UNIVERSITY OF KERALA

SCHEME AND SYLLABUS OF INDUSRTIAL MICROBIOLOGY

For

CAREER RELATED FIRST DEGREE PROGRAMME IN

BIOCHEMISTRY (CORE) & INDUSTRIAL MICROBIOLOGY (VOCATIONAL)

Under

CHOICE BASED CREDIT & SEMESTER SYSTEM

Aim of the Programme:

Microbiology deals with the study of microbes. The Degree programme aims at providing an in depth understanding of the Microbiology, Microbial genetics, physiology of microbes, cell biology, Medical, Environmental, Food and Industrial Microbiology and their experimental aspects. Microbiologists study the interaction of microorganisms with people and how they affect their lives, as well as the roles these organisms play in the environment. The students need to achieve the program specific outcome listed below.

Program Specific Outcome

After successful completion of the programme a student will acquire/develop following competencies:

1. Acquire knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others.

2. Demonstrate key practical skills/competencies in working with microbes for study and use in the laboratory as well as outside, including the use of good microbiological practices.

3. Competent enough to use microbiology knowledge and skills to analyze problems involving microbes, articulate these with peers/ team members/ other stake holders, and undertake remedial measures/ studies etc.

4. Develop a broader perspective of the discipline of Microbiology to enable them to identify challenging societal problems and plan his professional career to develop innovative solutions for such problem

Syllabus for Career related First Degree Programme in B.Sc. Biochemistry and Industrial Microbiology (2a) under CBCS System

Distribution of hours and credits

Semester	Course Title	L	P	C	T
I	English-I	**5**	**-**	**3**	**16**
	Additional language-I	**5**	**-**	**3**	
	IM1121: Foundation course-I Biomolecules (Core)	**3**	**-**	**3**	
	Practical for IM1121 (Core) - P1	**-**	**2**	**-**	
	IM1171-Vocational Course-I- Fundamentals of Microbiology	**3**		**4**	
	Practical for IM1171 (Vocational- P1)		**2**		
	CH 1131.7: Complementary course-I	**3**	**2**	**3**	
II	English-II	**5**	**-**	**3**	**20**
	Additional language-I	**5**	**-**	**3**	
	IM1241: Environmental Studies (Core course I)	**3**		**4**	
	IM1242: Practical -Qualitative analysis of Biomolecules (Core course II) – P-II		**2**	**2**	
	IM1222-Foundation Course-II-(Microbial Taxonomy and Physiology (Vocational)	**3**	**-**	**2**	
	IM1271-– Practical- Microbial physiology & Culture Techniques (Vocational Course -II – P2)	**-**	**2**	**3**	
	CH1231.7 Complementary course-II	**3**	**2**	**3**	
III	English-III	**5**	**-**	**3**	**16**
	IM1341: Analytical Biochemistry and Biophysical Chemistry (Core course-III)	**3**	**-**	**4**	
	Practical for IM1341 (Core) - P3	**-**	**3**	**-**	
	IM1371: Cell Biology (Vocational course-III)	**4**	**-**	**3**	
	IM1372- Microbial genetics and biotechnology (Vocational Course-IV)	**3**		**3**	
	Practical for IM1372- (Vocational-P3)		**2**		
	CH1331.7 Complementary course-III	**3**	**2**	**3**	
	English-IV	**5**	**-**	**3**	
	IM1441: Physiological aspects of Biochemistry and Enzymology (Core course-IV)	**3**	**-**	**3**	

IV	**IM1442: Practical-Quantitative analysis of Biomolecules (Core course-V) - P4**	**-**	**3**	**3**	**24**
	IM1471- Environmental, Soil & Agricultural Microbiology (Vocational Course-V)	**3**	**-**	**3**	
	IM1472 – Food and Diary Microbiology (Vocational course-VI)	**3**	**-**	**2**	
	IM1473 – - Practical- Environmental & Food Microbiology (Vocational course-VII- P4)	**-**	**3**	**3**	
	CH1431.7 Complementary course-IV	**3**	**-**	**3**	
	CH1432.7 Complementary course-V(Chemistry Lab)	**-**	**2**	**4**	
V	**IM1541: Molecular Biology (Core course-VI)**	**2**	**-**	**3**	18
	IM1542: Food Science (Core course-VII)	**2**	**-**	**3**	
	IM1543: Practical- Serum and Food analysis (Core course-VIII) - P5	**-**	**6**	**3**	
	IM1571- Fermentation Technology (Vocational Course-VIII)	**4**	**-**	**3**	
	IM1572: Practical- Industrial Microbiology (Vocational course-IX- P5)	**-**	**6**	**4**	
	IM1551/1552: Clinical approach to life/Lifestyle diseases -Open course (Core) #	**3**	**-**	**2**	
	IM1645 Project (Core/Vocational)		**2***	**-**	
VI	**IM1641: Clinical Biochemistry (Core course-IX)**	**3**	**-**	**3**	26
	IM1642: Metabolism (Core course-X)	**3**	**-**	**4**	
	IM1643: Advanced Biochemistry (Core course-XI)	**3**	**-**	**3**	
	IM1643: Practical-Urine analysis & Hematology (Core course-XII) – P6	**-**	**5**	**3**	
	IM1671: Medical Microbiology (Vocational course-X)	**3**	**-**	**3**	
	IM1672: Practical- Medical Microbiology & Immunology (Vocational course-XI-P6)	**-**	**6**	**4**	
	IM1661: Immunology –Elective course (Vocational)	**2**	**-**	**2**	
	IM1645: Project (Core/Vocational)		**-**	**4**	

Total credits: 120

***1hour- Core Biochemistry, 1hour- Vocational Microbiology**

L-Lecture, P- Practical, C- Credit, TC-Total Credit

Open course is to be studied by students from other departments of the college and will be handled by core (biochemistry) faculty. The department can choose any one of the open courses available in the scheme- either Clinical approach to life or Life style diseases.

Summary of courses and credits of various study components included in the programme.

Study components	Number of courses	Total credits	Total
English	4	12	120
Additional Language	2	6	
Foundation courses	2	5	
Core courses	12	38	
Vocational courses	11	35	
Complementary courses	5	16	
Open courses	1	2	
Elective courses	1	2	
Project	1	4	

Accumulated Total Minimum Credits required for Programmes of study-120 Credits. Minimum Credits for Social Services/Extension Activity-1 Credit. Minimum Duration -6 Semesters.

Scheme of Examination and Evaluation

- Each theory examinations are of 3 hours (for core, vocational, elective and open).
- Practical examination is of six hours duration.
- Evaluation and grading are in accordance with the general guidelines given by the university.
- Evaluation of each course shall be done in percentage score.
- Evaluation shall involve Continuous Evaluation (CE) and End Semester Evaluation (ESE)
- The CE and ESE ratio shall be 1:4 for both Courses with or without practical.
- There shall be a maximum of 80 marks for ESE and maximum of 20 marks for CE

I. Attendance (Max Marks.5): Students who secure a minimum of 75% attendance in the aggregate for all the courses of a semester taken together alone will be allowed to register for End semester evaluation. Others have to repeat the semester along with the next Batch, unless they could make up the shortage of attendance through condonation. However, the award of

grade for attendance in CE shall be made course-wise for practical only. Condonation of shortage of attendance to a maximum of 10 days in a semester subject to a maximum of two times during the whole period of a degree programme shall be granted by the University on valid reasons. This condonation shall not be considered for awarding marks for CE in practicals. Benefits of attendance for a maximum of 10 days in a semester shall be granted to students who participate/attend University Union activities, meeting of the University bodies and extra-curricular activities on production of participation/attendance certificate by University authorities/Principals as in the case may be.

II. Assignments or Seminars: (Max. Marks 5): Each student shall be required to do one assignment or one seminar for each Course. Valued assignments shall be returned to the students. The seminars shall be organized by the teacher/teachers in charge of CE and the same shall be assessed by a group of teachers including the teacher/ teachers in charge of that Course. Assignments/Seminars shall be evaluated on the basis of their quality. The teacher shall define the expected quality of an assignment in terms of structure, content, presentation etc. and inform the same to the students. Due weight shall be given for punctuality in submission. Seminar shall be similarly evaluated in terms of structure, content, presentation, interaction etc.

III. Tests: (Max. marks 10): For each Course there shall be one class test during a semester. Valued answer scripts shall be made available to the students for perusal within 10 working days from the date of the test. The marks of CE shall be consolidated by adding the marks of attendance, Assignment/ Seminar and Test paper respectively for a particular Course.

The allotment of marks for attendance and for practical shall be as follows.

Attendance less than

51 %	- 0 Mark
51% to 60%	- 1 Mark
61% to 70%	- 2 Marks
71% to 80%	- 3 Marks
81% to 90%	- 4 Marks
91% to 100%	- 5 Marks

The marks for the components of Practical for Continuous Evaluation shall be as shown below.

a. Attendance 5 Marks

b. Record 5 Marks

c. Regularity/ consistency 5 Marks

d. Performance 5 Marks

Scheme of Practical Examination

Scheme of Practical Examination- Vocational Microbiology			
Duration :6 Hours Max.Marks:80			
Sl. No.	**Experiment***		**Marks**
	Experiment I		
1.	Principle and procedure		5
2.	**II. Major experiment (1 × 30 = 30 marks)** Principle & Procedure - 5 Marks Demonstration - 15 Marks Result - 5 Marks Interpretation - 5 Marks		30
3.	**III. Minor experiment (1× 10 =10 marks)** Procedure - 2 Marks Demonstration - 13 Marks Result - 3 Marks Interpretation - 2 Marks		20
4.	**IV. Spotters (2x5 bunches/ 1× 10 =10 marks)**		
	Identification & Description	mark	10

5.	**V. Record**	10
6.	**VI. Viva**	5
Total Marks		**80**

PROJECT

Components required: -

Institutional visit (compulsory) + report

Project work (lab work)

Report of the project work done

Viva voce of the work

Scheme for the Evaluation of Project

Weightage may be assigned for various components as follows

1. Rationale of the study
   General background of the study
   Relevance of the study
2. Objective & scope of the study
3. Methodology-Appropriateness & Accuracy
4. Results & Discussion
   Presentation (figures, graphs, legends etc) Analysis
   Relevance/importance
5. References/literature up to latest reports & documentation
6. Conclusion
7. General presentation
   - Free of typographic errors
   - Free of redundant

	Course code	Paper	Duration	Maximum Marks
I	IM 1171	Vocational course- I Fundamental Microbiology	3 hours	80
II	IM1222	FOUNDATION COURSE II- Microbial Taxonomy and Physiology	3 hours	80
	IM 1271	Vocational course- II Microbiology Practical- Microbial Physiology and culture techniques	6 hours X 2 days	80
III	IM1371	Vocational course- III Cell Biology	3 hours	80
	IM1372	Vocational course- IV Microbial Genetics & Biotechnology	3 hours	80
IV	IM 1471	Vocational course- V Environmental, Soil & Agricultural Microbiology	3 hours	80
	IM 1472	Vocational course- VI Food & Diary Microbiology	3 hours	80
	IM 1473	Vocational course- VII Microbiology Practical- Environmental & Food Microbiology Techniques	6 hours X 2 days	80
V	IM 1571	Vocational course- VIII Fermentation Technology	3 hours	80
	IM 1572	Vocational course- IX Microbiology Practical- Industrial Microbiology	6 hours X 2 days	80
VI	IM 1671	Vocational course- X Medical Microbiology	3 hours	80
	IM 1681	Elective course- Immunology- Elective	3 hours	80
	IM 1672	Vocational course- XI Microbiology Practical- Medical Microbiology & Immunology	6 hours X 2 days	80

SEMESTER I

COURSE CODE: IM 1171

VOCATIONAL COURSE I

CORSE TITLE: FUNDAMENTALS OF MICROBIOLOGY

CREDITS: 4 **Total lecture hours- 54 hours (3hours /week)**

PRE – REQUISITE:

Basic knowledge on Microbiology gained during H. Sc.

COURSE OBJECTIVES:

To become familiar with the foundation concepts of history of Microbiology and to understand the structure and functions of a typical prokaryotic cell. To gain the knowledge of microscopy, staining concepts, culture methods and culture media. To understand and implement sterilization techniques and safety measures.

COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

1. Get acquainted with contributions of various scientists. CO1
2. Gain knowledge about microscopy and general characters of microorganisms. CO2
3. Acquainted with staining techniques. CO3
4. Explore basic techniques of microbiology. CO 4
5. Identify the shapes of microbes and cultivate microbes in the lab. CO 5 & CO 6

(CO1 - Remember; **CO2** - Understand; **CO3** - Apply; **CO4** - Analyze; **CO5** - Evaluate; **CO6** Create)

Module-I 9Hours

History, Scope, and relevance of Microbiology–Spontaneous generation theory. Contribution of Anton Van Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming, Joseph Lister, & Edward Jenner.

Module-II 9Hours

Microscopy- Principles & uses of bright field, dark field, phase contrast, confocal, fluorescent, electron microscopy (TEM & SEM). Principles of staining of bacteria- simple staining, Negative staining, Gram's staining, Acid fast staining (Ziehl Neelsen staining), spore staining & staining of metachromatic granules.

Module-III 9Hours

Bioinstrumentation- Principles and applications of common instruments in Microbiology laboratory –Autoclave, Hot air oven, Incubator, colony counter- Biosafety levels and biosafety cabinets.

Module-IV 9Hours

Sterilization and Disinfection – Principles – Methods of Sterilization – Physical methods – Dry heat, Moist heat, Filtration (Membrane & HEPA), Radiation – Chemical Sterilization – Halogens, aldehydes, phenols and their mode of action – Testing of disinfectants -Phenol coefficient test, Rideal walker test

Module-V 9Hours

Culture Media – Solid, Liquid and semisolid – Types of Media – Synthetic and Complex, Enriched, Enrichment, Selective and Differential media, Nutritional requirements of bacteria - (Carbon, Nitrogen, growth factors) Anaerobic culture technique –Mclntosh filde's jar method, gas pak jar. Pure culture techniques – Serial dilution, Pour, Spread and Streak plate, Preservation of culture-short term-serial sub culturing, overlay with mineral oil, long term-lyophilization, cryopreservation, storage in soil

Module-VI 9Hours

Morphology and anatomy of bacterial cell- Cell size, shape, arrangement. Structure of prokaryotic plasma membrane, cell wall, capsule, slime layer, S-layer, flagella, pili, nucleoid, inclusion bodies, endospore. Structure of viruses -T4 bacteriophage.

REFERENCES:

- Microbiology - Pelczar, Chan and Kraig (ISBN 0-07-462320-6)

- Microbiology -Prescott, Harley and Klein (ISBN 0-07-111217-0)
- Microbiology-Bernard D Davis
- Foundations in Microbiology-Talaro and Talaro
- Essentials of Microbiology (Sixth edition) - Purohit and Singh (ISBN 81-85031-67-3)
- Ananthanarayanan R and CK Jayaram Panicker. (2017). Textbook of microbiology, 10thEd. Orient Longman.
- Dubey, R.C. & D.K. Maheshwari, (2010). A text Book of Microbiology. S. Chand & Co.
- Tauro P., Kapoor, K.K. Yadav, K.S. An introduction to Microbiology 1st Ed., New Age International Publishers
- Brock Biology of Microorganisms by M. Madigan, K. Bender, D. Buckley, W. Sattley, D. Stahl. 15th
- Edition. Pearson Education. 2018. 3. Alcamo's Fundamentals of Microbiology by J. C. Pommerville. 10th Edition. Jones and Bartlett Learning. 2013.

E-RESOURCES:

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1089622/pdf/amjphealth00130-0063.pdf
- https://nptel.ac.in/courses/102/103/102103015/
- https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Kaiser)/Unit_1%3A_Introduction_to_Microbiology_and_Prokaryotic_Cell_Anatomy/1%3A_Fundamentals_of_Microbiology
- http://www.wales.nhs.uk/sitesplus/888/agordogfen/149787
- http://ecoursesonline.iasri.res.in/course/view.php?id=108
- https://www.cliffsnotes.com/study-guides/biology/microbiology/microbial-cultivation-and-growth/microbial-cultivation
- https://nios.ac.in/media/documents/dmlt/Microbiology/Lesson-04.pdf
- https://www.bellarmine.edu/faculty/dobbins/Secret%20Readings/Lecture%20Notes%20113/chapt13_lecture1.pdf

SEMESTER I

PRACTICAL FOR IM 1171

VOCATIONAL PRACTICAL -I

CREDIT - 0 **Total Hrs-36 (2Hrs /week)**

PRE- REQUISITE:

Basic knowledge on Microbiology gained during H. Sc

COURSE OBJECTIVES:

This course develops the concepts of methodology involved in studying the different components of microbial cell and various techniques and instruments used in Microbiology laboratory isolation, visualization and handling of microorganisms

COURSE OUTCOME:

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

Get acquainted to the laboratory precautions and techniques to be followed in

1. General microbiology laboratory. CO2
2. Understand the working of common instruments in Microbiology laboratory. CO2
3. Understand the preparation of media used in Microbiology laboratory. CO3
4. Identify microscopic morphology of microorganisms. CO4
5. Acquire skills to isolate microorganisms. CO3, CO6
6. Understand the cultural characteristics of microorganisms. CO2, CO3

(**CO1** - Remember; **CO2** - Understand; **CO3** - Apply; **CO4** - Analyze; **CO5** - Evaluate; **CO6** Create)

EXPERIMENTS:

Part I (18hrs)

1. Laboratory precautions- General rules and regulations.
2. Common instruments in Microbiology laboratory.
3. Cleaning and sterilization of glass wares.
4. Preparation of media.
5. Isolation of pure culture — Isolation of bacteria by pour plate, streak plate and spread plate methods.
6. Cultural characteristics of Microorganisms - Colony morphology on culture plate

Part II (18hrs)

7. Study of the various components of the microscope, its handling and maintenance.
8. Preparation of bacterial smear
9. Staining of bacteria:
10. Simple staining of bacteria,
11. Gram staining,
12. Negative staining,
13. Spore staining,
14. Volutin granule staining
15. Motility of bacteria by hanging drop method.
16. Lactophenol cotton blue mounting of fungi and study of fungal microscopic characteristics

REFERENCES:

- Dubey R C and Maheswari, D K (2002). Practical Microbiology. S. Chand & Co Ltd. (ISBN 81-219-2153-8)
- Microbiology *A Laboratory Manual* - James G Cappucino Natalie Sherman (ISBN 81-297- 0265-7)
- Experiments in Microbiology Plant Pathology and Biotechnology- K. R. Aneja

- William Claus. G.W. (1989). Understanding Microbes – A Laboratory textbook for Microbiology, W.H. Freeman and Co., New York.

SEMESTER II

COURSE CODE: IM 1222

FOUNDATION COURSE II - (VOCATIONAL)

CORSE TITLE: MICROBIAL TAXONOMY AND PHYSIOLOGY

CREDITS - 3 **Total lecture hours- 54 hours (3hours/week)**

PRE - REQUISITE:

Basic knowledge of microorganisms during the first year of this programme.

COURSE OBJECTIVES:

The major objective of this paper is to develop clear understanding of taxonomical classification of Microorganisms, various aspects of microbial physiology, growth, nutritional requirement and nutritional classification and energy generation.

COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

1. Know about basics of microbial classification, taxonomy. CO 2
2. Explore the taxonomy, characters, life cycle and economic importance of Fungi, algae, protozoa with representative types. CO3
3. Gain knowledge about growth and key factors influencing the growth of microorganisms. CO 3
4. Distinguish the Microorganisms based on their nutritional requirements and transport mechanisms of nutrients uptake CO 4
5. Be acquainted applications of bioluminescence CO 4

(**CO1** - Remember; **CO2** - Understand; **CO3** - Apply; **CO4** - Analyze; **CO5** - Evaluate; **CO6** Create)

Module-I **12 Hours**

Classification of microorganisms- Criteria for classification-morphological, Nutritional, ecological, molecular. Numerical taxonomy, matching coefficients, dendrogram, phylogenetic tree. Phylogenetic relationship. Major systems of classification. Three-kingdom and Five kingdom classification. Bergy's manual (Brief account)

Module-II **10 Hours**

General characters & Classification of fungi-with examples (Ascomycetes, Chytridiomycota Basidiomycetes, Zygomycetes, Deutoromycetes- brief account). Classification of algae-(green algae, brown algae and diatoms with examples). Classification of protozoa-(Sarcodina, Mastigophora, Rhizopoda, Ciliata, Sporozoa, Amoebas)

Module-III **10 Hours**

Bacterial growth- Different phases of growth- Bacterial growth curve- Generation time-Binary fission, factors affecting bacterial growth (Temperature, pH, pressure, salt concentration, nutrients, oxygen concentration). Batch, continuous culture, Fed batch, Synchronous growth.

Module-IV **12 Hours**

Nutritional classification of bacteria based on - Carbon source- Autotrophs, Heterotrophs, Energy source – Phototrophs, Chemotrophs, and Electron source - Lithotrophs Organotrophs-Major Nutritional Types of Bacteria- Photolithotrophic autotrophy, Photoorganotrophic heterotrophy, Chemolithotrophic autotrophy, Chemoorganotrophic heterotrophy- Bacterial Photosynthesis -: photosynthetic pigments in prokaryotes-oxygenic and anoxygenic photosynthesis in prokaryotes-light and dark reaction.

Module-V **10 Hours**

Uptake of nutrients by bacteria- Passive diffusion, facilitated diffusion, active transport- ABC transport, symport, antiport, group translocation- sugar phosphotransferase system (PTS), Iron uptake. Bioluminescence and its Applications.

REFERENCES:

- Microbiology - Pelczar, Chan and Kraig (ISBN 0-07-462320-6)

- Microbiology -Prescott, Harley and Klein (ISBN 0-07-111217-0)
- Essentials of Microbiology-Purohit and Singh
- Brock's Biology of Microorganisms-Mardigon Martinko And Parker
- Microbial Genetics-Frifielder
- Microbiology-Zins
- Dubey R.C. and Maheshwari, (2010). Text book of Microbiology, S.Chand Publications.
- Doelle. H.W (1975). Bacterial Metabolism. 2ndEd. Academic Press.
- Moat. A.G. J.W.Foster, (1988). Microbial physiology. 2ndEd. Springer – Verlag.
- David White, (2011). The Physiology and Biochemistry of Prokaryotes, 4thEd.Oxford University Press.
- Atlas & Atlas. Microbiology. Pearson Publications. 4thEd.
- Gerard J. Tortora, Berdell R. Funke & Christine L. Case, (2013). Microbiology - An Introduction 11thEd. Pearson
- Joanne Willey and Kathleen Sandman and Dorothy Wood, (2020). Prescott‟s Microbiology 11thEd. Wm, C. Brown publishers

E-RESOURCES:

- https://facultystaff.richmond.edu/~lrunyenj/bio384/lecturenotes/ch5.pdf
- https://www.weizmann.ac.il/SAERI/sites/AERI/files/photosynthesislecture.pdf
- https://microbenotes.com/classification-of-bacteria-on-the-basis-of-nutrition/
- https://nios.ac.in/media/documents/dmlt/Microbiology/Lesson-03.pdf
- http://www.uobabylon.edu.iq/eprints/publication_10_1062_180.pdf

SEMESTER II

COURSE CODE: **IM 1271**

VOCATIONAL COURSE II- PRACTICALS (P-2)

MICROBIAL PHYISIOLOGY & CULTURE TCHNIQUES

CREDITS - 3 **Total Hrs-36 (2Hrs /week)**

PRE- REQUISITE:

Basic knowledge of microorganisms during the first semester of this programme.

COURSE OBJECTIVES:

To gain skill in isolation and enumeration of microorganisms from various samples and to understand the identification of microorganisms using biochemical tests.

COURSE OUTCOME:

1. Identify standard methods for the isolation, identification and culturing of microorganisms. CO3 &CO4
2. Comprehend the ubiquitous nature of microorganisms and identify the different groups of microorganisms from different habitats and their applications. CO3 &CO4
3. Carry out experiments to evaluate effect of physical and chemical factors on microbial growth. CO3 &CO4

(CO1- Remember; CO2 - Understand; CO3 - Apply; CO4 - Analyze; CO5 - Evaluate; CO6 – Create)

EXPERIMENTS:

Part I (18 hrs)

1. Isolation and enumeration of bacteria from soil.
2. Isolation and enumeration of bacteria from Water.
3. Isolation and enumeration of bacteria from Air.
4. Biochemical tests- IMViC
5. Sugar fermentation
6. Urease test
7. TSI

8. Catalase and Oxidase

Part II (18hrs)

9. Candle jar method for cultivation of anaerobic bacteria.
10. Slide culture technique for fungi
11. Measurement of fungal growth by colony diameter method.
12. Germicidal effect of ultra violet light on bacterial growth.
13. Effect of different disinfectants and antiseptics on bacterial growth.

REFERENCES:

- Dubey R C and Maheswari, D K (2002). Practical Microbiology. S. Chand & Co Ltd. (ISBN 81-219-2153-8)
- Microbiology *A Laboratory Manual* - James G Cappucino Natalie
- Sherman (ISBN 81-297- 0265-7)Experiments in Microbiology Plant Pathology and Biotechnology- K. R. Aneja

SEMESTER III

COURSE CODE: IM 1371

VOCATIONAL COURSE III

COURSE TITLE: CELL BIOLOGY

CREDITS -3 **Total lecture hours- 72hrs (4hrs/week)**

PRE- REQUISITE:

Basic knowledge of prokaryotic and eukaryotic cell structures acquired during HSc and first year of this programme

COURSE OBJECTIVES:

This course is intended to provide the basic understanding of structures and purposes of basic components of cell membranes, different cell organelles, cellular communication, cell division and its regulation

COURSE OUTCOME:

On the successful completion of the course, student will be able to:

1. Recall the origin of life and history of cytology and draw the structure of cell organelles and locate its parts along with functions. CO 2
2. Distinguish the structure of prokaryotic and eukaryotic cell. CO2
3. Students will understand and describe the structure and basic components of prokaryotic and eukaryotic cells. CO2
4. Explain the communications of cells with other cells and to the environment. CO2
5. Compare and contrast the events of cell cycle and its regulation. CO4
6. Design the model of a cell. CO6

(**CO1**- Remember; **CO2** - Understand; **CO3** - Apply; **CO4** - Analyze; **CO5** - Evaluate; **CO6** – Create)

Module-I **12 Hours**

Introduction to cell biology: Brief introduction on theory biogenesis and abiogenesis, Early conditions on earth- Haldane and Oparin theory of the origin of life, Urey-Miller experiment, Fox's experiments. Robert Hooke –Discovery of cells and the cell theory. Ultrastructure of prokaryotic cell wall and plasma membrane- peptidoglycan layer, fluid mosaic model.

Module-II **12 Hours**

Fundamentals of cell biology: difference between prokaryotic and eukaryotic cell, ultrastructure of eukaryotic cell- Structure and functions of subcellular organelles- nucleus, mitochondria, chloroplast, ribosomes, Endoplasmic reticulum, Golgi bodies, lysosomes, microfilaments, microtubules, glyoxysomes and peroxisomes.

Module-III **12 Hours**

Cell-cell interactions- definition, cell junctions- tight junctions, gap junction, desmosomes, hemi desmosomes. Cell-cell adhesion- definition, cell adhesion molecules (CAM's)-integrins,

immunoglobulin (Ig) superfamily, cadherins, and selectins. Cell-cell signaling- autocrine, paracrine, juxtacrine, and endocrine. Role of bacterial cell signaling in virulence and pathogenesis.

Module-IV **12 Hours**

Apoptosis- definition, mechanism- intrinsic and extrinsic pathway, difference between apoptosis and necrosis. Cell cycle, cell cycle check points. Analysis of cell cycle by flow cytometry. Cell division- mitosis and meiosis- different stages.

Module-V **12 Hours**

Chromosomal changes and cytogenetics: Chromosomal aberrations- structural aberrations, and numerical aberration. Gene mutations- complementation test, chromosome preparation, G-Banding, FISH. Disorders associated with chromosomal aberrations -Philadelphia chromosome. Lampbrush chromosomes.

Module-VI **12Hours**

Chromosome structure, types of chromosomes, special type of chromosomes- polytene, lamp brush. Chromatin organization- nucleosome, plectonemic and solenoid model. Oncogenes and tumor suppressor genes.

REFERENCES:

- Cell and Molecular Biology by Gerald Karp, John Wiley & Son, Inc. New York
- Principles of Genetics by D. Peter Snustad and Michael J Simmons, John Wiley & Son,
- Biochemistry by Lubert Stryer, W.H Freeman and Company, New York
- Cell and Molecular Biology by De Robertis & De Robertis,jr.

E-RESOURCES:

- https://www.ncbi.nlm.nih.gov/books/NBK9841/
- https://sta.uwi.edu/fms/MDSC1001/THECELL.pdf
- http://yengage.yenepoya.edu.in/idata/YenepoyaUniversity/ilFile/58/file_5807/001/cell%20-%20HPK%20to%20JD%20to%20GP.pdf
- https://www.ncbi.nlm.nih.gov/books/NBK9851/
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2117903/

- https://www.ncbi.nlm.nih.gov/books/NBK115545/

SEMESTER III

COURSE CODE: IM 1372

VOCATIONAL COURSE- IV

COURSE TITLE: MICROBIAL GENETICS AND BIOTECHNOLOGY

CREDITS - 3 **Total lecture hours- 54hrs (3hrs/week)**

PRE- REQUISITE:

Basic knowledge of microorganisms during the first year of this programme.

COURSE OBJECTIVES:

To become familiar with the foundation concepts of microbial genetics and to understand the importance of replication, transcription, translation, mutation and repair in the cell. To gain the knowledge of recombinant DNA technology and its applications and also to acquaint knowledge about animal cell culture, plant tissue culture techniques and basic knowledge on intellectual property rights.

COURSE OUTCOME:

On the successful completion of the course, student will be able to:

1. Recall the origin of life and history of cytology and draw the structure of cell organelles and locate its parts along with functions CO2
2. Distinguish the structure of prokaryotic and eukaryotic cell CO2

3. Students will understand and describe the structure and basic components of prokaryotic and eukaryotic cells. CO2
4. Explain the communications of cells with other cells and to the environment. CO2
5. Compare and contrast the events of cell cycle and its regulation. CO4

(**CO1** - Remember; **CO2** - Understand; **CO3** - Apply; **CO4** - Analyze; **CO5** - Evaluate; **CO6** – Create)

Module-I **9 Hours**

Evidence of DNA as genetic material- Griffith's transformation experiment, Bernard Davis *U*-tube experiment, Hershey and chase experiment. DNA replication- pattern of replication- definition, Meselson and Stahl experiment. Prokaryotic replication & its types: φ- Theta mode and σ-sigma mode or rolling circle model of replications. Genes, Alleles, Multiple alleles, genotype, phenotype, dominance, co-dominance, linkage- definition.

Module-II **9 Hours**

Plasmids and its types- fertility F-plasmids, resistance plasmids, virulence plasmids, degradative plasmids, and Col plasmids. Different method used for introducing foreign DNA into the cell: DNA direct transformation, electroporation, Microinjection and biolistic methods.

Module-III **9 Hours**

Gene transfer mechanisms- Transformation, conjugation, F-factor, high frequency recombination (Hfr) strains; F^+, F^-, F prime (F'); transduction - generalized transduction; abortive transduction; specialized transduction. Ames test & its significance

Module-IV **9 Hours**

Animal cell tissue culture- Animal cell culture media and its type, primary culture, cell lines & its types- finite cell lines, continuous cell lines, monolayer and suspension cultures, organ culture. Maintenance of cell lines-Contamination of cell lines, replacement of Medium and subculture. Applications of animal tissue culture.

Module-V **9 Hours**

Plant cell tissue culture- Media components. Plant tissue culture techniques- explant, callus culture, cell or suspension culture- filter paper raft nurse tissue technique, micro chamber technique, protoplast culture and somatic hybridization. Applications of plant tissue culture. Brief account on transgenic plants- Herbicide resistant plants (Glyphosate tolerant plants), insect resistant plants (transgenic plants with Bt Toxin), Transgenic animals (transgenic mice)

Module-VI **9 Hours**

Intellectual property: Intellectual property rights- Patents - Types of patents, Criteria for patentability, the process of patenting, trade secrets, copyrights & trademarks.

REFERENCES:

- Molecular Biology of the Gene by Watson, JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AAM.
- Genes V by Lewin B, 1994. Oxford University press.
- Molecular Cell Biology by Lodish, H, Baltimore D, Berk A, Zipursky SL, Matsudaira P, Darnell J.
- Molecular Biology by Freifelder D., 1991 Narosa Publishing Home.
- Principles of Gene Manipulation, 4th Ed., by R.S.Old and S.B.Primrose.
- Principles of Genetics by Gardner EJ, Simmons MJ, Snustad DP.
- Genes and Genomes by Singer M, Berg P.1991 University Science Books.

E-RESOURCES:

- https://www.onlinebiologynotes.com/types-of-plant-tissue-culture/#:~:text=Tissue%20and%20cells%20cultured%20in,enzymatic%20(pectinase%20solutions)%20means.
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7325846/
- https://www.icsi.edu/media/website/IntellectualPropertyRightLaws&Practice.pdf
- https://www.bits-pilani.ac.in/Uploads/MicroModule/2011-12-12--7-46-19-276_Patent_ManualOct_25th_07.pdf

SEMESTER III

PRACTICAL FOR IM 1372

VOCATIONAL PRACTICAL-P3

CREDITS - 0 **Total lecture hours- 36 hrs.**
(2hrs/week)

PRE- REQUISITE:

Basic knowledge of microorganisms during the first year of this programme

COURSE OBJECTIVES:

The objective of this course is to train the student in basic molecular biology and microbial genetics techniques. The student will learn how to isolate and analyze, DNA and plasmids. The student will become familiar with transferring genetic material into bacteria by transformation and conjugation methods, plant tissue culture, mushroom cultivation and bioassay for evaluating mutagen or carcinogen.

COURSE OUTCOME:

1. Is able to perform agarose gel electrophoresis. CO3, CO5
2. Is able to isolate antibiotic resistant bacterial population. CO3, CO5
3. Is able to perform replica plate technique CO4, CO5
4. Is able to isolation genomic and plasmid DNA. CO3
5. Learns to set up bacterial recombination CO2

(**CO1** - Remember; **CO2** - Understand; **CO3** - Apply; **CO4** - Analyze; **CO5** - Evaluate; **CO6** – Create)

EXPERIMENTS:

Part I (18 hrs)

1. Isolation of antibiotic resistant bacterial population by gradient plate method.
2. Isolation of streptomycin resistant mutant by replica plate technique
3. Isolation of plasmid DNA.

4. Preparation of genomic DNA from bacteria.
5. Principle and application of agarose gel electrophoresis.

Part II (18hrs)

6. Plant regeneration from callus or plant tissue.
7. Mushroom cultivation.
8. Bioassay for evaluating the mutagen or carcinogen by Ames test.
9. Demonstration of genetic recombination in bacteria by conjugation.
10. Demonstration of Bacterial transformation.

REFERENCES:

- Dubey R C and Maheswari, D K (2002). Practical Microbiology. S. Chand & Co Ltd. (ISBN 81-219-2153-8)
- Lab manual in Biochemistry, Immunology and Biotechnology-Arti Nigam, Archana Ayyagari (ISBN 13:978-0-07-061767-4)
- Experiments in Microbiology Plant Pathology and Biotechnology- K. R. Aneja
- Molecular Cloning: A Laboratory Manual, Volume 1& 2: Joseph Sambrook, David William Russell

SEMESTER IV

COURSE CODE: IM1471

VOCATIONAL COURSE –V

ENVIRONMENTAL, SOIL AND AGRICULTURAL MICROBIOLOGY

CREDITS - 3 **Total lecture hours- 54hrs (3hrs/week)**

PRE- REQUISITE:

Basic knowledge of microorganisms during the first year of this programme.

COURSE OBJECTIVES:

The major objective of this paper is to impart knowledge about structure, composition and functioning of microbial communities of diverse environment and to become familiar with basics of microbial interactions, and also to understand the use of microbial population in agriculture, mineral recovery, management of various types of pollutants and conversion processes of various types of wastes into value added products.

COURSE OUTCOME:

On the successful completion of the course, student will be able to:

1. Know about basics of Microorganisms interactions CO2
2. Gain knowledge about solid and liquid waste management CO 3
3. Gain knowledge about role of microorganisms in Biogeochemical cycling CO2
4. Gain knowledge about the application of microorganisms in agriculture CO3
5. Understand about different plant diseases and their management CO2 & CO3

(**CO1** - Remember; **CO2** - Understand; **CO3** - Apply; **CO4** - Analyze; **CO5** - Evaluate; **CO6** – Create)

Module-I **9 Hours**

Microorganisms as components of ecosystem-as producers and decomposers, Microbial interactions- Mutualism, Proto-cooperation, Commensalism, Predation, Parasitism, Amensalism, Competition. Bacterial life in extreme environments & effect of temperature, pH, pressure, salt, radiation.

Module-II **9 Hours**

Waste management– Waste- types; Solid waste - treatment of solid waste – composting, incineration, land filling. Liquid waste - Conventional methods of treatment of liquid waste- House hold sewage treatment – septic tank, imhoff tank, cess pool. Municipal sewage treatment-primary, secondary and tertiary, disinfection.

Module-III **9 Hours**

Bioremediation- xenobiotic compounds, Degradation of pesticides, detergents, lignin, petroleum and hydrocarbon compounds. Microbes in mining- Bacterial leaching.

Module-IV **9 Hours**

Biogeochemical cycling- Role of microorganisms in carbon cycle- organic matter decomposition, humus formation, phosphorous cycle, iron cycle, sulfur cycle- Winogradsky column and nitrogen cycle-nitrogen fixation -symbiotic, non-symbiotic.

Module-V 9 Hours

Rhizosphere and Rhizoplane concept. Mycorrhizae – brief account of ectomycorrihizae, endo mycorrhizae and ecto-endo mycorrhizae. Applications of mycorrhizal fungi. Biofertilizers-brief account of production and application of *Rhizobium, Azotobacter, Azospirillum and cyanobacteria.*

Module-VI 9 Hours

Plant pathology- Symptoms, etiology, epidemiology and management of the following plant diseases: mosaic disease of tobacco, bunchy top of banana, bacterial blight of paddy, phytophthora disease of coconut, leaf spot of paddy and citrus canker.

REFERENCES:

- Microbial Ecology Fundamentals and applications – Atlas and Bartha (ISBN 981-405-344-9)
- Environmental Microbiology- K.Vijaya Ramesh (ISBN 81-8094-003-9)
- Agricultural Microbiology- Rangaswamy G, D.J. Bhagyaraj (ISBN-81-203-0668-6)
- Soil Microbiology an *exploratory approach* – Mark S.Coyne (ISBN 981-240-203-9)
- Introduction to Soil Microbiology –Alexander
- Soil Microbiology-Waksman
- Soil Microorganisms And Its Growth-N.S. Subba Rao
- Biofertilizers in Agriculture- Subha Rao

E-RESOURCES:

- https://www.soinc.org/sites/default/files/uploaded_files/417_MICROBES_AND_ECOLOGY.pdf
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4187170/#:~:text=Extremophiles%20include%20members%20of%20all,bacteria%2C%20archaea%2C%20and%20eukarya.&text=Among%20bacteria%2C%20the%20best%20adapted,ice%20to%20continental%20hot%20springs.
- https://www.thebalancesmb.com/waste-treatment-and-disposal-methods-2878113
- https://www.intechopen.com/books/biodegradation-life-of-science/pesticide-

biodegradation-mechanisms-genetics-and-strategies-to-enhance-the-process

- https://openoregon.pressbooks.pub/envirobiology/chapter/3-2-biogeochemical-cycles/
- https://www.onlinebiologynotes.com/biofertilizer-advantages-types-methods-of-application-and-disadvantages
- https://www.ag.ndsu.edu/pdl/documents/common-ND-plant-diseases.pdf

SEMESTER IV

COURSE CODE: IM 1472

VOCATIONAL COURSE –VI

FOOD AND DAIRY MICROBIOLOGY

CREDITS - 2 **Total lecture hours- 54hrs (3hrs/week)**

PRE-REQUISITE:

Basic knowledge of microorganisms during the first year of this programme.

COURSE OBJECTIVES:

The course will enable students to understand the importance of microorganisms in food and dairy industry. The course will teach the strategies to develop various fermented and non-fermented products using microorganisms and also the role of microbes in food spoilage, preservation, Good manufacturing practices, principle of HACCP and various food borne diseases.

COURSE OUTCOME:

On the successful completion of the course, student will be able to:

1.	Understand the role of Microbes in food.	CO 2
2.	Familiarize the preservation techniques in food.	CO2 &CO3
3.	Create awareness about spoilage of food by microbes	CO3 &CO4
4.	Gain acquaintance about fermented foods	CO3 &CO6
5.	Get the knowledge about food borne diseases and their outbreaks	CO4 &CO5

(**CO1** - Remember; **CO2** - Understand; **CO3** - Apply; **CO4** - Analyze; **CO5** - Evaluate; **CO6** – Create)

Module-I **10 Hours**

Food as a substrate for microorganisms, Importance of food and dairy Microbiology. Source of contamination (primary sources) – Factors influencing microbial growth in foods. Extrinsic- pH, moisture, oxidation-reduction potential, Intrinsic- nutrient content, inhibitory substance and biological structure.

Module-II **10 Hours**

Importance of microbes in food industry- Fermented food products by microbes: bread, Fermented vegetables- sauerkraut, pickles, Alcoholic beverages- beer, wine, Fermented milk products- cheese, yogurt. Microorganisms as food-SCP.

Module-III **10 Hours**

General principles underlying spoilage, Spoilage of different kinds of foods- cereals, vegetable and fruits, meat, fish, eggs, poultry, bread, wine. Food Poisoning Bacterial (Escherichia, Salmonella) (b) Fungal: Mycotoxins (c) Viral: Hepatitis A, (d) Protozoa – Amoebiasis.

Module-IV **12 Hours**

Spoilage of milk and dairy products: milk borne infections (Brucella, *Mycobacterium bovis*) Pasteurization methods in milk, Bacteriological Examination of Milk-Enumeration of viable bacteria, MBRT, Resazurin test, Phosphatase Test.

Module-V **12 Hours**

Food preservation: Principles of food preservation – methods of preservation. Physical (irradiation, drying, heat processing, chilling and freezing, high pressure and modification of atmosphere). Chemical preservation- (Sodium benzoate Class I & II). Food Sanitation: Personnel hygiene, Good manufacturing practices (GMP), Hazard Analysis Critical Control Products (HACCP).

REFERENCES:

- Food Microbiology by Adams, M.R. and Moss, M.O.1995. The Royal Society of Chemistry, Cambridge.

- Food Microbiology by Frazier, W.C. and Westhoff, D.C.1988. TATA McGraw Hill Publishing company ltd., New Delhi.
- Modern Food Microbiology by Jay, J.M.1987. CBS Publishers and distributors, New Delhi.
- A Modern Introduction to Food Microbiology by Board, R.C.1983. Blackwell Scientific Publications, Oxford.
- Dairy Microbiology by Robinson, R.K.1990. Elsevier Applied Science, London.
- Food Poisoning and Food Hygiene, Hobbs, B.C. and Roberts, D.1993. Edward Arnold. London

E-RESOURCES:

- https://www.biotechnologynotes.com/food-biotechnology/microorganisms-in-food/growth-ofmicroorganisms-in-food-intrinsic-extrinsic-factors-biotechnology/14135
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6723656/
- http://faculty.weber.edu/coberg/class/3853/3853%20mos%20and%20food%20spoilage%20notes.htm
- https://www.intechopen.com/books/poisoning-from-specific-toxic-agents-to-novel-rapid-and-simplified-techniques-for-analysis/food-poisoning-caused-by-bacteria-food-toxins-
- http://www.midnaporecollege.ac.in/RemoteClass/Microbial%20spoilage%20of%20milk.pdf
- https://foodsafetyhelpline.com/what-are-the-different-methods-of-food-preservation/

SEMESTER IV

COURSE CODE: IM 1473

VOCATIONALCOURSE VII- PRACTICAL-P4

COURSE TITLE: ENVIRONMENTAL & FOOD MICROBIOLOGY TECHNIQUES

CREDITS - 3 **Total lecture hours- 54hrs (3hrs/week)**

PRE- REQUISITE:

Basic knowledge of microorganisms during the first year of this programme

COURSE OBJECTIVES:

The course impact knowledge to students on water quality analysis, isolation of N2 fixing microorganisms, management different diseases of plants caused by microorganisms and also to gain knowledge on various methods of microbial analysis of food and dairy products.

COURSE OUTCOMES:

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

1. Acquire knowledge about water quality analysis. CO3, CO4
2. Acquire knowledge about the isolation of N2 fixing microorganisms. CO3
3. Acquire knowledge about the management different diseases of plants caused by microorganisms. CO3, CO4
4. Acquire knowledge about milk quality analysis. CO3, CO4
5. Acquire knowledge about the microbiological examination of different kinds of food. CO3, CO4

(**CO1** - Remember; **CO2** - Understand; **CO3** - Apply; **CO4** - Analyze; **CO5** - Evaluate; **CO6** – Create)

EXPERIMENTS:

Part I (27 hrs)

1. Determination of Biochemical oxygen Demand (BOD) of water.
2. Determination of Chemical oxygen Demand (COD) of water.
3. Bacteriological examination of water by multiple tube fermentation test.
   a. Presumptive coliform test
   b. Confirmed coliform test
   c. Completed coliform test)
4. Isolation & culturing of *Rhizobium* from root nodules of higher plants.
5. Study of the following disease

   (a)Tobacco mosaic disease, (b) Bacterial blight of paddy,

   (c) Leaf spot of mulberry, paddy (d) Bunchy top of banana,

   (e) Citrus canker

Part II (27 hrs)

6. Determination of number of bacteria in milk by standard plate count.
7. Determination of quality of a milk sample by MBRT, phosphatase test.
8. Determination of TDT and TDP Effect of pH on bacterial growth.
9. Effect of salt concentrations on bacterial growth.
10. Microbiological examination of foods-
    a. Isolation and enumeration of bacteria and fungi from spoiled vegetables,
    b. Isolation and enumeration of bacteria and fungi from spoiled fruits
    c. Isolation and enumeration of bacteria and fungi from Spoiled fish or meat.
    d. Isolation and enumeration of bacteria and fungi from soft drinks.

REFERENCES:

- Dubey R C and Maheswari, D K (2002). Practical Microbiology. S. Chand & Co Ltd. (ISBN 81-219-2153-8)
- Experiments in Microbiology Plant Pathology and Biotechnology- K. R. Aneja.

SEMESTER V

COURSE CODE: IM 1571

VOCATIONAL COURSE – VIII

COURSE TITLE: FERMENTATION TECHNOLOGY

CREDITS - 3 **Total lecture hours- 72hrs (4hrs/week)**

PRE- REQUISITE:

Knowledge of microorganisms studied during the first & second year of this programme.

COURSE OBJECTIVES:

The course will enable students to apply the learning of microbiology concepts toward the exploitation of microbial population for industrial and human benefits. The strategies for development of microbial strains, process optimization, large scale production and product recovery will be covered for industrially relevant microbial products.

COURSE OUTCOME:

On the successful completion of the course, student will be able to:

1. Screen and isolate beneficial microorganisms from the environment. CO3
2. Understand about strain improvement techniques CO2
3. Understand the parts and design of fermenter CO2
4. Gain theoretical knowledge on production of microbial products. CO2
5. Gain knowledge about different techniques of fermentation product recovery CO2
6. Gain knowledge about different microorganisms important in food industry CO2

(**CO1** - Remember; **CO2** - Understand; **CO3** - Apply; **CO4** - Analyze; **CO5** - Evaluate; **CO6** – Create)

Module-I **12 Hours**

Fermentation technology - isolation, screening techniques- primary and secondary and strain improvement of industrially important microorganisms- Mutation, Recombination and protoplast fusion. Media for industrial fermentation, sterilization of fermenter and media, inoculum preparation, types of fermentation -single, batch, continuous, dual or multiple, solid- state and submerged fermentation.

Module-II **12 Hours**

Design and parts of fermenter - body construction- agitator, sparger, baffles, pH control sensor, stirrer glands and bearings, temperature control difference in fermentation process of biomass, chemicals and conversion products- comparative brief account. Cell and enzyme immobilization.

Module-III **12 Hours**

Recovery of fermentation product (Down-stream processing) - Methods for cell lysis, Physical separation, liquid liquid extraction, Precipitation, chromatography, drying.

Module-IV 12 Hours

Microbial products - raw materials, organism and industrial process involved in the production of penicillin, streptomycin, ethanol, acetone and butanol, , vitamin B12, riboflavin, alpha lysine, amylase, protease, pectinase, citric acid. Biopesticide production

Module-V 12 Hours

Microbes in food industry - bacteria (lactics, acetics, proteolytic and lipolytic bacteria, Thermophillic and thermoduric bacteria, pigmented bacteria and coliform bacteria), molds (*Mucor, Rhizopus, Penicillium, Aspergillus* and yeasts (Genus Saccharomyces, Zygosaccharomyces, Genus candida & salt tolerant yeast). Production of SCP.

Module-VI 12 Hours

Fermentation - Bacteria grouped according to major products of glucose, dissimilation-Lactic acid fermentation, Homolactic fermentation, Heterolactic fermentation, Ethanolic fermentation, and propionic acid fermentation, mixed acid, fermentation, Butanediol fermentation and butyric acid fermentation. Amino acid fermentation (stickland reaction). Pasteur effect.

REFERENCES:

- Industrial Microbiology - L.E. Casida,JR (ISBN 0 85226 1012).
- Industrial Microbiology-A.H.Patel (ISBN 0333 90842 2).
- Prescott & Dunn's Industrial Microbiology Reed G (Ed) ISBN 81-239-1001-0) (Fourth
- Edition).
- Food Microbiology-William C.Frazier Dennis .C Westhoff (ISBN 0-07-46210147).
- Fermented foods Economic Microbiology Vol 7 Rose A (ed).
- Manual of Industrial Microbiology And Biotechnology, Demin & Davis.
- Applied Microbiology-Musharraffudde.
- Nduka Okafor. Modern Industrial Microbiology and Biotechnology. (2007). CRC Press.
- Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton. Industrial Microbiology: An Introduction, (2013). Wiley Blackwell Publishers.
- Crueger W and Crueger A. Biotechnology: A Textbook of Industrial Microbiology.2ndEd. (1991). Sinauer Associates Inc.,U.S.

- Srivastva, M.L. 2008. Fermentation Technology, Narosa Publ. House, New Delhi. 2. Michael 12.J. Waites, Neil L.Morgan, John S. Rockey and Gray Higton. 2001. Industrial Microbiology An Introduction, Replika Press Pvt Ltd. New Delhi.
- Wulf Crueger and Anneliese Crueger. 2000. A textbook of Industrial Microbiology II Ed. Panima Publishing Corporation, New Delhi.

E-RESOURCES:

- https://www.biologydiscussion.com/industrial-microbiology-2/strain-improvement-of-microorganisms-microbiology/66010
- http://www.generalmicroscience.com/industrial-microbiology/fermentor-design/
- https://www.biotechnologynotes.com/industrial-biotechnology/fermentation-process/downstream-process-in-fermentation-with-methods-industries-biotechnology/13671
- https://www.onlinebiologynotes.com/different-fermentation-pathway-bacteria/
- https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000444FN/P000551/M012164/ET/1463034230Q-I.pdf
- https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000002BI/P001357/M021492/ET/1501755459BioprocessenggPGPthshala.pdf
- https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000015FT/P000057/M000079/ET/1455710283ET21.pdf
- https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/food_technology/technology_of_fruits_and_vegetables/29.technology_of_vinegar_production/et/2860_et_m29.pdf
- http://www.fao.org/3/x0560e/x0560e10.htm
- https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000014ER/P000284/M026024/ET/1514784562Paper15EMB_Module18__etext.pdf

SEMESTER V

COURSE CODE: IM 1572

VOCATIONAL COURSE –IX- PRACTICAL-P5

COURSE TITLE: INDUSTRIAL MICROBIOLOGY

CREDITS - 4 **Total lecture hours- 108hrs (6hrs/week)**

PRE- REQUISITE:

Basic knowledge of microorganisms and laboratory techniques studied during the first & second year of this programme.

COURSE OBJECTIVES:

To make the students knowledgeable on production of various industrial products and to understand various techniques used in fermentation industries.

COURSE OUTCOME:

1. The students will be able to understand screening methods for Industrial microbes. CO2
2. The students will be able to understand various techniques used in Fermentation Industries. CO2
3. The students will be able to know the Industrial production of various Products CO3

(**CO1** - Remember; **CO2** - Understand; **CO3** - Apply; **CO4** - Analyze; **CO5** - Evaluate; **CO6** – Create)

EXPERIMENTS:

Part I (54 hrs)

1. Yeast Cell immobilization
2. Isolation of amylase producers.
3. Demonstration of microbial antibiosis by crowded plate technique.
4. Production of wine from grapes.
5. Isolation of lipolytic microbes.
6. Isolation of protease producers.
7. Bioassay of antibiotic.

Part II (54 hrs)

8. Citric acid production by *Aspergillus* sp

9. Amylase production by SSF.
10. Enrichment of coir pith degraders.
11. Analysis of Mycotoxin (Aflatoxin) in fungus- contaminated food materials.
12. Demonstration of fermentation by yeast.

REFERENCE:

- Dubey R C and Maheswari, D K (2002). Practical Microbiology. S. Chand & Co Ltd. (ISBN 81-219-2153-8)
- Experiments in Microbiology Plant Pathology and Biotechnology- K. R. Aneja.

IM1645- PROJECT (Core/Vocational)

Credit 4 **(1 Hr /week)**

The students should do one project either in Biochemistry or Microbiology. The total number of students in the program should be equally divided into two batches and one batch should do a project in core subject and the other batch should do the project in the vocational subject. Which batch would come under which faculty can be decided by drawing lots.

The project report should be based on a mini-project work done by the students. This should include original laboratory work, analysis of results and should be presented along with relevant and current literature review. The evaluation of dissertation should be done on the basis of evaluation of the project report and a viva-voce examination of the student. The students will do the project in the fifth semester and have to submit their reports in the sixth semester.

A report of the industrial visit carried out to any industries/institutions relevant to the subject should accompany the project report.

Scheme for evaluation of project

Total weightage: 30

Project: 20

Industrial Visit: 10 (The visit carries a weightage of 6 and the visit report carries a weightage of 4)

SEMESTER VI

COURSE CODE: IM 1671

VOCATIONAL COURSE – X

COURSE TITLE: MEDICAL MICROBIOLOGY

CREDITS-3 **Total lecture hours- 54hrs (3hrs/week)**

PRE- REQUISITE:

Knowledge of microorganisms during the first & second year of this programme.

COURSE OBJECTIVES:

The student will able to learn the basic concepts of medical microbiology and microbial pathogenesis: study of microbes, antimicrobial agents, epidemiology, and virulence factors associated with the pathogenic microorganisms.

COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

1. Gain the basic knowledge about infections, outbreaks and control measures. CO2 & CO3
2. Understand the pathogenicity of Gram positive bacterial pathogens. CO2 & CO3
3. Gain the basic knowledge about fungal infections. CO 2 & CO3
4. Gain the basic knowledge about viral and parasitic infections. CO 2 & CO3
5. Gain the basic knowledge antibiotics their mode of action and antibiotic sensitivity testing CO 2 & CO3

(**CO1** - Remember; **CO2** - Understand; **CO3** - Apply; **CO4** - Analyze; **CO5** - Evaluate; **CO6** – Create)

Module-I **9 Hours**

Normal Microbial flora- Resident flora and transient flora, Beneficial and harmful effects of normal flora. Brief account on normal flora of skin, conjunctiva, upper respiratory tract, mouth, teeth, stomach, upper and lower intestine, genitourinary tract. Nosocomial infection

Module-II **9 Hours**

Bacteriology: Pathogenicity, laboratory diagnosis, prevention and control of the diseases caused by (brief account only): *Staphylococcus aureus, Streptococcus pyogenes, Neisseria gonorrhoeae, Escherichia coli, Salmonella typhi, Vibrio cholerae, Corynebacterium diptheriae, Clostridium tetani, Mycobacterium tuberculosis, Treponema pallidum, Mycoplasma pneumoniae & Chlamydia trachomatis.*

Module-III **9 Hours**

Mycology: Brief account on the following fungal diseases: **Superficial mycoses-** Pityriasis versicolor, Tinea nigra. **Cutanaceous mycoses**- Dermatophytes, Candidiasis. **Subcutanaceous mycoses**- Mycotic mycetoma, Rhinosporidiosis. **Systemic mycoses-** Cryptococcosis, Histoplasmosis and **Opportunistic mycoses**- Aspergillosis, Penicilliosis.

Module-IV **9 Hours**

Virology: Air borne viral disease (Influenza, measles, mumps, rubella, small pox). Insect borne (dengue fever) food and water borne disease (polio). Direct contact diseases – Hepatitis B, AIDS. Zoonotic diseases-rabies, Emerging viral infections- SARS, Nipah.

Module-V **9 Hours**

Protozoology: Disease caused by Protozoa (Pathogenic mechanisms, Disease transmission and life cycle) – Plasmodia, Toxoplasma, Entamoeba histolytica, Trypanosoma

Module-VI **9 Hours**

Antimicrobial chemo therapy: Antibiotics and their mode of action. Drug resistances– Mechanism of drug resistances. Antimicrobial sensitivity tests- diffusion and dilution techniques.

REFERENCES:

- Ananthanarayan and Panicker's Textbook of Microbiology- ISBN 81 250 2808 0
- Notes on Medical Bacteriology – J. Douglas SleighMorag C.Timbury
- Parasitology –B.Dasgupta
- Medical Mycology – Rippon
- Principles of Bacteriology Virology and immunity Vol 4 Lopka and Wilson
- Fundamentals of medical Virology by Kucera and Myrvik

E-RESOURCES:

- https://www.ncbi.nlm.nih.gov/books/NBK7617/
- https://www.ncbi.nlm.nih.gov/books/NBK8448/
- https://www.ncbi.nlm.nih.gov/books/NBK7716/#:~:text=Treponema%20pallidum%20subsp%20pallidum%20causes,transmitted%20by%20close%20nonvenereal%20contact.
- https://www.ncbi.nlm.nih.gov/books/NBK8103/
- https://www.ncbi.nlm.nih.gov/books/NBK8149/
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- https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/zoology/08._biology_of_parasitism/10._plasmodium__morphology_and_life_cycle/et/7829_et_et.pdf
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- https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000035ZO/P000888/M027352/ET/1519016883M18Morphology,Lifecycle,PathogenecityEntamoebaPart1Quad1.pdf
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SEMESTER VI

COURSE CODE: IM 1672

VOCATIONAL COURSE IX- PRACTICAL

COURS TITLE: MEDICAL MICROBIOLOGY & IMMUNOLOGY

CREDITS - 4 **Total lecture hours- 108 hrs.**
(6hrs/week)

PRE- REQUISITE:

Basic knowledge of microorganisms studied during the first & second year of this programme.

COURSE OBJECTIVES:

The student will be able to evaluate methods used to identify common infectious agents in the clinical microbiology lab. The student will be able to assess treatment strategies including the appropriate use of antimicrobial agents and common mechanisms of antimicrobial action and resistance and to perform various serological and immunological diagnostic tests.

COURSE OUTCOME:

1. To learn standard laboratory procedures in clinical microbiology. CO2& CO3
2. To understand how to handle and identify medically important bacteria. CO2& CO3
3. To perform antimicrobial sensitivity tests. CO2& CO3
4. Gain knowledge on various serological and immunological Techniques involved in diagnosis. CO2& CO3

(**CO1** - Remember; **CO2** - Understand; **CO3** - Apply; **CO4** - Analyze; **CO5** - Evaluate; **CO6** – Create)

EXPERIMENTS:

Part I (54 hrs.)

1. Antibiotic sensitivity testing- Kirby-Bauer method
2. Determination of MIC and MBC of antibiotics

3. Identification of common bacterial pathogens by using morphological, cultural and biochemical characters

- *Staphylococcus,*
- *Streptococcus*
- *Escherichia coli,*
- *Pseudomonas*
- *Klebsiella*

4. Urine culture and its microbiological analysis.
5. Isolation of Enteric pathogens from stool by direct plating method

Part II (54 hrs.)

6. ASO latex agglutination test
7. RA latex agglutination test
8. Tube agglutination test: WIDAL test.
9. RPR card test for syphilis.
10. HBs Ag detection by using immunochromatographic technique
11. ABO blood grouping

REFERENCES:

- Lab manual in Biochemistry, Immunology and biotechnology-Arti Nigam, Archana Ayyagari (ISBN 13:978-0-07-061767-4)
- Medical Laboratory technology –*Methods and interpretation* (ISBN 81-8448-449-6)
- Mackie & McCartney Practical Medical Microbiology (ISBN 0 443 04906 8)
- Diagnostic Microbiology, Bailey and Scott's, (2013). 13thEd. The Mosby Company
- Talib. V.H, (2008). Handbook of Medical Microbiology, 2ndEd. CBS Publishers.
- Medical laboratory techniques, Abdul Khader, (2003). 1stEd. Frontline Publications

ELECTIVE COURSE

COURSE CODE: IM 1661

COURSE TITLE: IMMUNOLOGY

ELECTIVE COURSE (VOCATIONAL)

CREDIT:2 **Total lecture hours- 36hrs (2hrs/week)**

PRE - REQUISITE:

Basic knowledge of immunology studied during HSc and first, second year of this programme.

COURSE OBJECTIVES:

The objective of this course is to understand the various components of the host immune system, their structure and organization, and functions to serve as the defense system of the body. It would also make the students understand the operational mechanisms which underlie the host defense system, allergy and organ transplantation.

COURSE OUTCOMES:

1. Understand the basics of Immunology and defense mechanisms CO2
2. Gain knowledge about immunity types and function of immunoglobulins. CO2
3. Understand about the cells and organs of immune system CO2
4. Know about the autoimmune diseases CO2
5. Create awareness about hypersensitivity and immunodeficiency disease. CO3 & CO4

(**CO1** - Remember; **CO2** - Understand; **CO3** - Apply; **CO4** - Analyze; **CO5** - Evaluate; **CO6** – Create)

Module-I **6 Hours**

Infections, Epidemic, Pandemic and Endemic diseases. Determinants of microbial pathogenicity. Immunity, types of immunity -Innate immunity and acquired immunity- (natural and artificial active, natural and artificial passive), immune response-primary and secondary immune response. Mechanism of immune response.

Module-II **6 Hours**

Antigens, structure and types of antigens-endogenous and exogenous, & super antigens. Antigenicity and immunogenicity. Haptens, adjuvants and its types. Structure and functions of different classes of immunoglobulins (IgG, IgM, IgA, IgD& IgE).

Module-III **10 Hours**

Cells of immune system (Lymphocytes, Mononuclear cells, granulocytes, dendritic cells), Phagocytosis, Organs of immune system (primary and secondary lymphoid organs), Complement system and activation pathways (classical, alternate and lectin pathways), Membrane attack complex. Structure, and function of Major Histo compatibility complex (MHC class 1 and Class II) –brief introduction only.

Module-IV **8 Hours**

Brief introduction to antigen and antibody reactions, Precipitation reactions- immunodiffusion test, simple diffusion in one-dimension, double diffusion in one-dimension, simple diffusion in two-dimension, double diffusion in two-dimension, electro diffusion- rocket immunodiffusion. Agglutination reactions- slide agglutination, tube agglutination, latex agglutination, complement fixation. Neutralization-, ASO test. Immunoassays of diagnostic importance- ELISA- direct ELISA and indirect ELISA, RIA, immunofluorescence. Production of monoclonal and polyclonal antibodies, and its applications.

Module-V **6 Hours**

Brief account on Immunodeficiency disorders, Hypersensitivity reactions, Immunohematology (Blood groups and Rh incompatibilities), Autoimmunity, Vaccines, booster dose, and its types. Transplantation- definition, types of grafts -xenograft, allograft, isograft.

REFERENCES:

- Immunology: An Introduction by Ian R Tizard (2006) Publisher: Cengage Learning
- Immunology and Immunotechnology by Chakravarty (2006)
- Kuby Immunology by Thomas J. Kindt (2006) Publisher: W H Freeman & Co
- Elements of Immunology (2009) by Khan Publisher: Dorling Kindersley (India) Pvt
- Immunology by K.R. Joshi (2007) Publisher: Agrobios (India)
- Basic Immunology, 3ed by: Abbas Publisher: Elsevier
- Immunology by P.R. Yadav (2004) Publisher: Discovery Publishing House

- Immunology by David A. Marcus, Richard A. Goldsby, Barbara A. Osborne (2003) Publisher: WH. Freeman & Company

E-RESOURCES:

- https://www.medicalnewstoday.com/articles/320101#the-immune-response
- https://www.cdc.gov/vaccines/vac-gen/immunity-types.htm
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3670108/
- https://www.ncbi.nlm.nih.gov/books/NBK271
- http://www2.hawaii.edu/~johnb/micro/micro161/antigen-antibody_reactions/Chap5_Ag_Ab_reactions.htm
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4600970/
- https://www.immunology.org/policy-and-public-affairs/briefings-and-position-statements/transplant-immunology

MODEL QUESTION PAPERS

First Semester B.Sc. Degree Examination

Career Related First Degree Programme under CBCSS

Group 2 (a): Biochemistry and Industrial Microbiology

Vocational Course I

IM 1171 – FUNDAMENTALS OF MICROBIOLOGY

Time: 3 Hours **Max. Marks: 80**

SECTION — A

Answer all questions. Answer in a word to a maximum of two sentences. Each question carries 1 mark

1. Psychrophiles

2. Simple staining is used to study

3. Acid fastness in Mycobacteria is due to the presence of _____

4. Thermal death time

5. N-acetyl glucosamine is a component of _____

6. Rideal-Walker test is used for _____

7. Heating milk at 63°C for 30 min is called _____

8. Plasmid

9. Prophage

10. Application of Indian ink

(10 x 1 = 10 Marks)

SECTION - B

Answer any eight questions. Answer not to exceed 1 paragraph. Each questions carries 2 marks.

11. Mechanism of action of penicillin

12. Mac Conkey Agar

13. Hot air oven

14. Spheroplast

15. Generation time

16. Heterotrophs

17. Applications of SEM

18. Tyndallisation

19. Mycoplasma

20. Mesosomes

21. Quellung reaction

22. Mechanisms of lethal effects of phenols

(8 x 2 = 16 Marks)

SECTION — C

Answer any six questions. Answer not to exceed 120 words. Each questions carries 4 marks

27. Structure of lipopolysaccharide

24. Ziehl and Nielsen staining method and its applications

25. Selective media. Application with example

26. Structure of bacterial spore 27. Methods of testing disinfectants

28. Principle and applications of TEM

29. Staining method for metachromatic granules

30. General structure of algae

31. Virus cultivation methods

(6 x 4 = 24 Marks)

SECTION — D

Answer any two of the following. Each question carries 15 marks.

32. Describe classification of bacteria based on morphological features diagrammatic representation and examples. Describe structure of flagella and arrangement in various bacteria with examples.

33. Explain principle and applications of bright field, fluorescence and phase contra microscopy.

34. Explain various culture methods and methods for culture preservation.

35. Explain various sterilization methods and its applications. Explain sterilisation control.

(2 x 15 = 30 Marks)

Second Semester B.Sc. Degree Examination

Career Related First Degree Programme under CBCSS

Group 2 (a): Biochemistry and Industrial Microbiology

Foundation Course II

IM 1222: MICROBIAL TAXONOMY AND PHYSIOLOGY

Time: 3 Hours **Max. Marks : 80**

SECTION — A

Answer all questions. Answer in a word to a maximum of two sentences. Each question carries 1 marks

1. Method of classifying organisms (taxa) into groups based on subset of similarity attributable to shared derived (synapomorphies) characters is known as _____

2. Five kingdom classification is proposed by _____

3. Cephaleuros is an example of _____ algae.

4. Aflatoxin is produced by _____

5. _____ is the diphasic (two-phase) growth response seen in a culture of microorganisms making a phenotypic adaptation to the addition of a second substrate.

6. Hydrogen sulfide or thiosulfate can serve as the electron donor, generating elemental sulfur and sulfate ions, respectively. This reaction occurs in _____ type of photosynthesis.

7. Three kingdom classification is proposed by _____

8. The photoreceptor in photosynthetic bacteria are _____

9. Ergot is obtained from _____

10. Classification based on overall similarity is known as _____

(10 x 1 = 10 Marks)

SECTION - B

Answer any eight questions. Answer not to exceed 1 paragraph. Each questions carries 2 marks.

11. Synapomorphic character.

12. Turbidostat.

13. Floridean starch.

14. Halobacteria.

15. Siderophore.

16. Symbiotic nitrogen fixation.

17. Fed-batch culture.

18. Tenericutes.

19. Phylogenetic tree.

20. Numerical taxonomy.

21. Bergy's manual of systematic bacteriology.

22. Trypanosomiasis.

(8 x 2 = 16 Marks)

SECTION — C

Answer any six questions. Answer not to exceed 120 words. Each questions carries 4 marks

23. Structure of bacterial cell wall.
24. Nutritional classification of bacteria.
25. Anoxygenic photosynthesis with examples.
26. Continuous culture.
27. Bioluminescence.
28. Different mechanism for the uptake of nutrients by bacteria.
29. Briefly describe growth cycle of bacteria and the equation for calculating growth rate constant.
30. Give a brief description of Batch and Fed-batch fermentation.
31. Proposed classification of Ernst Haeckel and R.H. Whittaker.

(6 x 4 = 24 Marks)

SECTION — D

Answer any two of the following. Each question carries 15 marks.

32. Write briefly on factors affecting bacterial growth.
33. Discuss the classification of Protozoa.
34. Write an essay on bacterial photosynthesis.
35. Write a note on symbiotic and non-symbiotic Nitrogen fixation.

(2 x 15 = 30 Marks)

Third Semester B.Sc. Degree Examination

Career Related First Degree Programme under CBCSS

Group 2(a): Biochemistry and Industrial Microbiology

Vocational Course III

IM 1371: CELL BIOLOGY

Time: 3 Hours **Max. Marks: 80**

SECTION — A

Answer all questions. Each question carries 1 mark.

1 Theory of spontaneous generation.

2. Chromatin.

3. G - banding.

4. Philadelphia Chromosome.

5. Prophase.

6. Glyoxysome.

7. Nucleosome

8. Gene mutation.

9. Apoptosis.

10. Aneuploidy.

(10 X 1 = 10 Mark)

SECTION — B

Answer any eight of the following. Each question carries 2 mark.

11. Necrosis.

12 Anaphase.

13. P^{53}

14. S phase.

15. Nucleoid.

16. Crossing over.

17. Oncogene.

18 Cyclins.

19. Ribosomes.

20. Continuous cell line.

21 Diplotene.

22. HLIT

(8 x 2 = 16 Marks)

SECTION — C

Answer any six of the following. Each carries 4 marks. Describe the following.

23. Origin of life.

24. Cell cycle.

25. Lysosomes functions.

26. Cdk functions.

27 Microsatellites.

28. Genetic drift.

29 Chromosomal aberrations.

30. Cell—matrix interactions.

31. Structure and functions of mitochondria.

(6 x 4 = 24 Marks)

SECTION — D

Answer any two of the following. Each question carries 15 marks.

32. Write an essay on structure and functions of sub-cellular organelle.

33. Write an essay on cell-cell signaling.

34. Write an essay on meiosis.

35. Write an essay on chromatin structure.

(2 x 15 = 30 Marks)

Third Semester B.Sc. Degree Examination

Career Related First Degree Programme under CBCSS

Group 2 (a): Biochemistry and Industrial Microbiology

Vocational Course IV

IM 1372: MICROBIAL GENETICS AND BIOTECHNOLOGY

Time: 3 Hours **Max. Marks : 80**

SECTION — A

Answer all questions. Each question carries 1 mark. Explain the following:

1. MS media composition

2. HeLa Cells

3. Direct regeneration
4. Explant
5. Particle gun bombardment
6. Patent
7. DMEM
8. Function of tra region of F factor
9. Linkage
10. Primase.

(10 x 1 = 10 Marks)

SECTION — B

Answer any eight of the following. Each question carries 2 mark.

11. Somoclonal variations and its importance
12. Crossing over
13. Sex linked genes
14. The Law of Segregation
15. Multiple allelism
16. Applications embryonic stem cells
17. Bt cotton
18. Somatic embryo
19. Distinguish Hfr bacteria and F" bacteria
20. Explain relation of totipotency and tissue culture
21. Explain trypsinization
22. Major enzymes involved in prokaryotic DNA replication.

(8 x 2 = 16 Marks)

SECTION — C

Answer any six questions. Each question carries 4 marks. Describe the following

23. Serum is an important component of cell culture, justify its functions.
24. Methods to produce transgenic animals.
25. Explain the principle involved and applications of electroporation and microinjection.

20. Compare test cross and back cross.

27. Describe mechanism of conjugation.

28. Intellectual property right and its applications.

29. Describe importance and applications of GM food with examples.

30. Haemophilia A and B are more likely to occur in males than females. Explain the genetic basis of this.

31. Describe vvarious types of cell lines and its important features.

(6 x 4 = 24 Marks)

SECTION — D

Answer any two questions. Each question carries 15 marks. Write essay on the following.

32. Describe prokaryotic replication.

33. Gene transfer mechanisms in bacteria.

34. Explain plant tissue culture techniques, its applications and importance of transgenic plants with examples.

35. Explain ethical problems associated with the use of rDNA technology.

(2 x 15 = 30 Marks)

Fourth Semester B.Sc. Degree Examination

Career Related First Degree Programme under CBCSS

Group 2 (a): Biochemistry and Industrial Microbiology

Vocational Course V

IM 1471- Environmental, Soil & Agricultural Microbiology

Time: 3 Hours **Max. Marks: 80**

SECTION — A

Answer all questions/ Answer in a word to a maximum of two sentences/ Each question carries 1 mark

1. What is microbial interaction?

2. Define pH
3. Why incineration?
4. What are agrochemicals?
5. How the bacteria leaching?
6. What is rhizoplane?
7. Define biocontrol agents.
8. Give importance of etiology.
9. What is arbuscule?
10. What is citrus canker?

(10 x 1 = 10 Marks)

SECTION - B

Answer any eight questions answer should not exceeding one paragraph. Each question carries 2 marks

Comments on:

11. Disinfection
12. Bioremediation
13. Azotobacter
14. Pathogenicity
15. Bacterial blight of paddy,
16. Necrosis
17. Microbial inoculants.
16. Mycorrhizae
19. Microfeuna
20. Associative symbiosis
21. Xenobiotic compound,
22. Bioremediation of Hydrocarbons.,

(8 x 2 = 16 Marks)

SECTION — C

Answer any six questions. Answer not to exceeding 120 words. Each question carries 4 marks

23. Give short note on land filling.

24. Discuss the microbe-microbe interactions.

25. Explain about rhizodeposits.

26. Write about root nodules.

27. What are the symptoms of plant nutrient deficiency? Give two examples.

28. Explain the N_2-fixation mechanism.

29. Discuss about the phosphorus solubilizing microbes.

30. Write about microbes in mining.

31. Write a short note on vermicompost.

(6 x 4 = 24 Marks)

SECTION — D

Answer any two questions. Each question carries 15 marks.

32. What is biosphere? Discuss the biosphere components and functions in biogeochemical cycle.

33. Discuss in detail the role of microorganisms in carbon cycle.

34. Write an essay on production and application of Azospirillum and cyanobacteria.

35. How will you manage the municipal sewage through biotechnological tools?

(2 x 15 = 30 Marks)

Fourth Semester B.Sc. Degree Examination

Career Related First Degree Programme under CBCSS

Group 2 (a): Biochemistry and Industrial Microbiology

Vocational Course VI

IM 1472: FOOD & DIARY MICROBIOLOGY

Time: 3 Hours **Max. Marks: 80**

SECTION — A

Answer all questions. Answer in a word to a maximum of two sentences. Each question carries 1 mark

1. What is tyndallisation?

2. Why humidity importance?
3. What is spoilage?
4. How fungi grow in bread?
5. What is pasteurization?
6. What is temperature of cold storage?
7. Importance of solar drying.
8. What is toxin?
9. What is germicidal ice?
10. What is leavening?

(10 x 1 = 10 Marks)

SECTION - B

Answer any eight questions answer should not exceeding one paragraph. Each question carries 2 marks

Comment on:

11. Food preservation
12. Spoilage of honey
13. Significance of SCP
14. Importance of mold in food
15. Thermoduric bacteria
16. Microbial decomposition of food
17. Methods of pre-treatment in food
18. Appertization
19. Changes in the food due to radiation
20. Clostridium
21. Extrinsic factors
22. Personal hygiene

(8 x 2 = 16 Marks)

SECTION — C

Answer any six questions. Answer not to exceeding 120 words. Each question carries 4 marks

23. Discuss the primary source of food contaminations.

24. Write about the heat processing of food preservation.

25. Write a short note on staphylococcal infection.

26. Write a short note on brucellosis.

27. Comments on meat and meat products contaminated microbial agents.

28. Discuss the food poisoning impact in Hepatitis.

29. Explain the amoebiasis.

30. Write the significance of chilling preservation method.

31. Discuss the sodium benzoate class l.

(6 x 4 = 24 Marks)

SECTION — D

Answer any two questions. Each question carries 15 marks.

32. Explain in detail about production of cheese. What are microbes involved in cheese production?

33. What are the opportunistic pathogens to contaminated food? Give two examples with detail report.

34. Give detail account on food borne infections and intoxications

35. Write an essay about food sanitation.

(2 x 15 = 30 Marks)

Fifth Semester B.Sc. Degree Examination

Career Related First Degree Programme under CBCSS

Group 2 (a): Biochemistry and Industrial Microbiology

Vocational Course

IM 1571: FERMENTATION TECHNOLOGY

Time: 3 Hours **Max. Marks: 80**

SECTION — A

Answer all questions. Each question carries 1 mark.

1. Any two uses of citric acid.

2. Ashbya gossypii.

3. Any two examples of antifoam agents.
4. Name the device used for introducing air into the fermenter.
5. Crowded plate technique is used for
6. Rennet.
7. Secondary screening.
8. Significance of thermoduric microorganisms in food industry.
9. Any two industrial uses of protease enzyme.
10. Industrial use of pectinase enzyme.

(10 x 1 = 10 Marks)

SECTION - B

Answer any eight questions of the following. Each question carries 2 marks

Comment on:

11. Disadvantages of batch culture.
12. Methods used to reduce contaminations in a fermenter.
13. lmmobilization technology.
14. Differentiate between homolactic and heterolactic fermentation.
15. Liquid-liquid extraction.
16. Control of pH and dissolved oxygen levels in a batch fermenter.
17. Secondary metabolites.
18. Significance of coliform bacteria.
19. Significance of Pasteur effect.
20. Lacctobacillus delbrueckii.
21. Corn steep liquor.
22. Idiophase.
23. Lactic acid production.
24. Impellers.
25. Amino acid fermentation.
26. Anaerobic fermentation.

(8 x 2 = 16 Marks)

SECTION — C

Answer any six questions. Each question carries 4 marks

27. Microbial inoculants and their importance.
28. Discuss about various raw materials used for the preparation of fermentation media.
29. Cell disruption methods.
30. Chemostat.
31. Purification of citric acid.
32. Explain various chromatographic techniques used in downstream processing.
33. Differentiate between batch sterilization and continuous sterilization.
34. Explain the role of Rhizopus in food fermentations.
35. Production of SCP.
36. Purification of Penicillin.
37. Ethanol fermentation.
38. Write about methods used in sterilization of fermentation media

(6 x 4 = 24 Marks)

SECTION — D

Answer any two of the following. Each question carries 15 marks.

39. Discuss the fermentative production of Acetone and Butanol.
40. What is meant by strain improvement? Discuss the general methods adopted for this.
41. Write in detail about the production of single cell proteins.
42. What are the major types of biopesticides? Write in detail about the production of biopesticides.
43. Explain various processes involved in downstream processing.
44. Discuss the role of microbes in food processing industries.

(2 x 15 = 30 Marks)

Sixth Semester B.Sc. Degree Examination

Career Related First Degree Programme under CBCSS

Group 2 (a): Biochemistry and Industrial Microbiology

Vocational Course X

IM 1671- MEDICAL MICROBIOLOGY

Time: 3 Hours **Max. Marks : 80**

SECTION — A

Answer all questions. Answer in a word to a maximum of two sentences. Each question carries 1 mark

1. Nosocomial infection.
2. DPT vaccine.
3. Causative agent of Botulism.
4. What is ASO test?
5. Dimorphic fungi.
6. Malaria is tran6miXed from person to person by _____ mosquitoes.
7. Break bone fever.
8. Negri bodies.
9. _____ organism is used for the production of 9treptCIm'\/Ci-Fl
10. Quellung reaction.

(10 x 1 = 10 Marks)

SECTION - B

Answer any eight questions. Answer not to exceed 1 paragraph. Each questions carries 2 marks.

11. Which are the bacilli showing drumstick appearances?
12. Explain Schick test.
13. Travelers' diarrhea. Explain.
14. What is Candidiasis?
15. How can we diagnosis HIV?
16. Explain Sporozoite.
17. Mention major reasons for antibiotic resistance in microorganisms.

I8. Toxic shock syndrome toxin.

19. Name two common bacterial diseases of respiratory tract explain with causative agent.
20. Give short notes on Aspergillosis.

21. What is meant by congenital disease?

22. Discuss symptoms of measles.

23. Write notes on *Trypanosomabruei*.

24. Explain Mic.

25. Negative staining.

26. Explain mechanism of action of macrolides.?

(8 x 2 = 16 Marks)

SECTION — C

Answer any six questions. Answer not to exceed 120 words. Each questions carries 4 marks

27. Write notes on beneficial effect of normal flora.

28. Most commonly used serological test for the detection of syphilis. Explain.

29. What causes Toxoplasmosis, give details?

30. Give short notes on diagnostic method for Mycobacterium.

31. Write in detail about any one vector borne disease.

32. What are the symptoms of mumps?

33. Discuss morphology of Influenza virus with figure.

34. Write notes on Mucormycosis.

35. Give short notes on cholera.,

36. Reproductive cycle of Chlamydia.

37. Antibiotics which act as cell wall inhibitor, explain.

38. What are the importance of Antimicrobial sensitivity tests?

(6 x 4 = 24 Marks)

SECTION — D

Answer any two of the following. Each question carries 15 marks.

39. Write an essay on normal flora of human body.

40. Write an essay on air borne viral diseases.

41. Explain in detail on pathogenesis, diagno6is and treatment of diphtheria.

42. Write an essay on HIV.

43. Explain the life cycle, pathogenesis and diagnosis of malarial parasite.

44. Discuss in detail about various types of mycoses with examples.

(2 x 15 = 30 Marks)

Sixth Semester B.Sc. Degree Examination

Career Related First Degree Programme under CBCSS

Group 2 (a): Biochemistry and Industrial Microbiology

Elective Course

IM 1661: IMMUNOLOGY

Time: 3 Hours **Max. Marks: 80**

SECTION — A

Answer all questions. Answer in a word to a maximum of two sentences. Each question carries 1 mark

1. Haptens
2. Name two pandemic viral disease
3. Atopy
4. Neutrophils
5. Serum
6. NK cells
7. Bombay blood group
8. Name the antibody produced during allergy.
9. Haemagglutination
10. BCG

(10 x 1 = 10 Marks)

SECTION - B

Answer any eight questions. Answer not to exceed 1 paragraph. Each questions carries 2 marks.

Comment on:

11. Mast cells
12. Phagocytosis
13. Erythroblastosis Foetalis
14. Anaphylaxis
15. Major blood group antigens
16. Widal Test
17. Rheumatoid factor
18. Anatomical barriers of Innate Immunity
19. B lymphocytes
20. Exogenous antigen
21. Interferons
22. Oposonization
23. Spleen as secondary lymphoid organ
24. Adjuvants
25. Difference between epitope and paratope
26. what is ADCC?

(8 x 2 = 16 Marks)

SECTION — C

Answer any six questions. Answer not to exceed 120 words.

Each questions carries 4 marks

27. Hybridoma Technology.
28. Hypersensitivity I.
29. Narrate the structure of IgM.
30. Primary Lymphoid organs.
31. Narrate antigenic determinants of immunoglobulin.
32. ELISA.
33. Explain the difference between MHC I and MHC II.
34. Myasthenia Gravis.
35. Narrate basic types of transplants.

36. Describe structure of C1 macromolecular complex.

37. Narrate difference between passive and active immunity.

38. Describe cell mediated immunity.

(6 x 4 = 24 Marks)

SECTION — D

Answer any two of the following. Each question carries 15 marks.

39. Differentiate between innate and acquired immunity. Describe the development of acquired immunity.

40. Describe different organs of immune system.

41. What do you mean by complement system? Narrate different complement pathways.

42. Explain the basic structure and function of immunoglobulin and narrate different types.

43. What is hypersensitivity? Explain different types.

44. Write briefly on different kinds of antigen-antibody reactions.

(2 x 15 = 30 Marks)