition, 2004, Cold Spring Harbour Laboratory press. 4. Maloy SR, Cronan JE and Friefelder D, Microbial Genetics 2nd EDITION., 2004, Jones and Barlett Publishers 5. Larry Snyder. Molecular Genetics of Bacteria: 3rd (third) Edition. Digital links <ul style="list-style-type: none"> • http://www.mooc.list.com/tag/molecular-biology • http://www.mooc.list.com/course/microbiology.sayloro • https://lipidnanostructuresgroup.weely.com 		

<ul style="list-style-type: none"> • http://www.mooc.list.com/microbial https://open.umn.edu/opentextbooks/textbooks/biochemistry-free-for-all-ahern
<p>This course can be opted as an elective by the students of following subjects: Open for all </p>
<p>Course prerequisites: To study this course, a student must have had the subject “Agriculture and Environmental Microbiology” in II Semester of certificate course in Microbial Technology</p>
<p>Suggested Continuous Evaluation Methods </p>
<p>Further Suggestions: None</p>

Programme/Class: Diploma	Year: Second	Semester: Third
Subject: MICROBIOLOGY		
Course Code: B094301T	Course Title: Bioinformatics	
Course Learning Outcomes:		
At the end of the course students will be able to:		
CO1: Understand various biological databases and tool for better skill development and employability.		
CO2: Understand DNA and RNA sequencing to acquire employability skills.		
CO3: Identify the homologous of DNA and protein sequences for skill development and employability.		
CO4: Understand protein structure prediction method to acquire knowledge for better skill development and employability.		
CO5: Learn about different protein structure visualization tool for better skill development and employability.		
CO6: Understand various protein modeling methods to acquire better employability skills.		
CO7: Understand various methods for phylogenetic analysis for skill development and employability.		
CO8: Understand various immuno-informatics databases and tools for effective development of 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. Hours (60)
I	Introduction of Bioinformatics: Biological Databases, Primary, secondary and composite databases, Data retrieval with ENTREZ, SRS, DBGET; Sequence and molecular file formats for better skill development and employability.	6
II	Principles of Nucleic acid and Protein sequencing: Chemical chain termination, Dideoxy chain termination method, Automatic sequencer; RNA sequencing (Edman degradation method) to acquire employability skills.	12
III	Sequence alignment: Pairwise and multiple, global and local. Database similarity searches (BLAST, FASTA and Types of BLAST) for skill development and employability.	6
IV	Protein structure prediction: Protein databases, Protein identification and Protein characterization, Primary structure analysis and prediction, Ramachandran Plot, Secondary structure analysis and prediction (GOR method; Chou Fasman method), tertiary structures. Microarray Data Analysis for better skill development and employability.	6
V	Structure visualization methods: Structure visualization methods- PyMOL, RASMOL, CHIME, Swiss-PDB Viewer, Protein Structure alignment and analysis. Application of Bioinformatics in drug discovery and drug designing for better skill development and employability.	6

VI	Protein modeling: Method of protein modeling, Homology modeling, Fold recognition, Ab-initio modeling, Protein classification and protein classification databases to acquire better employability skills.	8
VII	Evolutionary analysis and molecular phylogeny: Concept of phylogeny, Types of trees, Distance based methods (UPGMA and NJ algorithm), Character based methods (maximum parsimony and maximum likelihood) phylogenetic software-PHYLIP, PAUP, tree viewing software for skill development and employability.	8
VIII	Immuno-Informatics: Introduction to immunoinformatics, Tools and databases-BIMAS, SVMHC, ProPed, B-cell epitope database, T-cell epitope database. Introduction to vaccine design. Reverse Vaccinology for effective development of employability skills.	8

Suggested Readings:

1. Bioinformatics by Andreas D Boxevanis (Wiley Interscience)
2. Fundamental concept of bioinformatics by Dan e. krane
3. Introduction to bioinformatics by Attwood and Parry Smith (Pierson education Publication)
4. Instant notes in Bioinformatics by Westhead, parish and Tweman (Bios scientific publishers)
5. Bioinformatics: Principles and applications by Ghosh and Mallick (oxford) university press)

Suggestive digital platforms web links-

- <https://pubmed.ncbi.nlm.nih.gov/>
- <http://www.bioinform.com/index>
- <http://bioinfo.ernet.in/www.ncbi.nlm.nih.gov>
- <http://www.bic.nus.edu.sg/>

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 “Agriculture and Environmental Microbiology” in II Semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods

House Examination/Test:10 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	3	1	1	1	2	1	2	2	1	3
CO2	1	1	1	1	2	1	1	2	1	2
CO3	1	1	3	1	2	1	1	2	1	1
CO4	2	2	3	1	2	2	1	2	2	1
CO5	2	2	1	2	1	2	1	1	2	2
CO6	2	2	1	2	1	2	1	1	2	3
CO7	2	2	3	2	1	2	2	1	2	1
CO8	3	1	1	2	1	1	2	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
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C01	2	2	1
C02	2	2	2
C03	2	2	1
C04	2	2	2
C05	2	3	2
C06	3	3	2
C07	3	3	1
C08	3	3	1

Programme/Class: Diploma	Year: Second	Semester: Third
Subject: MICROBIOLOGY		
Course Code: B094301P	Course Title: Experiment in Bioinformatics	
Course Outcomes: After completing the course, the student will be able to: <ul style="list-style-type: none"> • Bioinformatics databases and tools for molecular structure and function prediction. • Identify the homologous protein and DNA sequences. • Visualization and characterization of protein structures • Are able to design of new drug molecules. 		
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	Introduction to various biological databases.	10
2	To study the various biological databases associated with NCBI databases and tools. To study various file formats of NCBI.	10
3	To introduce Entrez as a biological data retrieval system. To identify all the possible open reading frames in a sequence.	10
4	To obtain the local alignment and global alignment of the given sequences using the tool BLAST and Needleman-Wunsch algorithm	10
5	To compute the various physical and chemical parameters of a protein.	10
6	To determine the Secondary structure of P68871 AND P24071. To learn how to retrieve structural data of a protein using PDB database.	10
Suggested Readings: <ol style="list-style-type: none"> 1. Bioinformatics by Andreas D Boxevanis (Wiley Inter science) 2. Fundamental concept of bioinformatics by Dan e. krane 3. Introduction to bioinformatics by Attwood and Parry Smith (Pierson education Publication) 4. Instant notes in Bioinformatics by Westhead, parish and Tweman (Bios scientific publishers) 5. Bioinformatics: Principles and applications by Ghosh and Mallick (oxford) university press) Suggestive digital platforms web links- <ul style="list-style-type: none"> • https://pubmed.ncbi.nlm.nih.gov/ • http://www.bioinform.com/index • http://bioinfo.ernet.in/www.ncbi.nlm.nih.gov • http://www.bic.nus.edu.sg/ 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 “Agriculture and Environmental Microbiology” in II Semester of certificate course in Microbial Technology		
Suggested Continuous Evaluation Methods		
Further Suggestions: None		

Programme/Class: Diploma	Year: Second	Semester: Third
Subject: MICROBIOLOGY		
Course Code: B094302T	Course Title: Bioinstrumentation	
<p>Course Learning Outcomes: At the end of the course students will be able to:</p> <p>CO1: Gain knowledge about the Basic laboratory Instruments and Biochemical techniques for skill development, employability and entrepreneurship development.</p> <p>CO2: Understand the different types of centrifugation techniques as well as types rotors used for better skill development and employability.</p> <p>CO3: Learn the theory and application of various types of chromatographic techniques to acquire knowledge for better skill development and employability.</p> <p>CO4: Learn the basic principles of different types of electrophoresis techniques and their application to promote better employability skills and entrepreneurship development.</p> <p>CO5: Understand the principle, modes of molecular vibration, instrumentation and application of IR spectroscopic instruments for skill development and employability.</p> <p>CO6: Understand the principle, instrumentation and application of Mass spectroscopic instruments to induce entrepreneurship development and employability skills.</p> <p>CO7: Understand the radioisotopic techniques and the applications of radioisotopes in biology and medicine for skill development and employability.</p> <p>CO8: Understand the design of different Biosensor and their application for skill development, employability and entrepreneurship development.</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	Basic laboratory Instruments and Biochemical techniques: Principle of Autoclave, Incubator, Waterbath; Biosafety cabinet; Principle and working of pH meter, Preparation of buffers and solutions, Safety measures of radio-tracer techniques for skill development, employability and entrepreneurship development.	6
II	Centrifugation Techniques: Theory and Principle of centrifugation, sedimentation, sedimentation rate, sedimentation coefficient. Use and design of different types of rotors, Types of centrifuges- Density gradient centrifugation (zonal and isopycnic), differential centrifugation, Ultra centrifugation for better skill development and employability.	12
III	Chromatography Techniques: Theory and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GLC and HPLC to acquire knowledge for better skill development and employability.	6

IV	Electrophoresis Techniques: Gel electrophoresis - Theory and Application of PAGE and Agarose Gel Electrophoresis; Paper electrophoresis; Capillary electrophoresis; Iso-electric Focusing to promote better employability skills and entrepreneurship development.	6
V	IR spectroscopy: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier - Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy, Data Interpretation for skill development and employability.	6
VI	Mass Spectroscopy: Principle, Theory, Instrumentation of Mass Spectroscopy, sample inlets; Ion source and ionization; Mass analyzers; Applications of Mass spectroscopy to induce entrepreneurship development and employability skills.	8
VII	Radio-isotopic Techniques: Introduction to Radioisotopes and their Biological Applications; Radioactive Decay – Types and Measurement; Principles and Applications of GM Counter, Solid and Liquid Scintillation Counter; Autoradiography, Radiation Dosimetry for skill development and employability.	8
VIII	Biosensors: Biosensors- various components of biosensors, Types of Biosensors, - electrochemical biosensors, colorimetric/ thermal detection biosensors, Advantages and limitations; Application and uses of biosensors for skill development, employability and entrepreneurship development.	8

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.
4. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.

Website Sources:

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

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 “Agriculture and Environmental Microbiology” in II Semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods

House Examination/Test: 10 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	2	1	1	2	1	1	3
CO2	2	1	1	2	2	1	2	1	1	2
CO3	3	1	1	2	2	1	2	1	1	2
CO4	3	1	3	2	2	2	2	2	1	2
CO5	1	2	2	1	2	2	1	2	2	3
CO6	1	2	3	1	3	2	1	2	2	3
CO7	1	2	3	1	3	2	1	2	2	3
CO8	1	2	2	1	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	2	2
CO2	2	2	1
CO3	2	2	1
CO4	2	2	2
CO5	2	3	1
CO6	3	3	2
CO7	3	3	1
CO8	3	3	2

Programme/Class: Diploma	Year: Second	Semester: Third
Subject: MICROBIOLOGY		
Course Code: B094302P	Course Title: Biotechnical Lab	
Course Outcomes: After completing the course, the student will be able to:		
<ul style="list-style-type: none"> • Define and explain various fundamentals of spectroscopy, qualitative and quantitative analysis. • Discuss the terms, principle, instrumentation, operation and applications of Molecular spectroscopic techniques. • Differentiate between principle, instrumentation and operation of atomic absorption and emission Spectroscopy. • Explain the various Separation techniques and its instrumentation. 		
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	Working Principle and structural components of simple microscope and compound microscope.	8
2	Basics Working and Principle of Biological Safety Cabinet (Laminar Air Flow Chamber) and UV-Vis spectrophotometer	16
3	Basics Working and Principle of Autoclave, Incubator, Water bath, Centrifuge, Chromatography apparatus, etc.	10
4	To study the working principle of various lab equipments such as electronic balance, use of glass and micropipettes.	10
5	To identify different amino acids in a mixture using paper chromatography and thin layer chromatography.	8
6	To perform of Electrophoresis of extracted DNA.	8
Suggested Readings:		
<ol style="list-style-type: none"> 1. Skoog & West Principle of Instrumental Analysis 7th Edn 2018. 2. Freilder. Physical Biochemistry: Application to Biochemistry and Molecular Biology, 2nd Edn 1983. 3. Keith Wilson & John Walker Principles and Techniques of Biochemistry and Molecular Biology:, 7th Cambridge University Press, 2010. 4. S. K. Sawhney & Randhir Singh., Introductory Practical Biochemistry 5th Edn, 2014. 5. G. R. Chatwal & S. K. Anand, Instrumental Methods of Chemical Analysis, Oscar publication, 2015 		
Website Sources:		
<ul style="list-style-type: none"> • https://onlinecourses.nptel.ac.in/ • https://www.wikipedia.org/ • https://library.nitrkl.ac.in/ 		
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 “Agriculture and Environmental Microbiology” in II Semester of certificate course in Microbial Technology		
Suggested Continuous Evaluation Methods		
Further Suggestions: None		

Programme/Class: Diploma	Year: Second	Semester: Third
Subject: MICROBIOLOGY		
Course Code: B094303T	Course Title: Introductory Bioprocess	
Course Learning Outcomes:		
At the end of the course students will be able to:		
CO1: Understand the concepts of Bioprocess engineering its Components like Inoculum preparation, medium formulation etc. for effective development of entrepreneurship and employability skills.		
CO2: Know the batch, fed-batch and continuous cultivation techniques and quantify the biomass and product yield to promote entrepreneurship development and employability skills.		
CO3: Sterilize the fermentation medium and vessel and also be able to design the sterilization process for skill development and employability.		
CO4: Estimate the substrate consumption and product formation in fermentation process using material balance equations to induce entrepreneurship development and employability skills.		
CO5: Use the concept of energy balance equations and can quantify internal energy, heat enthalpy etc for skill development and employability.		
CO6: Understand the designing of different types of bioreactors and its components used in fermentation industries to acquire better employability skills.		
CO7: Learn about the scale up of laboratory bioreactors and bioprocess to pilot plant and industry scale for skill development and employability.		
CO8: Learn about the monitoring and controlling the bioreactors using feedback and PID Controller 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	Introduction to Bioprocess: Steps in Bioprocess Development: Recombinant DNA products, Inoculum preparation, Media Preparation and formulation for effective development of entrepreneurship and employability skills.	6
II	Cultivation system: Batch, fed batch and Continuous cultivation system- Washout phenomenon, chemostat and turbidostat, Biomass and product yield, yield coefficient to promote entrepreneurship development and employability skills.	6
III	Sterilization: Sterilization and kinetics of sterilization, Sterilization of media: Batch Sterilization, Continuous Sterilization. Sterilization of air, Air filters and X ₉₀ for skill development and employability.	6
IV	Material Balances: Material Balance equation, Law of Conservation of Mass, Steady State material balance, Stoichiometric of growth and product formation to induce entrepreneurship development and employability skills.	6
V	Energy balance: Steady state and equilibrium, stoichiometry of growth and product formation. Basic concept of internal energy, enthalpy and heat capacity for skill development and employability.	6

VI	Bioreactor's design: Configuration and construction material, stirred tank, bubble column, Airlift reactor, operating characteristics of packed bed, fluidized bed and trickle bed bioreactor to acquire better employability skills.	8
VII	Scale up of bioprocess: some consideration in aeration, agitation, mass transfer and heat transfer. Basic principle of scale-up of bioreactor for skill development and employability.	8
VIII	Monitoring and control of bioreactor – Overview of methods for online and offline monitoring of bioreactors; Advanced control strategies viz. Feed Back Controllers and PID controllers to enhance knowledge for skill development and employability.	8

Suggested Readings:

1. Michael L. Shuler, Fikret Kargi, Bioprocess Engineering – Basic Concepts, 2nd Ed., Pearson Education India, 2015
2. James Bailey, David Ollis, Biochemical Engineering Fundamentals, 2nd Ed., McGraw Hill Education, 2017
3. Roger G. Harrison, Paul W. Todd, Scott R. Rudge, Demetri P. Petrides, Bioseparations Science and Engineering, 2nd Ed., Oxford University Press, 2003.
4. Pauline M. Doran, Bioprocess Engineering Principles, 2nd Ed., Academic Press, 2012
5. Stanbury, Peter F., Allan Whitaker, and Stephen J. Hall. Principles of fermentation technology. Elsevier, 2013

Website Sources:

- <https://onlinecourses.nptel.ac.in/>
- <https://www.wikipedia.org/>
- <https://www.ncbi.nlm.nih.gov/books>
- <https://www.masterclass.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 had the subject “Agriculture and Environmental Microbiology” in II Semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods

House Examination/Test: 10 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	3	2	1	1	1	1	2	1	2	2
CO2	1	2	3	1	2	1	2	1	2	2
CO3	1	2	2	1	3	1	2	1	2	2
CO4	1	2	2	2	2	2	2	2	3	3
CO5	3	1	2	2	2	2	1	2	1	1

CO6	2	1	1	2	2	3	1	2	1	1
CO7	2	1	2	2	2	2	1	2	1	1
CO8	2	1	2	1	2	2	1	2	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	2	3
CO2	2	2	3
CO3	2	2	1
CO4	2	2	3
CO5	2	3	1
CO6	3	3	1
CO7	3	3	1
CO8	3	3	1

Programme/Class: Diploma	Year: Second	Semester: Third
Subject: MICROBIOLOGY		
Course Code: B093304T	Course Title: Quality Assurance	
<p>Course Learning Outcomes: At the end of the course students will be able to: CO1: Gain knowledge about quality & quality control and understand TQM- both lab and commercial to acquire knowledge for better employability skills and entrepreneurship development. CO2: Understand how ICH works, its guidelines. Responsibilities of QA & QC to promote entrepreneurship development and employability skills. CO3: Learn about maintenance and keeping records of hygiene activity in labs, environment and areas of high caution to acquire knowledge for entrepreneurship development and employability skills. CO4: Learn selection of appropriate instrument & procedure to be followed. Primary & Secondary tests for quality assurance for effective entrepreneurship development and employability skills. CO5: Learn about good laboratory practices and protocols & disqualification for skill development and employability. CO6: Learn about complaint filing, receiving and handling for skill development and employability. CO7: Understand and appreciate the importance of documentation for skill development and employability. CO8: Understand and learn about calibrations of different measuring equipment & validation of a procedure for skill development and employability.</p>		
Credits: 3	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>Quality Assurance and Quality Management concepts: Definition and concept of Quality control, Quality assurance and GMP Total Quality Management (TQM): Definition, elements, philosophies to acquire knowledge for better employability skills and entrepreneurship development.</p>	6
II	<p>ICH Guidelines: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines Quality by design (QbD): Definition, overview, elements of QbD program, tools ISO 9000 & ISO14000: Overview, Benefits, Elements, steps for registration NABL accreditation: Principles and procedures to promote entrepreneurship development and employability skills.</p>	12
III	<p>Organization and personnel: Personnel responsibilities, training, hygiene and personal records. Premises: Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination to acquire knowledge for entrepreneurship development and employability skills.</p>	6

IV	Equipments and raw materials: Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials. Quality Control: Quality control test for containers, rubber closures and secondary packing materials for effective entrepreneurship development and employability skills.	6
V	Good Laboratory Practices: General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities for skill development and employability.	6
VI	Complaints: Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal. Warehousing: Good warehousing practice, materials management for skill development and employability.	8
VII	Document maintenance in pharmaceutical industry: Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records for skill development and employability.	8
VIII	Calibration and Validation: Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of General principles of Analytical method Validation for skill development and employability.	8

Suggested Readings:

1. Quality Assurance Guide by organization of Pharmaceutical Products of India.
2. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69.
3. Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I WHO Publications.
4. A guide to Total Quality Management- Kushik Maitra and Sedhan K Ghosh
5. How to Practice GMP's – P P Sharma.
6. ISO 9000 and Total Quality Management – Sadhank G Ghosh
7. The International Pharmacopoeia – Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms
8. Good laboratory Practices – Marcel Deckker Series
9. ICH guidelines, ISO 9000 and 14000 guidelines

Website Sources

- <https://nptel.ac.in/courses/110/104/110104080/>
- <https://nptel.ac.in/courses/110/101/110101010/>
- <https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ge14/>

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 “Agriculture and Environmental Microbiology” in II Semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods

House Examination/Test:10 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	3	2	1	2	1	2	1	2	2
CO2	2	3	2	1	3	1	2	1	1	2
CO3	3	2	3	2	2	1	2	3	1	2
CO4	3	2	1	2	3	2	1	2	1	3
CO5	1	2	2	2	2	2	3	2	2	3
CO6	3	1	1	2	2	3	2	2	2	2
CO7	1	1	1	2	1	2	1	1	2	2
CO8	3	1	3	2	1	2	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	2	2	2
CO2	2	2	2
CO3	2	2	3
CO4	2	2	3
CO5	2	2	1
CO6	3	3	1
CO7	3	3	1
CO8	3	3	2

Programme/Class: Diploma	Year: Second	Semester: Third
Subject: MICROBIOLOGY		
Course Code: Z030301	Course Title: Human Values and Environment studies	
<p>At the end of the course students will be able to:</p> <p>CO1: Learn concept of value. Values in personal/professional life for skill enhancement.</p> <p>CO2: Understand and will be able to distinguish between right and wrong actions. Identification of threats & Opportunities for skill development.</p> <p>CO3: Learn the basics of management, CSR and its models for skill development and employability.</p> <p>CO4: Learn about Decision making Process, its techniques and approaches and Dilemmas in decision making process for skill development and employability.</p> <p>CO5: Look at core concepts for a morality. Articulate solution evolver to management issue in general to acquire knowledge for better skill development.</p> <p>CO6: Learn about environment, our surroundings & issues of sustainable development for a better future to promote entrepreneurship development and employability skills.</p> <p>CO7: Learn about various international laws and agreements to save environment for skill development and employability.</p> <p>CO8: Learn about air quality, its parameters, index, assets etc for skill development and employability.</p>		
Credits: 2	Core: Co-Curricular Course	
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	Total No. of Lectures/ Hours (30)
I	<p>Human Values- Introduction- Values, Characteristics, Types, Developing Value system in Indian Organisation, Values in Business Management, value-based Organisation, Trans –cultural Human values in Management. Swami Vivekananda's philosophy of Character Building, Gandhi's concept of Seven Sins, APJ Abdul Kalam view on role of parents and Teachers for skill enhancement.</p> <p>Human Values and Present Practices – Issues: Corruption and Bribe, Privacy Policy in Web and social media, Cyber threats, Online Shopping etc. Remedies</p> <p>UK Bribery Act, Introduction to sustainable policies and practices in Indian Economy.</p> <p>Principles of Ethics</p> <p>Secular and Spiritual Values in Management- Introduction- Secular and Spiritual values, features, Levels of value Implementation. Features of spiritual Values, Corporate Social Responsibility- Nature, Levels, Phases and Models of CSR, Corporate Governance. CSR and Modern Business Tycoons Ratan Tata, Azim Premji and Bill Gates for skill development.</p>	<p>02</p> <p>02</p> <p>03</p>

II	<p>Holistic Approach in Decision making- Decision making, the decision making process, The Bhagavad Gita: Techniques in Management, Dharma and Holistic for skill development and employability.</p> <p>Management.</p> <p>Discussion through Dilemmas – Dilemmas in Marketing and Pharma Organizations, moving from Public to Private – monopoly context, Dilemma of privatization, Dilemma on liberalization, Dilemma on social media and cyber security, Dilemma on Organic food, Dilemma on standardization, Dilemma on Quality standards for skill development and employability</p> <p>Case Studies</p>	03 03 02
III	<p>Ecosystem: Concept, structure & functions of ecosystem: producer, consumer, decomposer, food web, food chain, energy flow, Ecological pyramids</p> <p>Conservation of Biodiversity- In-situ & Ex- situ conservation of biodiversity to acquire knowledge for better skill development</p> <p>Role of individual in Pollution control</p> <p>Human Population & Environment</p> <p>Sustainable Development</p> <p>India and UN Sustainable Development Goals</p> <p>Concept of circular economy and entrepreneurship to promote entrepreneurship development and employability skills.</p>	7
IV	<p>Environmental Laws?</p> <p>International Advancements in Environmental Conservation</p> <p>Role of National Green Tribunal</p> <p>Air Quality Index for skill development and employability.</p> <p>Importance of Indian Traditional knowledge on environment</p> <p>Bio assessment of Environmental Quality</p> <p>Environmental Management System</p> <p>Environmental Impact Assessment and Environmental Audit for skill development and employability.</p>	8

Suggested Readings:

1. A foundation course in Human Values and Professional Ethics by RR. Gaur, R. Sangal et.al
2. JUSTICE: What's the Right Thing to Do? Michael J. Sandel.
3. Human Values by A. N. Tripathi New Age International
4. Environmental Management by N.K. Uberoi
5. <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>
6. <https://www.india.gov.in/my-government/schemes>
7. <https://www.legislation.gov.uk/ukpga/2010/23/content>
8. Daniel Kahneman, Thinking, Fast and Slow; Allen Lane Nov 2011 ISBN: 9780141918921

Suggested Continuous Evaluation Methods: In addition to the theoretical inputs the course will be delivered through case studies and dilemmas. Assignments, Presentation, Group Discussions. This will instill in student a sense of decision making and practical learning. The course participants can be evaluated on the following structure. > Assignments (10) > Presentation (10) > Attendance (5) > Final exam (75)

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	1	1	3	2	1	2	2	2

CO2	2	1	3	1	1	2	1	2	2	2
CO3	2	3	3	1	3	2	3	2	1	2
CO4	3	1	1	2	1	1	2	1	3	3
CO5	1	2	2	2	1	3	2	1	1	1
CO6	1	2	1	2	3	11	3	2	1	1
CO7	3	2	1	1	2	2	2	2	2	2
CO8	3	1	2	2	2	2	3	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	1	2
CO2	2	1	2
CO3	2	2	2
CO4	2	2	1
CO5	3	1	1
CO6	3	3	3
CO7	3	3	2
CO8	3	3	2

Programme/Class: Diploma	Year: Second	Semester: Fourth
Subject: MICROBIOLOGY		
Course Code: B080401T	Course Title: Molecular Biology and Microbial Genetics	
<p>Course Outcomes: At the end of the course students will be able to: CO1: Describe the structure of DNA and RNA, physical, topological and kinetic properties of genome for skill development and employability. CO2: Explain the significance and process details of replication in prokaryotes and eukaryotes for skill development. CO3: Describe the general transcription factors, mechanism of transcription and post transcriptional modifications in prokaryotes and eukaryotes for better employability skills. CO4: Describe the RNA and its types, process of translation in both prokaryotes and eukaryotes for skill development and employability. CO5: Define the regulation of prokaryotic and eukaryotic gene expression recognize and distinguish genetic regulatory mechanisms at various levels to acquire knowledge for better employability skills. CO6: Explain the plasmids and their types, significance, properties of plasmids for skill development and employability CO7: Describe the mechanism, process and types of horizontal gene transfer in prokaryotes for effective development of employability skills. CO8: Describe the processes that lead to mutations and other genetic change to acquire knowledge for entrepreneurship development and employability skills.</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	Overview of the genome organization – DNA/and RNA as genetic material, DNA double helix structure salient features, types of DNA. RNA Structure. Denaturation and renaturation, cot curves. DNA topology: linking number, topoisomerases. DNA organization in prokaryotes, viruses, eukaryotes for skill development and employability.	6
II	DNA Replication in Prokaryotes and Eukaryotes- Bidirectional and unidirectional replication, semi-conservative and semi- discontinuous replication. Mechanism of DNA replication, Replication of chromosome ends eukaryotes for skill development.	6
III	Transcription in Prokaryotes and Eukaryotes Concept of transcription unit. General transcription process in prokaryotes and eukaryotes; post-Transcriptional modification in eukaryotes, Alternative splicing mechanism, RNA interference for better employability skills.	8
IV	Translation in prokaryotes and eukaryotes Ribosome structure, tRNA structure and processing, Mechanisms of translation in both prokaryotes and eukaryotes, Genetic code, Wobble hypothesis, Fidelity of translation for skill development and employability.	8

V	Regulation of gene expression in prokaryotes and eukaryotes Overview of regulation of gene expression, Regulation of gene expression by DNA methylation, histone acetylation and histone methylation mechanisms; Transcription control mechanisms, Inducible Operon System, Repressible Operon System, Translation control mechanisms to acquire knowledge for better employability skills.	10
VI	Plasmids in prokaryotes and eukaryotes Plasmid replication and partitioning, host range, plasmid incompatibility, plasmid amplification, regulation of plasmid copy number, curing of plasmids. Types of plasmids for skill development and employability.	6
VII	Bacterial gene exchange processes- Mechanisms of Genetic Exchange, Horizontal gene transfer, Transformation; Conjugation; Transduction, Complementation for effective development of employability skills.	8
VIII	Mutations, mutagenesis and repair Types of mutations, Physical and chemical mutagens. Loss and gain of function mutants. Reversion and suppression, Uses of mutations. Ames Test, DNA repair mechanism to acquire knowledge for entrepreneurship development and employability skills.	8

Suggested Readings:

1. Watson, J. et. Al. 2004. Molecular Biology of the Gene, 5th Edition, CSHL Press, New York.
2. Conn, E., & Stumpf, P. 2009. Outlines of Biochemistry, 5th Ed. Wiley India Pvt. Limited.
3. T A Brown. 2001. Essential Molecular Biology. Oxford University Press, USA
4. Brock, T.D. 1990. The Emergence of Bacterial Genetics, Cold Spring Harbor Lab Press.
5. Ptashne, M. 2002. Genes and Signals, Cold Spring Harbor Laboratory Press.
6. Miller, J.R. 1992. A Short Course in Bacterial Genetics: Lab Manual, Cold Spring Harbor Laboratory Press

Suggestive digital platforms web links-

- <https://www.classcentral.com/tag/microbiology>
- <http://www.mooc.list.com/tag/molecular-biology>
- <http://www.mooc.list.com/course/microbiology.sayloro>
- <https://lipidnanostructuresgroup.weely.com>
- <http://www.mooc.list.com/microbial>
- <https://open.umn.edu/opentextbooks/textbooks/biochemistry-free-for-all-ahern>

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 “Basic Biochemistry and Microbial Physiology” in III Semester of Diploma 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: 5Marks

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	2	2	1	2	1	2
CO2	2	1	2	1	3	2	1	2	1	2
CO3	2	1	2	1	2	1	1	1	1	2
CO4	2	2	2	2	2	1	1	1	2	3
CO5	3	2	2	2	2	1	2	2	2	3
CO6	3	3	3	2	3	1	2	2	2	3
CO7	3	3	1	2	3	2	2	1	1	3
CO8	3	2	1	1	3	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	2	1
CO2	2	1	1
CO3	2	3	1
CO4	2	3	2
CO5	2	3	2
CO6	3	3	2
CO7	3	2	2
CO8	3	2	3

Programme/ Class: Diploma	Year: Second	Semester: Fourth
Subject: MICROBIOLOGY		
Course Code: B080402P	Course Title: Experiment in Molecular Biology and Microbial Genetics	
Course Outcomes:		
The student at the completion of the course be able to:		
<ul style="list-style-type: none"> • understand the fundamentals of molecular biology and genetic research. • use some basic equipment in a molecular biology laboratory. • extract genomic DNA from microbes using molecular biology techniques • measure DNA and verify purity using UV spectrometer and electrophoresis. • understand the basic principle of plasmid isolation and their conformations using electrophoresis. • understand the mutagenic effect of chemical and physical agents and perform test to identify mutagenic effect of chemicals 		
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	Isolation of genomic DNA from <i>E. coli</i> and analysis by agarose gel electrophoresis.	8
2	Estimation of DNA using diphenylamine reagent.	8
3	Resolution of proteins by polyacrylamide gel electrophoresis (SDS-PAGE) and visualization using coomassie dye.	10
4	<ul style="list-style-type: none"> • Replica plating method: Preparation of master and replica plates. • Isolation of Histidine auxotrophs 	10
5	Isolation of plasmid DNA from <i>E. coli</i> . Study the different conformations of plasmid DNA through agarose gel electrophoresis	8
6	Study of the effect of chemical (nitrous acid) and physical (UV) mutagens on bacterial cells.	8
7	Demonstration of Ames test.	8
Suggested readings:		
<ol style="list-style-type: none"> 1. Michael Wink, An Introduction to Molecular Biotechnology (2nd), 2012. ISBN: 9783527326372, TX Wiley-Blackwell. 2. Seidman & Moore, Basic Laboratory Methods for Biotechnology: Textbook & Laboratory Reference, 2nd edition. 2009. Prentice Hall. ISBN: 0321570146. 3. Sambrook J and Russell DW., Molecular Cloning: A Laboratory Manual. 4th Edition, 2004, Cold Spring Harbour Laboratory press. 		
Digital links:		
<ul style="list-style-type: none"> • https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/ames-test • https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4846332/ 		
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 “Basic Biochemistry and Microbial Physiology” in III Semester of Diploma course in Microbial Technology.		
Suggested Continuous Evaluation Methods		
Further Suggestions: None		

Programme/Class: Diploma	Year: Second	Semester: Fourth
Subject: MICROBIOLOGY		
Course Code: B094401T	Course Title: Recombinant 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 and employability.		
CO2: Understand the vectors used in gene cloning such as Plasmids, Ti plasmid, Cosmids, Phagemids, shuttle vectors, expression vectors like YAC for skill development and employability.		
CO3: Understand the different mechanisms of gene recombination like transformation for skill development and employability. bacterial conjugation and methods of gene transfer such as transfection, microinjection, electroporation, shot-gun method for effective development of employability skills.		
CO4: Describe the techniques of construction of recombinant DNA molecule and gene libraries, screening and selection of recombinant host cells to acquire knowledge for better employability skills.		
CO5: Understand the technique of nucleic acid hybridization and uses of the mixed phase hybridization assay (Southern blot, Northern Blot, Western Blot, Microarray.) for skill development and employability.		
CO6: 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 r DNA technology to enhance knowledge for skill development and employability.		
CO7: Understand the genetic engineering in plants and its application in development of disease resistant, insect and virus resistant plants for better entrepreneurship development and employability skills.		
CO8: Understand the transgenic animal: stem cell method and transgenic cattle to acquire knowledge for entrepreneurship development and 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
I	Concepts of recombinant DNA technology: Steps involved in construction of rDNA, cell based and cell free DNA cloning Tools of r-DNA technology- Adaptors and Linkers, DNA ligase, Modifying enzymes, Restriction enzymes for skill development and employability.	6
II	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) for skill development and employability.	6
III	Gene recombination and Gene Transfer: Transformation, Bacterial Conjugation, Transduction, Transfection, Microinjection, Electroporation, Liposome mediated gene transfer, Shot-gun method for skill development and employability.	8
IV	In-vitro construction of recombinant DNA molecule: Screening and selection of recombinant host cells- Gene libraries- Genomic DNA and cDNA library to acquire knowledge for better employability skills.	8

V	Nucleic Acid Hybridization and Blotting: Probes, Stringency of hybridization reaction, Isotopic and Non-Isotopic labelling of probes, Southern blotting, Northern blotting and Western blotting for skill development and employability.	10
VI	Techniques in rDNA Technology: 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 technology to enhance knowledge for skill development and employability.	6
VII	Genetic Engineering of Plants: Developing Insect-Resistant Plants, Developing Virus-Resistant Plants, Developing Herbicide-Resistant Plants, Developing Stress and Senescence tolerant Plants for better entrepreneurship development and employability skills.	8
VIII	Transgenic Animals: Transgenic Mice: Methodology – Retroviral Vector Method, DNA microinjection method, Engineered Embryonic Stem Cell method, Transgenic Cattle, Sheep and Goats to acquire knowledge for entrepreneurship development and employability skills.	8

Suggested Readings:

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

Suggestive digital platforms web links-

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

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 Diploma 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: 5Marks

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	2	3	2	1	2	2	2	2
CO2	2	2	2	3	2	1	2	2	2	2
CO3	2	2	2	3	2	2	2	2	2	2
CO4	2	2	2	1	2	2	2	2	2	2
CO5	3	3	3	2	3	2	3	2	3	3
CO6	3	3	3	2	3	2	3	2	3	3
CO7	3	3	3	2	3	2	3	2	3	3
CO8	3	3	3	2	3	2	3	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
C01	2	3	1
C02	2	2	1
C03	2	3	2
C04	2	2	2
C05	3	3	2
C06	3	3	1
C07	3	3	2
C08	3	3	2

Programme/ Class: Diploma	Year: Second	Semester: Fourth
Subject: MICROBIOLOGY		
Course Code: B094401P	Course Title: Recombinant DNA Technology Lab	
Course Outcomes: The student at the completion of the course be able to: <ul style="list-style-type: none"> • understand the fundamentals of recombinant DNA technology research. • learn the technique of extracting genomic DNA and isolation of plasmid DNA. • understand the principle of ligation of DNA fragments. • understand the procedure for transformation of host cells with foreign DNA. 		
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	Genomic DNA isolation from plant source and analysis of isolated DNA by agarose gel electrophoresis.	10
2	Quantification of DNA using spectrophotometer.	7
3	Extraction of genomic DNA from blood.	10
4	Restriction digestion of Phage DNA with Endonucleases	10
5	Ligation of DNA fragments	8
6	Transformation of <i>E.coli.</i> cells	8
7	To estimate the RNA concentration by orcinol method	7
Suggested readings: <ol style="list-style-type: none"> 1. Ashok Kumar. Practical Manual Series Vol II: Molecular Biology & Recombinant DNA Technology. ISBN: 9789380428321.Narendra Publishing House. 2. Schleif, Robert F., Wensink, Pieter C. Practical Methods in Molecular Biology. ISBN 978-1- 4612-5956-5. Springer Publishers. 3. Sambrook J and Russell DW., Molecular Cloning: A Laboratory Manual. 4th Edition, 2004, Cold Spring Harbour Laboratory press. 		
Digital links: <ul style="list-style-type: none"> • https://www2.le.ac.uk/projects/vgec/highereducation/topics/recombinanttechniques • https://www.genome.gov/genetics-glossary/Recombinant-DNA • https://www.lecturio.com/magazine/recombinant-dna-and-gene-amplification/ 		
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 “Basic Biochemistry and Microbial Physiology” in III Semester of Diploma course in Microbial Technology.		
Suggested Continuous Evaluation Methods		
Further Suggestions: None		

Programme/Class: Diploma	Year: Second	Semester: Fourth
Subject: MICROBIOLOGY		
Course Code: B094402T	Course Title: Proteomics and Genomics	
Course Outcomes:		
At the end of the course students will be able to:		
CO1: Learn about how a protein attains conformational changes by different pre and post modification methods for skill development and employability.		
CO2: Know the techniques used in identification and separation of Proteins to acquire knowledge for entrepreneurship development and employability skills.		
CO3: Learn the principle and working of techniques for analysis of proteome and its use in biomedical diagnosis along with production to induce entrepreneurship development and employability skills.		
CO4: Learn about genome size and organization related theories, with its significance through different model organisms for skill development and employability.		
CO5: Understand the evolutionary value of DNA, Gene, Gene Families and RNA for skill development and employability.		
CO6: Learn how gene sequencing and analysis are carried out by different methods to acquire skills for better employability and entrepreneurship development.		
CO7: Acquaint with the techniques for physical, molecular mapping of genes for skill development and employability.		
CO8: Know how genetic variations are created to make GMOs and value of GMOs for human welfare 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 and scope of proteomics: Site Directed Mutagenesis, Protein Folding Methods, Molecular Chaperons, Post Translational Modifications, Glycosylation Vs protein conformation for skill development and employability.	6
II	Protein separation techniques; Yeast two hybrid system, Luciferase assay, 2D electrophoresis, MALDI-TOF to acquire knowledge for entrepreneurship development and employability skills.	6
III	Protein engineering: Protein chips and functional proteomics; clinical and biomedical application of proteomics; proteomics industry, SCP (Single Cell Protein) to induce entrepreneurship development and employability skills.	8
IV	Organization of genomes: Introduction: Genome, Genomics, and its importance, General features, C-value paradox. DNA renaturation kinetics. Genome diversity: taxonomy and significance of genomes – bacteria, yeast, Homo sapiens, Arabidopsis, etc. for skill development and employability	8

V	Pattern of genome evolution: The origin of genomes- Origin of macromolecules, RNA world and DNA world Acquisition of new genes (By gene duplication) and Gene families – (Types, Pseudogenes, Origin of gene families (lateral gene transfer, allopolyploidy). Synthetic genomes and their applications for skill development and employability.	10
VI	Gene Sequencing: DNA sequence analysis methods- Shotgun sequencing, BAC to BAC sequencing High-throughput sequencing, Fluorescence methods to acquire skills for better employability and entrepreneurship development.	6
VII	Gene variation and Genome mapping methods: Physical, genetic and molecular markers in mapping (RFLP, RAPD and AFLP,); single nucleotide polymorphisms (SNPS), Expressed sequence Tags (ESTs) for skill development and employability.	8
VIII	Genetically modified organism: Principles, tools and applications of gene manipulation for modern food (GM Food) production; Significance of GM foods, GM crops in India and their regulation for skill development and employability.	8

Suggested Readings:

1. Cantor and Smith, Genomics, John Wiley & Sons, 1999.
2. Introduction to Genomics- Arthur M Lesk, Oxford University Press, 2007.
3. R M Twyman, Principles of Proteomics, BIOS Scientific Publishers, 2004
4. L. Stryer, Biochemistry, W. H. Freeman and Co., New York, 2007
5. NPTEL- Phase-II, Proteomics and Genomics by Dr. Vikas Kumar Dubey, IIT, Guwahati

Suggestive digital platforms web links-

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

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 “Basic Biochemistry and Microbial Physiology” in III Semester of Diploma 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: 5Marks

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	2	3	2	2	1	3
CO2	2		2	1	2	3	2	2	1	3
CO3	2		2	1	2	3	2	2	2	2
CO4	2		2	2	3	2	1	1	2	2
CO5	2		2	2	3	2	1	1	2	2
CO6	3		3	2	3	2	1	1	1	2

CO7	3		3	2	2	1	1	1	1	2
CO8	3		3	1	2	1	2	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	2	1
CO2	2	2	2
CO3	2	2	2
CO4	2	2	1
CO5	2	2	2
CO6	3	3	3
CO7	3	3	2
CO8	3	3	2

Programme/ Class: Diploma	Year: Second	Semester: Fourth
Subject: MICROBIOLOGY		
Course Code: B094402P	Course Title: Proteomics and Genomics Lab	
Course Outcomes: The student at the completion of the course be able to: <ul style="list-style-type: none"> • understand the fundamentals of protein structure and its characteristics. • use some basic equipment in a proteomics and genomics laboratory. • extract genomic DNA from plants using molecular biology techniques • quantify DNA and verify purity using UV spectrometer and electrophoresis. • understand the basic principle of protein isolation and their separation using electrophoresis. 		
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 predict the secondary structure of a protein using the Chou-Fasman method.	8
2	To determine the conserved domain present in Q8NFM4 .	8
3	To find the approximate region on 2D gel where Q8N423 is found	10
4	To extract and analyze genomic DNA from leaves by CTAB method.	10
5	To perform southern blotting for the detection of a specific DNA fragment.	8
6	To perform western blotting technique to detect specific protein.	8
7	To perform amplification of DNA by using PCR.	8
Suggested readings: <ol style="list-style-type: none"> 1.Devarajan Thangadurai, Jeyabalan Sangeetha. Genomics and Proteomics: Principles, Technologies, and Applications. Apple Academic Press; 1st edition (24 June 2015) 2.Sandy B. Primrose, Richard Twyman. Principles of Gene Manipulation and Genomics, 7th Edition. ISBN: 978-1-405-13544-3. Wiley-Blackwell 3. Wong, T. S., Tee, K. L. (2020). A Practical Guide to Protein Engineering. Germany: Springer International Publishing. Digital links: <ul style="list-style-type: none"> • https://courses.lumenlearning.com/boundless-biology/chapter/genomics-and-proteomics/ • https://www.biologydiscussion.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 had the subject “Basic Biochemistry and Microbial Physiology” in III Semester of Diploma course in Microbial Technology.		
Suggested Continuous Evaluation Methods		
Further Suggestions: None		

Programme/Class: Diploma	Year: Second	Semester: Fourth
Subject: MICROBIOLOGY		
Course Code: B093404T	Course Title: Project Management and Entrepreneurship	
<p>Course Outcomes: At the end of the course students will be able to: CO1: Describe Entrepreneurship and examine the role of an entrepreneur in economic development for skill development and employability. CO2: Learn about the key principles behind small businesses. Also, will be able to do strategic planning for small businesses and assess the organizational strength for better employability skills. CO3: Analyze the concept of Project planning, scheduling, and Execution for skill development and employability. CO4: Have clarity about project organization and feasibility analysis to acquire knowledge for better employability skills. CO5: Learn about the different traditional sources for the arrangement of funds to enhance knowledge for entrepreneurship development and employability skills. CO6: Learn about many alternative sources for funding arrangements to develop entrepreneurship and employability skills. CO7: Understand the role played by commercial banks and other institutions in the approval of loans for skill development and employability. CO8: Learn about the concept of project implementation and network analysis for skill development and employability.</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	Concept of Entrepreneurship: Definition of Entrepreneurship given by various economists - the ideal definition–The conceptual model of Entrepreneurship given by John Kao. Views given by Schumpeter Walker & Drucker on Entrepreneurship for skill development and employability.	6
II	Small Business: Definition of Small Business - Composition of Small Business -Economic Contribution of Small Business. Strategic Planning for Small Business -Steps in Strategic Planning -Develop a clear Mission Statement -Assess Organization Strengths - Conduct a thorough Market Segment Analysis -Analyse Competitors - Create Company Goals -Formulate Strategic Options and Select appropriate Strategies for better employability skills.	6
III	Introduction-Project: Definition, features, types, infrastructure creation-a special type of projects, significance of infrastructure in economic development, bottlenecks in the infrastructure creation for skill development and employability.	8
IV	Project Identification: Idea generation, Project screening, Feasibility study. The advantages and disadvantages of starting your business –The advantages and disadvantages of buying all existing to acquire knowledge for better employability skills.	8
V	Arrangement of funds: Traditional sources of financing–venture capital, angels. Equity shares,	10

	preference shares, Debentures/bonds, loan from financial institutions- Loan syndication and consortium finance to enhance knowledge for entrepreneurship development and employability skills.	
VI	Alternative sources of financing: Foreign Issue, FDI & FII, ECB, Private equity, Securitization, BOT projects, PPP, Incubation fund, Franchising etc; Role played by various Financial Institutions like IDBI, ICICI and IFCI arrangements to develop entrepreneurship and employability skills.	6
VII	Special Role played by SIDBI and Commercial Banks: Approval of term loan applications by Commercial Banks–How to decide about a suitable agency for assistance, Role played by SFC and NSIC for skill development and employability.	8
VIII	Project Implementation: Project contracts – Principles, practical aspects of contacts, legal aspects of project management, global tender, Negotiation for projects, Project insurance, Human resource management, network analysis for skill development and employability.	8

Suggested Readings:

1. Scarborough and Zimmerer, Effective Small Business Management, Seventh ed., Pearson, 2002.
2. Pickle and Abrahamson, Small Business Management, Fifth ed., John Wiley & Sons, 1990.
3. J. Kao, Creativity & Entrepreneurship.
4. Gupta and Srinivasan, Entrepreneurial Development, 2015 ed., Sultan Chand & Sons, 2015.
5. V. Desai, Dynamics of Entrepreneurial Development & Management, Fifth ed., Himalaya Publishing House, 2012.
6. P. Chandra, Projects planning analysis selection implementation & review, Eighth ed., McGraw Hill Education India Private Limited, 2014.
7. Suggestive digital platforms web links-
 - <https://onlinecourses.nptel.ac.in/>
 - <https://www.wikipedia.org/>
 - <https://www.ediindia.org/>

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 “ ” in IV Semester of Diploma 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: 5Marks

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	2	2	1	2	2	1	2	1
CO2	2	3	2	2	2	2	2	1	3	2
CO3	2	1	2	2	2	3	1	1	2	2
CO4	2	1	2	3	3	2	1	1	2	1
CO5	2	1	1	3	1	1	1	2	3	2
CO6	3	2	1	3	1	3	2	2	1	1
CO7	3	2	1	2	1	3	2	2	1	2

CO8	3	2	2	1	3	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	2	2	2
CO2	2	2	2
CO3	2	2	1
CO4	2	2	1
CO5	2	3	3
CO6	3	3	3
CO7	3	3	1
CO8	3	3	1

Programme/Class: Diploma	Year: Second	Semester: Fourth
Subject: MICROBIOLOGY		
Course Code: B093405T	Course Title: Mushroom Culture Technology	
<p>Course Outcomes:</p> <p>At the end of the course students will be able to:</p> <p>CO1: Describe the characteristics, classification and morphology of kingdom fungi for skill development and employability.</p> <p>CO2: Describe the properties of mushrooms and understand the different types of poisonous mushrooms to enhance knowledge for better employability skills.</p> <p>CO3: Understand the types of commercial varieties of edible mushrooms present in India to acquire knowledge for better entrepreneurship development and employability skills.</p> <p>CO4: Recognize and understand the different parameters required for the cultivation of mushrooms to induce entrepreneurship development and employability skills.</p> <p>CO5: Describe the requirements and methods employed in development of pure culture of mushrooms and Factors affecting the mushroom preparation to acquire skills for entrepreneurship development and employability skills.</p> <p>CO6: Learn about different methods of storage of Mushrooms to develop entrepreneurship and employability skills.</p> <p>CO7: Describe the different types of food products made from Mushrooms for skill development, employability and entrepreneurship development.</p> <p>CO8: Describe the different diseases which commonly infects the Mushrooms to acquire knowledge for entrepreneurship development and employability skills.</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	Introduction to Kingdom Fungi: Introduction, General characteristics, thallus organization, mode of Nutrition and Classification of fungi for skill development and employability.	6
II	Introduction to mushroom: Nutritional value of Mushrooms, medicinal properties of edible mushrooms; Poisonous mushrooms to enhance knowledge for better employability skills.	6
III	Edible Mushrooms: Types of edible mushrooms available in India - Volvariella volvacea, Pleurotus citrinopileatus, Agaricus bisporus to acquire knowledge for better entrepreneurship development and employability skills.	8
IV	Cultivation Technology: Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low-cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag mushrooms to induce entrepreneurship development and employability skills.	8

V	Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation – Low-cost technology, Composting technology in mushroom production to acquire skills for entrepreneurship development and employability skills.	10
VI	Storage and nutrition: Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content -Vitamins to develop entrepreneurship and employability skills.	6
VII	Food Preparation: Types of foods prepared from mushroom. Research Centres - National level and regional level. Cost benefit ratio - Marketing in India and abroad, Export Value for skill development, employability and entrepreneurship development.	8
VIII	Insect - Pests affecting mushroom: Major insect pests - Mushroom flies/ nematodes/mites, Dry Bubble and wet bubble – major diseases of cultivated mushroom, Competitor/weed moulds encountered: Green, yellow and plaster moulds/ Coprinus to acquire knowledge for entrepreneurship development and employability skills.	8

Suggested Readings:

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

Suggestive digital platforms web links-

- <http://nhb.gov.in/pdf/Cultivation.pdf>
- <https://www.agrifarming.in/mushroom-cultivation>
- [https://nios.ac.in/media/documents/vocational/mushroom_production_\(revised\)\(618\)/Lesson-01.pdf](https://nios.ac.in/media/documents/vocational/mushroom_production_(revised)(618)/Lesson-01.pdf)
- <https://cropbag.in/mushroom-cultivation-complete-guide/>

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 Diploma 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: 5Marks

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	2	2	2	2	1	2	2

CO2	2	2	1	2	2	2	2	1	2	2
CO3	2	2	3	2	2	2	2	1	2	3
CO4	2	1	2	1	2	2	2	1	2	2
CO5	2	1	3	1	2	1	2	1	1	2
CO6	3	2	2	1	3	1	1	2	1	3
CO7	3	1	2	1	3	1	1	2	1	3
CO8	3	2	2	1	3	1	1	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	3	1
CO3	2	3	2
CO4	2	2	2
CO5	2	2	2
CO6	3	2	3
CO7	3	2	3
CO8	3	3	3

Programme: Certificate	Year: First	Semester: Fourth
Co-Curricular Course		
Course Code: Z040401	Course Title: Physical Education and Yoga	
Course outcomes:		
At the end of the course students will be able to:		
CO 1: Provide introduction about physical education its aims and objective for skill development.		
CO 2: Learn how the concept of physical education have changed over time period for skill enhancement.		
CO 3: Understand concept of fitness management and wellness, weight management and lifestyle of an individual for skill development, employability and entrepreneurship development.		
CO 4: Learn historical aspect of yoga, its scope, and its relation with sports, mental health and physical education to acquire knowledge for entrepreneurship development and employability skills.		
CO 5: Acquire knowledge about different asanas and difference between asanas and physical exercises for skill development.		
CO 6: Provide understanding of classification of pranayama and learn the basics of deep breathing for skill development.		
CO 7: Get knowledge about different traditional games of India for effective skill development.		
CO 8: Design traditional courses and will also know about their benefits for skill development and 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	Physical Education: <ul style="list-style-type: none"> • Meaning, Definition, Aim and Objective. • Misconception About Physical Education for skill development. • Need, Importance and Scope of Physical Education in the Modern Society. • Physical Education Relationship with General Education. • Physical Education in India before Independence. • Physical Education in India after Independence for skill enhancement 	6 Theory
II	Concept of Fitness and Wellness: <ul style="list-style-type: none"> • Meaning, Definition and Importance of Fitness and Wellness. • Components of Fitness. • Factor Affecting Fitness and Wellness Weight Management: <ul style="list-style-type: none"> • Meaning and Definition of Obesity. • Causes of Obesity. • Management of Obesity. • Health problems due to Obesity for skill development, employability and entrepreneurship development. Lifestyle: <ul style="list-style-type: none"> • Meaning, Definition, Importance of Lifestyle. • Factor affecting Lifestyle. Role of Physical activity in the maintains of Healthy Lifestyle to acquire knowledge for entrepreneurship development and employability skills.	5 Theory 3 Practical

<p style="text-align: center;">III</p>	<p>Yoga and Meditation:</p> <ul style="list-style-type: none"> • Historical aspect of yoga. • Definition, types scopes & importance of yoga. • Yoga relation with mental health and value education. <p>Yoga relation with Physical Education and sports for skill development.</p> <ul style="list-style-type: none"> • Definition of Asana, differences between asana and physical exercise. • Definition and classification of pranayama. • Difference between pranayama and deep breathing. • Practical: Asana, Suraya-Namaskar, Bhujang Asana, Naukasana, Halasana, Vajrasana, Padmasana, Shavasana, Makrasana, Dhanurasana, Tad Asana. <p>Pranayam: Anulom, Vilom. for skill development.</p>	<p style="text-align: center;">2 Theory 6 Practical</p>
<p style="text-align: center;">IV</p>	<p>Traditional Games of India:</p> <ul style="list-style-type: none"> • Meaning. • Types of Traditional Games- <ul style="list-style-type: none"> ✚ Gilli- Danda ✚ Kanche ✚ Stapu ✚ Gutte, etc. • Importance/ Benefits of Traditional Games for effective skill development • How to Design Traditional Games. <p>Recreation in Physical Education:</p> <ul style="list-style-type: none"> • Meaning, Definition of Recreation. • Scope and Importance of Recreation. • General Principles of Recreation. • Types of Recreational Activities. <p>Aerobics and Zumba.(Fir India Movement) for skill development and employability.</p>	<p style="text-align: center;">2 Theory 6 Practical</p>
<p>Suggested Readings:</p> <ul style="list-style-type: none"> • Singh, Ajmer, Physical Education and Olympic Abhiyan, “Kalayani Publishers”, New Delhi, Revised Addition, 2006 • Patel, Shri krishna, Physical Education, “Agrawal Publishers”, Agra, 2014-15 Panday, Preeti, Sharirik Shiksha Sankalan, “ Khel Sanskriti Prakashan, Kanpur • Kamlesh M.L., “Physical Education, Facts and foundations”, Faridabad P.B. Publications. • B.K.S. Yengar, &quot;Light and Yog. Yoga Deepika&quot;, George Allen of Unwin Ltd., London,1981.BrajBilari Nigam, Yoga Power &quot;TheKpath of Personal achievement&quot; Domen and Publishers,New Delhi, 2001. • Indira Devi, &quot;Yoga for You&quot;, Gibbs, Smith Publishers, Salt Lake City, 2002 DomenandPublishers, New Delhi - 2001. • Jack Peter, &quot;Yoga Master the Yogic Powers&quot;, Abhishek Publications, Chandigarh, 2004.Janice Jerusalem, &quot;A Guide To Yoga&quot;, Parragon Bath, Baiihe-2004. • नारंग, प्रियंका, परम्परागत भारतीय खेल, " स्पोर्ट्स पब्ललके शन" , नई दिल्ली, 2007 		
<p>Suggested Continuous Evaluation Methods:</p> <ul style="list-style-type: none"> ➤ Assignments (10) ➤ Presentation (10) ➤ Attendance (5) ➤ Final exam (75) 		

Suggested equivalent online courses:

- IGNOU.

Rajarshi Tandan Open University.

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	1	2	1	1	2	2	2	1
CO2	2	2	2	2	2	1	2	2	2	1
CO3	2	2	2	1	3	2	2	1	2	2
CO4	2	3	3	2	3	2	3	1	2	3
CO5	2	3	2	2	2	2	1	2	2	2
CO6	3	1	2	2	2	2	3	3	3	3
CO7	3	1	1	1	1	2	1	3	3	2
CO8	3	2	2	1	1	2	1	3	3	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	2	1
CO2	2	2	1
CO3	2	3	2
CO4	2	3	3
CO5	2	2	2
CO6	3	2	2
CO7	3	2	2
CO8	2	3	2

IFTM UNIVERSITY, MORADABAD
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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 better employability 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

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 global industry

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

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 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	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 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	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:

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

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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

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

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

CO5: Explain and understand the various applications of enzymes in global 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

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SYLLABUS
BMB-501 Food Microbiology

Unit I: History of microorganism in food developments, General characteristics of micro-organism important in food microbiology- Moulds, Yeasts-like fungi, Bacteria. Different modes of contamination of food-plant, animal, sewage soil, water and air.

Unit II: General Methods and principal of food preservation- preservation by the use of high temperature, drying and food and food additives. Microbiological quality standards of food-FDA, HACCP.

Unit III: Contamination, preservation and spoilage of cereals, vegetables and fruits, Dairy, Meat, Poultry and Egg products for skill development.

Unit IV: General principles of culture maintenance and preparation- bacterial cultures, yeast cultures and mold cultures. Factor affecting activity of culture-Bacteriophages, Antibiotics and Chemicals to develop employability skills.

Unit V: Bacterial food borne diseases-*Clostridium perferinges*, *Vibrios*, *E.coli*, *B.cereus*, *Y.enterocolitica*, *campylobacter*, *Listeria monocystogenes*, *staphylococcal*. Non-bacterial poisonings, infections and intoxications to acquire knowledge for employability.

Recommended Text/ Reference Books

1. B.Sivasankar, Food Preservation and processing, PHI Publication.
2. William .S. Frazier, Dennis C. Westhoff, Food Microbiology . Tata McGraw Hill publications.
3. Joklik, W.K., Willet H.P., Amos, D.B and Wilfert C.M. Zinssers Microbiology, 19th edition. Prentice-Hall International Inc.1988.
4. Paul J. Vandemark, Berry L. Batzingth microbes. The Benjamin/cummings publishing company. Inc, 1987.
5. Lansing M. Prescott, John P. Harley, Donald A. Kleein, Microbiology, 3rd edition broen publishers.

Course Outcomes:

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

CO1: Understand the substrate requirements for culture growth, growth characteristics and properties of different microorganisms for skill development, local employability and entrepreneurship development.

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CO2: Understand the techniques for control of microorganisms using heat for skill development, employability and entrepreneurship development.

CO3: Gain knowledge about the contamination, spoilage, and preservation of different types of foods for skill development and employability.

CO4: Understand the techniques and principles of culture maintenance and preparation-for skill development, employability and entrepreneurship development.

CO5: Explain the different types of bacterial food borne diseases and non-bacterial diseases for skill development, employability and entrepreneurship development 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	3	2	3	3	3	2	2	2	2	2
CO2	2	2	3	2	2	3	2	2	2	2
CO3	2	2	3	3	3	3	2	2	2	2
CO4	2	3	3	3	3	3	3	3	3	2
CO5	2	3	3	2	3	2	3	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
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3
CO5	3	3	3

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SYLLABUS
BMB-502 Microbial Biotechnology

Unit I: Microorganisms in Agriculture: Bacteria and fungi as biopesticides; Genetically modified crops containing insecticidal genes; Biofertilizers- Nitrogen fixers, PSB and Mycorrhiza.; Fuel from microorganisms- Biogas technology, Microbial hydrogen production, Concept of gasohol for skill development.

Unit II: Geomicrobiology: Microbial leaching of copper and uranium; Biorecovery of petroleum- MEOR; Bioremediation and Biodeterioration- Petroleum products, leather, textile and paper to enhance employability skills.

Unit III: Pharmaceutical Biotechnology: Genetically engineered microorganisms; Production of heterologous proteins- Insulin, Growth hormones, Interleukins and t plasminogen activator; Recombinant vaccines to develop entrepreneurship and employability.

Unit IV: Food from Microbes: Dairy products- Cheese, Butter, Yogurt; Microorganisms as food- SCP, Spirulina and Mushroom; Indian and Oriental fermented foods to create the entrepreneurship skills.

Unit V: Advanced Microbiology: Biosensors and Biopolymers; Biochips, Biofilms and Bioplastics; Microorganisms as bioindicators for skill development.

Recommended Text/ Reference Books

1. Willey, Joanne M; Sherwood, Linda; Woolverton, Christopher J; Prescott, Lansing M. Microbiology. New York : McGraw-Hill Higher Education. 2008
2. Martin Frobisher. Fundamentals of Microbiology 9th Edition. W.B. Saunders Company (June 1974)
3. E.C.S. Chan, Michael J. Pelczar, Jr., Noel R. Krieg. Microbiology (Fifth Edition). Published by Tata McGraw-Hill Education Pvt. Ltd 0 (1998-08-01)
4. R.Y. Stanier, Michael Doudoroff (Author). General Microbiology- Paperback Publisher- December 10, 1970
5. H. A. Modi. Introductory Food Microbiology. Pointer Publishers, 2007
6. Powar & Dagainawal. General Microbiology ? Vol. I. Himalaya Publishing House Pvt. Ltd. (2012).

Course Outcomes:

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

CO1: Understand the role of microbes in agriculture, GM crop, microbes as biofertilizer and biofuels for skill development, employability and entrepreneurship development at global level.

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CO2: Understand the concept of microbial leaching, biorecovery, bioremediation and bio-deterioration for skill development and employability globally.

CO3: Understand the role of GE microbes, production of biologically important proteins for skill development, employability and entrepreneurship development.

.CO4: Understand the process for production of dairy and food products using microbes for skill development.

CO5: Understand the working principle of biosensors, biopolymers, biochips, biofilms and bioplastic 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	2	3	3	3	3	2	3	2	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	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	2
CO2	3	3	2
CO3	2	2	1
CO4	3	2	2
CO5	2	1	1

IFTM UNIVERSITY, MORADABAD
B.Sc. (MICROBIOLOGY)

SYLLABUS
BMB-501 I Principle of Human Nutrition

UNIT I: Introduction: relationship of nutrition to health, growth and human welfare. Terms and definition use in nutrition. History of Nutrition knowledge for better employability in industry

UNIT II: Physiology of Nutrition: digestive system, digestion, circulatory and lymphatic system, excretion of waste products knowledge for better employability in industry

UNIT III: Macronutrients: Building Blocks and energy sources. 1 Carbohydrates- types, function, sources, requirements, toxicity, significance of fibres. 2 Lipids- types, function, sources, requirements, toxicity. 3 Protein- Amino Acids as building blocks of body, structure of protein, sources and requirements. knowledge for better employability in industry

UNIT IV: Micronutrients: Vitamins & Minerals, Classification, types, function, sources, requirements, toxicity. Complimentary to each other. knowledge for better employability in industry

UNIT V: Energy source: Energy value of food, 3 basic functions of energy: basal metabolism, physical activity, and thermogenesis and factors and affecting them. knowledge for better employability in industry

Recommended Text Books/References:

- 1- B. Srilakshmi- Dietetics, 7th ed
- 2- Ghosh, S.: The Feeding and Care of Infants and Young Children, VHAI. 6th Ed. Delhi.
- 3- Indian Council of Medical Research : Nutrient Requirements and Recommended Dietary Allowance for Indians, New Delhi
- 4- Textbook of Nutrition-Ravinder Chadha & Pulkit Mathur, Orient Blackswan Pvt. Ltd. Telangana
- 5- Sohi D. A Comprehensive Textbook of Nutrition & Therapeutic Diets, New Delhi: Jaypee Brothers Medical Publishers

Course Outcomes:

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

CO1: Understand the relationship of nutrition to health, growth and human welfare for local employability in global industry.

CO2: Gain knowledge about the Physiology of Nutrition-digestive system, digestion, circulatory and lymphatic system, excretion of waste products for employability in global industry.

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CO3: Understand the Macronutrients types, function, sources, and requirements for employability in global industry.

CO4: Understand the Micronutrients types, function, sources, and requirements for employability in industry.

CO5: Understand the Energy value of food, basic functions of energy for employability in industry 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. (MICROBIOLOGY)

SYLLABUS
BMB-501 II FOOD SCIENCE & NUTRITION

UNIT I: Different Food groups: Functional food groups-energy yielding, body building and protective foods (only sources and not properties and functions). Food Pyramid, My Plate. Study of various cooking methods - effects of cooking on parboiled and raw rice, principles of starch cookery, gelatinization. knowledge for better employability in industry

UNIT II: Pulses and grams: Varieties of pulses & grams, composition, nutritive value, cooking quality of pulses, germination and its effect. Vegetables - Classification, composition, nutritive value, selection and preparation for cooking, methods and principles involved in cooking. Fruits - Composition, nutritive value, changes during ripening, methods and effects of cooking, enzymatic browning. .knowledge for better employability in industry

UNIT III: Beverages - Classification, nutritive value, Milk based beverages- methods of preparing tea and coffee, fruit based beverages and preparation of carbonated non – alcoholic beverages. Spices and Condiments - Uses and abuses. Fats and Oils -. Sugar cookery- Stages of sugar cookery, crystallization and factors affecting crystallization. .knowledge for better employability in industry

UNIT IV: Milk - Composition, nutritive value, kinds of milk, pasteurization and homogenization of milk, Egg - Structure, composition, classification, nutritive value, uses of egg in cookery, methods of cooking, foam formation and factors affecting foam formation . knowledge for better employability in industry

UNIT V: Meat -Structure, composition, nutritive value, selection of meat, post mortem changes in meat, aging, tenderness, methods of cooking meat and their effects. Poultry – types, composition, nutritive value, selection, methods of cooking. Fish - Structure, composition, nutritive value, selection of fish, methods of cooking. .knowledge for better employability in industry

Recommended Text Books/References:

1. Food science, Chemistry and Experimental foods by M. Swaminathan.
2. Food Science by Norman.N.Potter.
3. Experimental study of Foods by Griswold R.M.
4. Food Science by Helen Charley.
5. Foundation of Food Preparation by A.G. Peckam

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Course Outcomes:

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

CO1: Understand the Functional food groups, Food Pyramid and Study of various cooking methods for employability in global industry.

CO2: Gain knowledge about the Varieties of pulses & grams, composition, nutritive value, cooking quality of pulses, germination and its effect for employability in industry.

CO3: Understand the Beverages - Classification, nutritive value for employability in industry.

CO4: Understand the Egg - Structure, composition, classification, nutritive value, uses of egg in cookery, methods of cooking for employability in global industry.

CO5: Understand the Meat -Structure, composition, nutritive value for local employability in global industry 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
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SYLLABUS
BMB-501 III TECHNOLOGY OF BEVERAGES

UNIT I: Introduction and History of growth: Type of beverages: fruit & vegetable juices, fermented and non-fermented beverages, synthetic beverages, carbonated and non-carbonated beverages. Tea, Coffee and Cocoa: Production, composition, processing and preparation knowledge for better employability in industry.

UNIT II: Fruit and Vegetable Beverages: Juice extraction, clarification, preservation, packaging, concentration and drying. Various beverages from fruit juices, their preparation and preservation. knowledge for better employability in industry.

UNIT III: Non carbonated and carbonated synthetic beverages: Ingredients, source of carbon dioxide, chemical and physical properties of carbon dioxide, carbonating process, packaging of carbonating beverages for better employability and entrepreneurship

UNIT IV: Alcoholic Beverages: Non-Distilled Beverages : Beer and Wine. Distilled Beverages :Vodka, Rum, Gin, Whisky, Arack, Toddy, Brandy their preparation and knowledge for better employability in industry.

UNIT V: Non-alcoholic beverages, Processing of tea, coffee and cocoa, Tea-waste utilization as feed for livestock and poultry; Coloring agents, Humectants, anti-caking agents, Low calorie sweeteners, pH control agents, thickeners skill development and for better employability and entrepreneurship

Recommended Text Books/References:

1. Foods: Facts and Principles : N. Shankuntala Manny and M. Shadaksharaswamy
2. <https://www.beveragetechnology>
3. Designing Great Beers: The Ultimate Guide to Brewing Classic Beer Styles by Ray Daniels, Brewers Publications, US
4. Historical Brewing Techniques : The Lost Art of Farmhouse Brewing by Lars Marius Garsho, Brewers Publications, US

Course Outcomes:

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

CO1: Understand the type of beverages for employability in global industry.

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CO2: Gain knowledge about the fruit and vegetable beverages: juice extraction, clarification, preservation for employability in industry.

CO3: Understand the non carbonated and carbonated synthetic beverages for employability in industry.

CO4: Understand the alcoholic beverages: non-distilled beverages : beer and wine. distilled beverages –vodka , rum etc for employability in industry.

CO5: Understand the non-alcoholic beverages, Processing of tea, coffee and cocoa for employability in industry and entrepreneurship development 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	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

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SYLLABUS

BMB-502 II Clinical Operations & Clinical Data Management

Unit I: Clinical Research: An Overview, Different types of Clinical Research.; Clinical Pharmacology: Pharmacokinetics, Pharmacodynamics, Pharmacoepidomology, Bioavailability. Bioequivalence, Terminologies and definition in Clinical Research. Drug Development Process: Preclinical trail, Human Pharmacology (Phase-I), Therapeutic Exploratory trail (Phase-II), Therapeutic Confirmatory Trail (Phase-III) and Post marketing surveillance (Phase-IV) *to develop employability.*

Unit II: Brief History of Clinical Research: Sulphanilamide Tragedy, Thalidomide Disaster, Nazi Experiments, Tuskegee Study, Belmont report, Nuremberg code, Declaration of Helsinki principles. Guidelines in Clinical Research; Regulation in Clinical Research; Clinical Research Regulatory Submission & approval Process- IND, NDA and ANDA submission Procedure. DCGI submission procedure. Other Regulatory authorities *to generate skills for employability.*

Unit III: Concept of Clinical Trail Management, Stake holders in Clinical Trail project. Sponsors perspective: Responsibility of Sponsors, Study Preparation Initial Documents and capability assessment, Study feasibility, Vendors/Service provider selection, Investigator selection, Budgeting in Clinical trial, Clinical Trail Agreement (CTA), Regulatory submission and approval, Sponsors obligation in Good Clinical Practice. Clinical Research Operation, Monitoring and Clinical Evaluation: Project management, Protocol in Clinical Research, Informed Consent, Ethics and Regulatory submission, Monitoring Visits, Investigator Meeting, Essential Document preparation *to generate skills for employability.*

Unit IV: International GMP regulation, Indian GMP regulation, Quality assurance in Pharmaceutical Industry, Quality control in Pharmaceutical Laboratory, GLP principles: Organizational and personal, Quality assurance program, facilities, Equipments, Reagents and Materials, Test systems, Test and Reference Items. Standard Operating Procedure, Performance of study reporting of results, storage of records and reports *to develop skills for employability.*

Unit V: CDM Systems: Clinical data management systems, Electronic data capture systems, Choosing vendor products, Implementing new systems, System validation, Test procedures, Change control, Coding dictionaries, Migrating and archiving Legacy Data. Drug Regulatory Authorities- Drug policy in India, Regulation on alternative system of Medicine, Safety of Herbal medicines, Medical and Scientific writing *for generating employability and entrepreneurship development.*

Recommended Text / Reference Books

1. Understanding Clinical Research by Renato D. Lopes.
2. Designing Clinical Research by Stephen B. Hulley.
Fundamentals of Clinical Trials by Lawrence M. Friedman,

Course Outcomes:

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

CO1: Understand the Different types of Clinical Research, Clinical Pharmacology, Pharmacokinetics, Pharmacodynamics Research for employability in global industry.

CO2: Gain knowledge about the History of Clinical Research Sulphanilamide Tragedy, Thalidomide Disaster, Nazi Experiments, Tuskegee Study, Belmont report for employability in global industry.

CO3: Understand the Concept of Clinical Trail Management for employability in global industry.

CO4: Understand the International GMP regulation, Indian GMP regulation for employability in industry.

CO5: Understand the clinical data management systems and safety of herbal medicines for employability in industry 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

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SYLLABUS

BMB-502 I Cloning Strategies and Nanomicrobiology

Unit-I: Nanotechnology Definition and concepts: Cellular Nanostructures, Nanopore; Criteria for suitability of nanostructures for biological applications knowledge to inculcate skills for better employability.

Unit-II: Basic characterization techniques Electron microscopy: Atomic force microscopy, Photon correlation Spectroscopy knowledge to inculcate skills for better employability.

Unit-III: Thin films: Colloidal nanostructures, Nanovesicles: Nanospheres: Nanocapsules, Health Care Nanotechnology: Nanostructures for diagnostics and biosensors; Nanoparticles for diagnostics and imaging knowledge to inculcate skills for better employability .

Unit-IV: Applications of Nano-Materials in Biosystems: Proteins - Lipids - RNA and DNA Protein Targeting - Small Molecule/Nanomaterial - Protein Interactions Nanomaterial-Cell interactions-Manifestations of Surface Modification (Polyvalency) knowledge to inculcate skills for better employability.

Unit-V: Nanomaterials and Diagnostics/Drug Delivery and Therapeutics MRI, Imaging Surface Modified Nanoparticles MEMS/NEMS based on Nanomaterials Peptide/DNA Coupled Nanoparticles Lipid Nanoparticles For Drug Delivery Inorganic Nanoparticles For Drug Delivery Metal/Metal Oxide Nanoparticles (antibacterial/antifungal/antiviral) Anisotropic and Magnetic Particles (Hyperthermia) knowledge to inculcate skills for better employability.

Recommended Text / Reference Books

1. Multilayer Thin Films, Editors: GeroDécher, Joseph B. Schlenoff Publisher: Wiley- VCH VaGmbH & Co. KGaA ISBN: 3527304401.
2. Bionanotechnology: Lessons from Nature Author: David S. Goodsell Publisher: Wiley- Liss ISBN 047141719X.1
3. Biomedical Nanotechnology Editor: Nechna I, Malsch Publisher: CRC Press ISBN: 08247-2579-4 Springer Handbook of Nanotechnology- B Bhusan

Course Outcomes:

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

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CO1: Understand the nanotechnology -structures, concepts and applications for employability in industry.

CO2: Gain knowledge about the basic characterization techniques through microscopy for employability in industry.

CO3: Understand the thin films colloidal nanostructures, nanovesicles, nanospheres, nanocapsules for employability in global industry.

CO4: Understand the applications of nano-materials in biosystems: proteins - lipids - rna and dna for employability in industry.

CO5: Understand the nanomaterials and diagnostics/drug delivery and therapeutics for employability in industry and entrepreneurship development 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	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. (MICROBIOLOGY)

SYLLABUS
BMB-502 III SUBSTITUTE AND FOOD EVALUATION

UNIT I: Food situation in India and outside. Trapping the unconventional post-harvest losses and prospects for food processing for export. Traditional foods – status and need for revival in the context of non-traditional foods, urbanization and other factors. knowledge for better employability in industry

UNIT II: Physical Principles underlying food processing and preservation including thermal processing, ionizing, radiations, refrigeration, freezing and dehydration. Physical and Chemical changes in food that affect texture, flavour, odour, stability and nutritive value during processing and storage. Basic processing technology of cereals and legumes, losses during storage, handling and processing. Basic processing technology of oilseeds. knowledge for better employability in industry

UNIT III: Basic processing technology of fruits and vegetables. Basic processing technology of milk and milk products. Basic processing technology of Meat, Fish, Poultry and eggs. Fermentation Technology, Enrichment and fortification technology. High protein technology (Single Cell Protein) knowledge for better employability in industry and skill development and entrepreneurship development.

UNIT IV: Quality control in food industry- Methods of evaluation and quality control of various aspects in quality of raw material, manufacturing processes and finished goods. Waste disposal and sanitation, Extruded foods , Food Irradiation knowledge for better employability in industry and skill development

UNIT V: Additives and Preservatives used in processing and Formulation, Food Adulteration , Chemical and physical properties of foods. Transportation, Types/Mode, optimization of transportation taking into account type of product, distance, storage, facilities etc.for better employability in industry

Recommended Text Books/References:

- 1.Kent, N.L. 2003. Technology of Cereal, 5th Ed. Pergamon Press.
2. Chakraverty. 1988. Post Harvest Technology of Cereals, Pulses and Oilseeds, revised Ed., Oxford & IBH Publishing Co. Pvt Ltd.
3. Marshall, Rice Science and Technology. 1994. Wadsworth Ed., Marcel Dekker, New York.
4. Manay, S. and Sharaswamy, M. 1987. Food Facts and Principles.Wiley Eastern Limited
5. Girdharilal, Siddappaa, G.S and Tandon, G.L., 1998, Preservation of fruits& Vegetables, ICAR, New Delhi

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Course Outcomes:

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

CO1: Understand the food situation in india and outside for local semployability in industry.

CO2: Gain knowledge about the physical principles underlying food processing and preservation for employability in global industry.

CO3: Understand the basic processing technology of fruits and vegetables for employability in industry.

CO4: Understand the methods of evaluation and quality control of various food industry for employability in industry.

CO5: Understand the additives and preservatives used in processing and formulation for employability in industry and entrepreneurship development 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	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	3
CO3	3	2	2
CO4	3	2	2
CO5	2	2	2

IFTM UNIVERSITY, MORADABAD
B.Sc. (MICROBIOLOGY)
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.

Course Outcomes:

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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

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 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	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 globally.

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 employability in 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
CO1	3	2	2	1	1	1	2	3	1	3
CO2	2	3	2	1	2	2	3	2	1	2
CO3	1	2	2	1	2	3	2	2	1	2
CO4	1	2	2	3	2	3	2	2	3	2
CO5	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
BMB-601 Advanced Virology

Unit I: History of Virology ; Viroids: Origin, Genome, Replication of Viroids. Origin of Virus, Morphology : Shape ,Size, Structure types of envelope, their composition, Viroids and Prions. Classification of Virus: LHT System, Baltimore Classification. Isolation & Cultivation of Virus for enhanced skill development.

Unit II: History of Plant Virology:Classification plant viruses, life cycle and pathogenicity of important viruses. Tobamovirus Group: Symptoms,Virus structure,Genome Organization, Multiplication. Potex Virus Group: Symptoms,Virus structure,Genome Organization.Ptyvirus Group: Symptoms,Virus structure,Genome Organization.Tymovirus Group: Symptoms,Virus structure,Genome Organization to enhance knowledge for employability.

Unit III: Tomato Spotted Wilt Virus,Cauliflower Mosaic Virus : Symptoms,Virus structure,Genome Organization.Potato Leaf Roll Virus: Symptoms,Virus structure,Genome Organization.Rice Tungro Virus.Mosaic Disease of Sugarcane,Transmission of Plant Virus, Effect of Viruses on Plants: External and Internal symptoms. Serological Tests for Diagnosis of Plant Virus for skill development.

Unit IV: Classification of animal viruses, life cycle and pathogenicity of important viruses, genome organization and replication of DNA viruses; Papovavirus, SV40, Poxviruses, Adenovirus, Herpesviruses. RNA containing Viruses; Picornavirus, Togaviruses, HIV, Working of Immune System in presence of HIV for effective development of skills.

Unit V: Bacteriophages;Classification,Morphological Groups,The Virulent dsDNA phage,the ssDNA phage,Phage lambda,Temperate and Transposable Phage;Phage Mu:M 13;Bacteriophage typing;Phage Therapy;Cyanophages,Myoviruses; Rhizobiophages to acquire knowledge for employability.

Recommended Text/ Reference Books

1. Molecular Virology, pathogenesis and control, ASM Press, Washington DC.
2. Roger Hull. Matthews' Plant Virology (Fourth Edition)
3. Dimmock N. J., Primrose S. B. Introduction to modern Virology, 4th edition, Blackwell scientific Publications, Oxford. 1994
4. Morag C and Embury M. C. 1994, Medical Virology 10th edition, Churchill Livingstone, London.
5. Luria,S.E.General Virology.John Wiley And Sons Inc.1953

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Course Outcomes:

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

CO 1: Classify the viruses on different basis and know about isolation and cultivation process of viruses for skill development.

CO 2: Understand the classification of plant viruses, genome organization, life cycle and pathogenicity of some viruses to enhance knowledge for local employability.

CO 3: Learn about structure genomic organization of some specific plant viruses along with symptoms and serological testing methods for skill development.

CO 4: Classify animal viruses and understand the infection cycle with example of some very important DNA and RNA viruses or effective development of skills

CO 5: Describe the Bacteriophages Mycophages, Cyanophages and the Bacteriophage therapy to combat the infection bacterial disease to acquire knowledge for 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
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	2
CO2	3	2	3
CO3	2	2	3
CO4	2	3	2
CO5	2	3	2

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SYLLABUS
BMB- 602 Clinical Parasitology

Unit I: Infection: Introduction to infection, types of infection, host-parasite relationship, toxicogenecity, exotoxin- AB toxin, specific host site exotoxins, membrane disrupting exotoxin, roles of exotoxin in disease, endotoxin to enhance knowledge for employability.

Unit II: Introduction to parasitology terminologies and definition. Transmission of Parasites- vector boron transmission, airborne transmission, water born transmission, food born transmission, vehicle transmission to acquire knowledge for employability.

Unit III: Protozoa: Geographic distribution, habitate, morphology, life cycle, pathogenesis, symptoms, laboratory diagnosis, prevention and control of the following parasite-
I) *Plasmodium*, II) *Entamoeba histolytica*, III) *Leishmania donovani*.for effective development of skills.

Unit IV: Cestodes: Geographic distribution, habitat, morphology, life cycle, pathogenesis, symptoms, laboratory diagnosis, prevention and control of the following parasite-
I) *Taenia solium*, II) *Echinococcus granulosus*, III) *Taenia sagenata* to enhance knowledge for skill development

Unit V: Helminths: Geographic distribution, ha bitate, morphology, life cycle, pathogenesis, symptoms, laboratory diagnosis, prevention and control of the following parasite-
I) *Ankylostoma duodenale*, II) *Ascaris lumbricularis*, III) *Enterobius vermicularis* for effective development of skills.

Recommended Text/ Reference Books

1. Joanne M Willey, Linda M. Sherwood, Christorpher J. Woolverton. Prescott, Harley and Klein Microbiology, Mc Graw Hill Publication.
2. Powar&Daginawal.General Microbiology ? Vol. I.Himalaya Publishing House Pvt. Ltd. (2012)
3. E.C.S. Chan,Michael J. Pelczar, Jr.,Noel R. Krieg.Microbiology (Fifth Edition).Published by Tata McGraw-Hill Education Pvt. Ltd 0 (1998-08-01)
4. Martin Frobisher.Fundamentals of Microbiology 9th Edition.W.B. Saunders Company(June 1974)
5. Harold W. Brown, Franklin A. Neva.Basic Clinical Parasitology, 4th edition.Appleton & Lange,U.S.; 1975

Course Outcomes:

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

CO1: Understand the mechanism of infection, concepts related to host-pathogen interaction, exotoxin and endotoxin for skill development.

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CO 2: Understand and acquaint the students with the key aspects of medical microbiology related to the diverse microbial pathogens, their virulence mechanisms, symptoms and their mode of transmission for global skill development.

CO 3: Understand morphology, symptoms, life cycle and diagnosis of important diseases caused by protozoans for better employability..

CO 4: Understand morphology, pathogenesis, life cycle and laboratory diagnosis of important diseases caused by cestodes for skill development.

CO 5: Understand morphology, geographical distribution, pathogenesis, life cycle and laboratory diagnosis of important diseases caused by helminthes for effective development of skills 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	3	2	2	1	1	1	2	3	1	3
CO2	2	3	2	1	2	2	3	2	1	2
CO3	1	2	2	1	2	3	2	2	1	2
CO4	1	2	2	3	2	3	2	2	3	2
CO5	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	2
CO2	3	2	3
CO3	2	2	3
CO4	2	3	2
CO5	2	3	2

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SYLLABUS
BMB-603 Dairy Microbiology

Unit I: Milk: definition, Uses, Sources, types of milk and chemical composition of milk. Fermented dairy products: Youhurt, Kefir, cultured cream, buttermilk, Chesses to develop employability skills.

Unit II: Microbial analysis of milk: Microflora of raw milk, Total bacterial count, Dye reduction test, Brucella ring test, Test for mastitis, Factors affecting the microbial growth in milk, temperature response of bacteria.

Unit III: Contamination of Milk and Milk Products, Spoilage of milk and cream, spoilage of condensed and dry milk products, spoilage of frozen desserts and butter Colour and flavor defects, Sweet curdling, Ropiness to develop the entrepreneurship skills and employability.

Unit IV: Processing of different milk products for control of microorganisms: Cream, Butter, condensed milk, evaporated milk and whole milk powder to promote entrepreneurship development.

Unit V: Preservation of milk and milk products- asepsis, removal of micro-organisms by use of heat (Pasteurization,UHT, LTH, HTST), use of low temp., drying, use of preservatives.

Recommended Text/ Reference Books

1. Dairy Microbiology Handbook: The microbiology of Milk and Milk Products-Richard K. Robinson.
2. Elmer H. Marth, James L. Steele. Applied Dairy Microbiology. Taylor & Francis, 1998
3. William C. Frazier, Dennis C. Westhoff. Food Microbiology. Tata McGraw-Hill Publishing Company, 1978
4. Manish Srivasatva. Handbook of MilkMicrobiology. Daya Books, 2002

Course Outcomes:

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

CO1: familiarize the concept of different types of milk, its uses, sources, chemical composition of milk and to understand the principle and procedure of manufacturing Fermented dairy products like yogurt, kefir, cultured cream, buttermilk, Cheese to develop employability skills at global level.

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CO2: understand the principle and procedure of microbial analysis of milk, microflora of raw milk, Total Bacterial count, Dry reduction test, Brucella ring test, Test for mastitis and to identify the factors affecting the microbial growth in milk for skill development.

CO3: describe the different microorganisms present in milk and milk products and factors responsible for the growth of microorganisms to develop employability skills

CO4: describe the processing methodology for controlling microorganisms in various dairy products like cream, butter, evaporated milk and other dairy products for skill development.

CO5: Describe the various methods employed for the preservation of milk products such as removal of microorganisms by use of heat, low temperature, drying and preservatives to develop employability 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	2	2	1	1	1	2	3	1	3
CO2	2	3	2	1	2	2	3	2	1	2
CO3	1	2	2	1	2	3	2	2	1	2
CO4	1	2	2	3	2	3	2	2	3	2
CO5	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	2
CO2	3	2	3
CO3	2	2	3
CO4	2	3	2
CO5	2	3	2

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SYLLABUS

BMB-602 I Microbial Quality Control in Food and Pharmaceutical Industries

UNIT I: Introduction to quality management: Definition, quality concepts, quality, quality perception, quality attributes, safety, health, sensory, shelf life, convenience, extrinsic attributes, factors affecting food behavior. Quality policy, quality objectives, strategic planning and implementation, McKinsey 7s model, competitive analysis for effective development of employability skills.

UNIT II: Quality risk management in Pharmaceuticals: Introduction, risk assessment, risk control, risk review, risk management tools, HACCP, risk ranking and filtering according to ICH Q9 guidelines; process development and stability testing drug substances and drug products as ICH Q8 guidelines for skill enhancement.

UNIT III: Pharmaceutical Quality System: Change management/ change control, deviations, out of specifications (OOS), out of trend (OOT). Complaints: Evaluation and handling, investigation and determination of root cause, corrective and preventive actions (CAPA), returns and recalls, vendor qualification, annual product reviews, batch review and batch release for entrepreneurship and employability skills.

UNIT IV: Food contamination and additives: Contamination in Food- Physical, chemical (heavy metals, pesticide residues, antibiotics, veterinary drug residues, dioxins, environmental pollutants, radionuclides, solvent residues, chemicals); Risk assessment studies- Safety and quality evaluation of additives and contaminants; Antioxidants mechanism of action, natural and synthetic anti-oxidants to promote entrepreneurship skills and employability.

UNIT V: Food Laws, standards and regulations: History, National and International laws & Regulations: FSSAI, USFDA, EU, Codex alimentarius, ISO Series, World Trade Organization- (Sanitary and Phyto Sanitary agreement (SPS), Technical Barriers in Trade(TBT); Standards of Identity, Standards of Quality, Standards of fill of the container for effective development of employability skills.

Recommended Text/ Reference Books

1. Antony J., and Preece D., Understanding, Managing and Implementing Quality: Frameworks, Techniques and Cases, Routledge, Taylor and Francis Group, New York.
2. Lawler E.E., Mohrman S.A., Benson G., Organizing for High Performance: Employee Involvement, TQM, Reengineering, and Knowledge Management in the Fortune 1000, Jossey-Bass, New Jersey.
3. Pie P.A. Luning, W.J. Marcelis, Food Quality Management Technological and Managerial principles and practices, Wageningen, 2002.
4. H.J Heinz, D.A. Shapton, Principles and Practices for the safe processing of Foods, Butterworth-Heinemann, 2002.
5. Ternel A, Luning, Willem J. Marcelis, Food Quality Management Technological and Managerial principles and practices, Wageningen, 2009.

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Course Outcomes:

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

CO1: Understand Definition, concepts, perception, attributes of quality for effective development of employability skills

CO2: Understand Quality risk management in Pharmaceuticals, HACCP, Fish Bone approach etc. to promote entrepreneurship skills and local employability.

CO3: Understand Pharmaceutical Quality System, OOS, OOT, Complaints: Evaluation and handling for skill development.

CO4: Learn about Physical and chemical contaminants in food processing, Risk assessment studies for effective development of employability skills.

CO5: Food Laws, standards and regulations FSSAI, USFDA, EU, Codex alimentarius, ISO Series, World Trade Organization for effective development of employability skills 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	3	2	2	1	1	1	2	3	1	3
CO2	2	3	2	1	2	2	3	2	1	2
CO3	1	2	2	1	2	3	2	2	1	2
CO4	1	2	2	3	2	3	2	2	3	2
CO5	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	2
CO2	3	2	3
CO3	2	2	3
CO4	2	3	2
CO5	2	3	2

SYLLABUS

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BMB-602 II Microbial Diagnosis In Health Clinics

UNIT I: General principles of diagnosis and collection of clinical samples: Importance of diagnosis of infectious diseases; Challenges in diagnosis (Interference from normal microflora, mixed infections, specificity and sensitivity issues); Choice of clinical samples for diagnosis of infectious diseases; Methods for collection of clinical samples (Blood, CSF, Urine, Faeces) for effective development of skills; Sample collection from oral cavity, throat and skin, biopsies); Methods of transport of clinical samples to laboratory and their storage for skill development.

UNIT II: Approaches for identification of pathogens: Microscopic examination-Examination of clinical sample by microscopy, Ziehl-Neelson staining of sputum sample for detection of tuberculosis, Giemsa staining of blood film for detection of malaria; Cultural Methods- Enrichment Culture, Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, TCBS agar, Salmonella Shigella agar; Microbial detection using chromogenic media; Distinct colony properties of various bacterial pathogens on relevant culture media (Streptococcus pyogenes, Mycobacterium tuberculosis, Salmonella, Shigella, E. coli, Vibrio); Biochemical Methods- Sugar fermentation profiling for entrepreneurship and employability skills, TSI, IMViC. Serological and Molecular methods: Serological Methods – Agglutination, ELISA, Western blot, Immunofluorescence, Lateral flow Immunoassays, Nucleic acid based methods – PCR; Real Time and Multiplex, Nucleic acid probes; Dot Blot and Colony Hybridization for better employability.

UNIT III: Rapid Detection of bacterial pathogens and antibiotic sensitivity of bacteria: Laboratory guidance and diagnostic testing for rapid detection of pathogens; Typhoid, Dengue and HIV, Swine flu, Zika virus; Testing for Antibiotic sensitivity in Bacteria; Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method to promote entrepreneurship skills and employability.

UNIT IV: Current approaches to diagnosis: Collection, transport and culturing of clinical samples. Principles of different diagnostic tests; ELISA (rapid diagnostic kits) and agglutination-based tests (Widal and VDRL test); Specific approaches to diagnose pathogens that are difficult to detect/culture by routine methods; Plasmid fingerprinting (creation of database for a wide collection of circulating strains of bacterial pathogens); indirect immunofluorescence test for syphilis; monoclonal antibodybased detection kits; immunoblotting for HIV, radio-immunoassays and its applications in cardiology, blood banking, diagnosis of allergies and endocrinology; diagnostic use of microarrays; PCR-ELISA test to detect specific serotypes of rotavirus; flow cytometry for analysing heterogeneous microbial populations and for diagnosis of Legionella pneumophila to acquire knowledge for entrepreneurship skills and employability.

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UNIT V: Anti-microbial chemotherapy: Antimicrobial agents- General characteristics and mode of action; Antibacterial agents; Five modes of action with one example each; Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism; Antifungal agents- Mechanism of action of Amphotericin B, Griseofulvin; Antiviral agents- Mechanism of action of Amantadine, Tamiflu, Azidothymidine. Antimicrobial resistance: MDR, XDR, TDR. NDM-1; National immunization schedule and other current vaccines for effective development of employability skills.

Suggested Readings:

1. Prescott's Microbiology by J. M. Willey, K. Sandman and D. Wood. 11th edition. McGraw Hill Higher Education, USA. 2019.
2. Brock Biology of Microorganisms by M.T. Madigan and J.M. Martinko. 15th edition. Prentice Hall International Inc., USA. 2017.
3. Textbook of Microbiology by R. Ananthanarayan and C.K.J. Paniker. 10th edition. Universities Press, India. 2017.
4. Jawetz, Melnick and Adelberg's Medical Microbiology by K.C. Carroll, S.A. Morse, T.A. Mietzner and S. Miller. 27th edition. McGraw Hill Education. 2016.
5. Microbiology: A Laboratory Manual by J. Cappucino and N. Sherman. 10th edition. Pearson Education, India. 2014.

Course Outcomes:

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

CO1: Learn about Importance of diagnosis of infectious diseases, Challenges in diagnosis for skill development.

CO2: Learn various methods of Microscopic examination of clinical samples and develop local employability skill and entrepreneurship

CO3: Learn about Rapid Detection of bacterial pathogens and antibiotic sensitivity of bacteria for skill development

CO4: Understand and learn Current approaches to diagnosis, PCR, ELISA, collection marking etc.for effective development of employability skills globally.

CO5: Understand Anti-microbial chemotherapy General characteristics and mode of action for better 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	2	2	1	1	1	2	3	1	3
CO2	2	3	2	1	2	2	3	2	1	2

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CO3	1	2	2	1	2	3	2	2	1	2
CO4	1	2	2	3	2	3	2	2	3	2
CO5	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	2
CO2	3	2	3
CO3	2	2	3
CO4	2	3	2
CO5	2	3	2

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SYLLABUS
BMB-603 I Biofertilizers Technology

Unit I: Introduction: History and concept of Bio fertilizers, status scope and importance of Biofertilizers, Classification of Biofertilizers. Nitrogen fixation *for generating skills for employability.*

Unit II: Structure and characteristic features of bacterial Bio fertilizers- *Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium and Frankia*; Cynobacterial biofertilizers- *Anabaena, Nostoc, Hapalosiphon* and fungal biofertilizers- *AM mycorrhiza and ectomycorrhiza to enhance skills.*

Unit III: Production technology: Strain selection, sterilization, growth and fermentation, equipment, mass production of carrier based and liquid biofertilizers. FCO specifications and quality control of bio fertilizers *to enhance skills for employability.*

Unit IV: Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers -Storage, shelf life, quality control and marketing. Factors influencing the efficacy of bio fertilizers *to generate skills for employability.*

Unit V: Quality standard for biofertilizers, Different methods of application of biofertilizers, Methods of quality control assessment in respect of biofertilizers, Strategies of Mass multiplication and packing Registration of biofertilizers *to enhance skills for employability.*

Recommended Books/Reference Books

1. General Microbiology by Dubey and Maheswari.
2. Biofertilizer Technology, Marketing and Usage-A Source Bookcum-Glossary(FDCO, New Delhi) by M.R.,P.Bhattacharya.
3. Biofertilizers in Agriculture and Forestry (Oxford and IBH Pub. Co., New Delhi) by Subbarao

Course Outcomes:

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

CO1: Understand History and concept of Bio fertilizers, status scope and importance in India and world *for generating skills for local employability.*

CO2: Understand the Structure and characteristic features of bacterial Bio fertilizers *Azotobacter, Bacillus, Pseudomonas, Rhizobium etc. to enhance skills*

CO3: Learn about Strain selection, sterilization, growth and fermentation and quality control of bio fertilizers *to enhance skills for employability*

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CO4: Understand about technology for seeds, seedlings, tubers. Storage and shelf life of *to generate skills for employability*
 CO5: Understand the Quality standard for biofertilizers, quality control assessment *to enhance skills for employability 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	3	2	2	1	1	1	2	3	1	3
CO2	3	3	2	1	2	2	3	2	1	2
CO3	2	2	2	1	2	3	2	2	1	2
CO4	2	2	2	3	2	3	2	2	3	2
CO5	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	2
CO2	3	2	3
CO3	2	2	3
CO4	2	3	2
CO5	2	3	2

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SYLLABUS
BMB-603 II Plant and Algal Physiology

Unit-I: Plant - Water relations: Physical properties of water, Importance of water to plant life., Diffusion imbibition and osmosis; concept & components of Water potential, Absorption and transport of water and ascent of sap, Transpiration-Definition, types of transpiration, structure and opening and closing mechanism of stomata knowledge for skill development.

Unit-II: Mineral nutrition & Enzymes: Mineral Nutrition: Essential elements (macro and micronutrients) and their role in plant metabolism, deficiency symptoms, Mineral ion uptake (active and passive transport), Nitrogen metabolism- biological nitrogen fixation in Rhizobium, outlines of protein synthesis (transcription and translation), Enzymes: General characteristics, mechanism of enzyme action and factors regulating enzyme action to inculcate skills.

Unit-III: Photosynthesis: Photosynthetic pigments, photosynthetic light reactions, photo-phosphorylation, carbon assimilation pathways: C₃, C₄, and CAM (brief account), Photorespiration and its significance. Translocation of organic solutes: mechanism of phloem transport, source-sink relationships. Plant Metabolism: Respiration: Glycolysis, anaerobic respiration, TCA cycle, electron transport system. Mechanism of oxidative phosphorylation, Lipid Metabolism: Types of lipids, Beta-oxidation knowledge for skill development.

Unit-IV: Growth and development: definition, phases and kinetics of growth, Physiological effects of phytohormones - Auxins, Gibberellins, Cytokinins, ABA, Ethylene and Brassinosteroids, Physiology of flowering - photoperiodism, role of phytochrome in flowering: Vernalization, Physiology of Senescence and Ageing knowledge for developing skills.

Unit-V: Photosynthesis in Marine Algae - Fine structure and properties of algal plastids, photosynthetic pigments in different algal groups, carbon fixation, photosynthesis in marine macro-algae - light absorption, effect of low light, photosynthetic rate. C₃ versus characteristics in marine algae. Storage and Structural Components in Algae: Seaweed polysaccharides, chemical structure, properties and extraction of agar, carrageenan and alginic acid. Low molecular weight compounds in algae knowledge to inculcate skills.

Recommended Text / Reference Books

1. Steward, F.C (1964): Plants at Work (A summary of Plant Physiology) Addison- Wesley Publishing Co., Inc. Reading, Massachusetts, Palo alto, London.
2. Devlin, R.M/(1969) : Plant Physiology, Holt, Rinehart & Winston & Affiliated East West Press (P) Ltd., New Delhi.
3. Noggle, R. & Fritz (1989): Introductory Plant Physiology Prentice Hall of India.

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4. Lawlor.D. W. (1989): Photosynthesis, metabolism, Control & Physiology ELBS/Longmans-London.
5. S. Mayer, Anderson & Bonning(1965): Introduction to Plant Physiology D. Van Nostrand. Publishing Co., N.Y.
6. Mukherjee, S. A.K. Ghosh(1998) Plant Physiology, Tata McGraw Hill Publishers(P) Ltd., New Delhi
7. Sambamurthy A,V,S.S.(2005) : A Text Book of Algae.
8. Stein, J.R. (1973) : Handbook of Phycology and Biochemistry,
9. Stewart, W.D. (1974) : Algal Physiology and Biochemistry

Course Outcomes:

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

CO1: Understand the plant water relationship for local skill development.

CO2: Understand about mineral nutrition and enzymes for skill development, employability and entrepreneurship development globally.

CO3: Understand about photosynthesis and other photosynthetic reactions of plant for skill development.

CO4: Understand about growth and development phases and kinetics for skill development.

CO5: Understand about photosynthesis in marine algae and their chemical structure and properties for 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	2	2	1	1	1	2	3	1	3
CO2	2	3	2	1	2	2	3	2	1	2
CO3	1	2	2	1	2	3	2	2	1	2
CO4	1	2	2	3	2	3	2	2	3	2
CO5	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

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C01	3	2	2
C02	3	2	3
C03	2	2	3
C04	2	3	2
C05	2	3	2

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SYLLABUS
BMB-603 III Clinical Pharmacokinetics

Unit-I: Introduction to Clinical pharmacokinetics: Compartmental and Non compartmental models, Renal and non-renal clearance, Organ extraction and models of hepatic clearance, Estimation and determinants of bioavailability, Multiple dosing, Calculation of loading and maintenance doses. Designing of dosage regimens: Determination of dose and dosing intervals, Conversion from intravenous to oral dosing, Nomograms and Tabulations in designing dosage regimen knowledge to inculcate skills for better employability.

Unit-II: Pharmacokinetics of Drug Interaction: Pharmacokinetic drug interactions, Inhibition and Induction of Drug metabolism, Inhibition of Biliary Excretion. Pharmacogenetics: Genetic polymorphism in Drug metabolism: Cytochrome P-450 Isoenzymes, Genetic Polymorphism in Drug Transport and Drug Targets, Pharmacogenetics and Pharmacokinetic/ Pharmacodynamic considerations. Introduction to Pharmacometrics: Introduction to Bayesian Theory, Adaptive method or Dosing with feedback, Analysis of Population pharmacokinetic Data knowledge to inculcate skills for better employability.

Unit-III: Non Linier Mixed Effects Modelling: The Structural or Base Model, Modeling Random Effects, Modeling Covariate Relationships, Mixture Model, Estimation Methods, Model Building Techniques, Covariate Screening Methods, Testing the model assumptions, Precision of the parameter estimates and confidence intervals, Model misspecification and violation of the model assumptions, Model Validation, Simulation of dosing regimens and dosing recommendations, Pharmacometrics software knowledge to inculcate skills for better employability .

Unit-IV: Altered Pharmacokinetics: Drug dosing in the elderly, Drug dosing in the paediatrics, Drug dosing in the obese patients, Drug dosing in the pregnancy and lactation, Drug dosing in the renal failure and extracorporeal removal of drugs, Drug dosing in the in hepatic failure knowledge o inculcate skills for better employability.

Unit-V: Therapeutic Drug monitoring: Introduction, Individualization of drug dosage regimen (Variability – Genetic, age, weight, disease and Interacting drugs), Indications for TDM, Protocol for TDM, Pharmacokinetic/Pharmacodynamic Correlation in drug therapy, TDM of drugs used in the following conditions: Cardiovascular disease: Digoxin, Lidocaine, Amiodarone; Seizure disorders: Phenytoin, Carbamazepine, Sodium Valproate; Psychiatric conditions: Lithium, Fluoxetine, Amitriptyline; Organ transplantations: Cyclosporine; Cytotoxic Agents: Methotrexate, 5-FU, Cisplatin; Antibiotics: Vancomycin, Gentamicin, Meropenem for developing skills.

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Recommended Text / Reference Books:

1. Leon Shargel, Susanna Wu-Pong, Andrew Yu. Applied Biopharmaceutics & Pharmacokinetics. New York: McGraw Hill.
2. Peter L. Bonate. Pharmacokinetic – Pharmacodynamic Modeling and Simulation. Springer Publications.
3. Michael E. Burton, Leslie M. Shaw, Jerome J. Schentag, William E. Evans. Applied Pharmacokinetics & Pharmacodynamics:
4. Principles of Therapeutic Drug Monitoring. Ippincott Williams & Wilkins.
5. Steven How-Yan Wong, Irving Sunshine. Handbook of Analytical Therapeutic Drug Monitoring and Toxicology. CRC Press, USA.
6. Soraya Dhillon, Andrzej Kostrzewski. Clinical pharmacokinetics. 1st edition. London: Pharmaceutical Press.
7. Joseph T. Dipiro, William J. Spruill, William E. Wade, Robert A. Blouin and Jane M. Pruemmer Concepts in Clinical Pharmacokinetics.
8. American Society of Health-System Pharmacists, USA.

Course Outcomes:

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

CO1: Understand about introduction of clinical pharmacokinetics for skill development at global level.

CO2: Understand about pharmacokinetics and drug interactions for skill development, employability and entrepreneurship development.

CO3: Understand about mixed effect modeling and pharmacometrics software for skill development at global level.

CO4: Understand about altered pharmacokinetics and drug dosing in different conditions for skill development.

CO5: Understand about therapeutic drug monitoring for employability 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	3	2	2	1	1	1	2	3	1	3
CO2	2	3	2	1	2	2	3	2	1	2
CO3	1	2	2	1	2	3	2	2	1	2
CO4	1	2	2	3	2	3	2	2	3	2
CO5	2	2	2	2	1	3	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	3	2	2
CO2	3	2	3
CO3	2	2	3
CO4	2	3	2
CO5	2	3	2

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Syllabus
BMB-602 III ECONOMIC BOTANY

UNIT I: Cultivated Plants: Introduction, Research centres, Concept of centres of origin, their importance with reference to Vavilov's work *for enhancing skills*

UNIT II: Cereals, Millets and Pulses: Wheat, Maize, Paddy, Raagi, Jowar, Cajanus, Dolichos, Cicer, Soyabean and Pisum-Origin, morphology, uses Distribution, family, botanical name, parts used, extraction and processing of the commercially important products *for development of entrepreneurship and to generate employability.*

UNIT III: Spices and Condiments: General account with special reference-Pepper, Clove, Coriander, Ginger, Cardamom, Garlic, Onion, Turmeric, Chilli And Cinnamomum-Botanical name, family, part used, morphology and uses *for development of entrepreneurship and to generate employability.*

UNIT IV: Beverages, Sugar and Oil Yielding Plants: Tea, Coffee, Sugarcane- morphology, processing, uses. Ground nut, Coconut, Oil palm, Sunflower, Sandal wood and Eucalyptus-General description with special reference to groundnut and eucalyptus *for development of entrepreneurship and to generate employability.*

UNIT V: Plants Yielding High Commercial Value Products: General description with special reference to Cotton, Jute, Hevea, Teak, Rosewood, Bogi, Rakta Chandana, Ocimum, Tinospora, Aloe, Rauwolfia, Emblica and Cathranthus *for development of entrepreneurship and to generate employability.*

Recommended Text/ Reference Books

1. Kochhar, S.L. (2017). Economic Botany, Cambridge University Press.
 2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
 3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
- S - Simpson, B. and M. Conner-Ogorzaly. 2001. Economic Botany:Plants in Our World. 3rd Ed. McGraw-Hill, New York.

Course Outcomes:

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

CO1: Understand the definition concept and importance with reference to Vavilov's work *for enhancing skills*

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CO2: Learn the extraction and processing of the commercially important products wheat, maize paddy, sorghum etc *for development of entrepreneurship and to generate local employability.*

CO3: Learn about spices and contaminants, Pepper, Clove, Coriander, Ginger, Cardamom, Garlic, Onion, Turmeric, Chilli etc *for development of entrepreneurship*

CO4: Learn about Beverages, Sugar and Oil Yielding Plants their extraction process and economy related to them.

CO5: Learn about **Plants Yielding High Commercial Value Products** eg- Cotton, Jute, Hevea, Teak *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	2	2	1	1	1	2	3	1	3
CO2	3	2	2	1	2	2	3	2	1	2
CO3	2	2	2	1	2	3	2	2	1	2
CO4	2	3	2	3	2	3	2	2	3	2
CO5	2	3	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	3	2
CO2	3	2	3
CO3	2	1	3
CO4	2	3	2
CO5	2	3	2