PG DIPLOMA IN INDUSTRIAL MICROBIOLOGY

Scheme A-1 (For Courses of Science & Arts Discipline having Major Practicum Component)

Year / Semester		Course Type				Total Credits
		Course Level	**Core Courses/ Dissertation**	**Practicum Courses**	**Internship/Apprenticeship/Seminar OR VAC** (CHM/EESC)	
First Year	**Sem-I**	400	CC-11 (6 Credits) Cell Biology and Biochemistry of Microorganisms	PC-11 (4 Credits) Practical based on- Cell Biology and Biochemistry of Microorganisms	Internship/Apprenticeship1 ***OR*** Seminar (2 Credits)	**22**
		400	CC-12 (6 Credits) Microbial Metabolism & Physiology	PC-12 (4 Credits) Practical based on- Microbial Metabolism & Physiology		
	Sem-II	400	CC-21 (6 Credits) Analytical techniques in Microbiology	PC-21 (4 Credits) Practical based on- Analytical techniques in Microbiology	VAC (CHM/EESC) (2 Credits)	**22**
		400	CC-22 (6 Credits) Fermentation Technology	PC-22 (4 Credits) Practical based on- Fermentation Technology		

Syllabus of Theory Paper

Part A Introduction				
Program: 1 year PG diploma/ 2 year PG Programme		Class`: M Sc	Year: First year (Semester-I)	Session: 2025-26
Subject: Industrial Microbiology				
1	Course Code	CC - 11		
2	Course Title	Cell Biology and Biochemistry of Microorganisms		
3	Course Type (Core Course)	Core		
4	Pre-requisite (if any)	To study this course, a student must have had the subject Microbiology/ Industrial Microbiology in three years Undergraduate level degree.		
5	Course Learning outcomes (CLO)	On completion of this course, learners will be able to demonstrate a knowledge and understanding of: • The basic principle of biochemistry including important molecules their economic and scientific importance inside the cell. • biochemical pathways of synthesis and degradation of these molecules and the transport of different metabolites generated with application in industrial processes. • Knowledge of major molecules, carbohydrate, lipids, proteins, amino acids and nucleic acid. • comprehensive knowledge of the cell biology and its functions.		
6	Credit Value	06		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks:40	

Part B- Content of the Course		
Total No. of Lectures-Tutorials-Practical (90 hours): **L-T-P:**		
Unit	**Topics**	**No. of Lectures (in Hrs)**
I	1.1 Impact of microorganisms in human civilization. Drishya (Visible) and Adrishya (invisible) microorganism description in Atherva Veda. 1.2 Structural organization of intracellular organelles: Cell wall, nucleus, mitochondria, golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast. 1.3 Function of intracellular organelles. 1.4 Structure & function of cytoskeleton and its role in motility. 1.5 Ribosome and protein synthesis: Ribosome, structure of 70s & 80s, polyribosomes. protein synthesis.	**18**
II	2.1 Cell signalling: primary messengers, cell-cell communication, modes of cell signalling, signal transduction pathways, cell junctions. 2.2 Overview of the extracellular signalling, signalling pathways, membrane receptors. 2.3 G-Protein coupled receptors and their effectors. Receptor tyrosine kinases. Ligand gated channels, Integrins, 2.4 Second messengers. cAMP. phospholipids and Calcium, insulin signalling. 2.5 Cell regulation: Cell growth and division. Cell cycle, phases of cell cycle, mitotic events, cell cycle check points, maturation promoting factor (MPF), cyclins and cdk. cell Synchrony	**18**
III	3.1 Carbohydrates: Stereoisomerism, aldose and ketose family of monosaccharides. Structure of oligosachharides and polysaccharide. 3.2 Enzymatic degradation of polysaccharides. 3.3 Amino Acids: Classification, structure and properties of amino acids. 3.4 Non protein amino acids, methods of separation of amino acid mixture. Detection of amio acids. 3.5 Protein degradation and amino acid sequencing. N-terminal and C terminal detection	**18**

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IV	4.1 Proteins: The peptide bond, primary secondary , tertiary and quaternary structure. 4.2 Alpha helix, beta plated sheet, beta turn, super secondary structure, motifs. 4.3 Position and number of disulfide bonds. 4.4 Constraints for polypeptide confirmation. Ramachandran plot. 4.5 Isolation and purification of proteins. Criterion of purity.	**18**
V	5.1 Enzymes: Classification and nomenclature. 5.2 Enzyme kinetics and Michaelis-Menton equation. Measurement of enzyme activity, specific activity, turnover number. Kinetics of enzyme inhibition. 5.3 Mechanism of enzyme action. Factors contributing to the catalytic efficiency of enzymes. 5.4 Regulation of enzyme activity: Allosteric enzymes , cumulative and coordinated regulation. Isozymes, covalent modification, zymogen. 5.5 Diagnostic importance of enzymes. Coenzymes.	**18**

Activities:

- *Listing charts of different cell cycles, Biochemical pathways and enzyme related activities.*
- *Industrial visit/ field visit to observe different biochemical pathways*
- *Preparation charts and models related to modules*
- *Registration of Virtual labs for activities related to modules from different web labs.*
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Keywords/Tags: *Visible, invisible microorganisms, enzymes, proteins, cell signalling*

Part C-Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Principles of Biochemistry Voet & Voet John Wiley & sons
2. Principles of Biochemistry . Lehninger by Nelson and Cox .
3. Biochemistry Lubert stryer. W.H.freeman .
4. Cell and Molecular Biology. 811' Edition. Eduardo D. P. De Robertis, E. M. F. De Robertis. Lippincott Williams & Wilkins, 2010.
5. The Cell: A Molecular Approach. 6th Edition. Geoffrey M. Cooper, ASM Press 2013
6. Cell and Molecular Biology: Concepts and Experiments. 6lh Edition. Gerald Karp. John Wiley & Sons, Inc. 2010
7. Suggestive digital platforms web links https://about.labxchange.org/types/virtual-lab-simulations

Suggested equivalent online courses: https://www.mooc.org, https://swayam.gov.in, https://nptel.ac.in

Part D-Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks : 100

Continuous Comprehensive Evaluation (CCE) : 40marks University Exam (UE) 60 marks

Internal Assessment : Continuous Comprehensive Evaluation (CCE):40	Class Test / Assignment/ Presentation	40
External Assessment : University Exam Section: 60 Time : 03.00 Hours	**Section(A)** : Five Very Short Questions (50 Words Each) **Section (B) :** Five Long Questions (500 Words Each)	02 x 05 = 10 05 x 10 = 50 **Total 60**

Any remarks/ suggestions:

Syllabus of Practicum Course

Part A Introduction			
Program: 1 year PG diploma/ 2 year PG Programme	**Class`: M. Sc.**	**Year: First (Semester-I)**	**Session: 2025-26**
Subject: Industrial Microbiology			

1	**Course Code**	**PC - 11**
2	**Course Title**	**Cell Biology and Biochemistry of Microorganisms**
3	**Course Type (Core Course)**	**Practical course**
4	**Pre-requisite (if any)**	**To study this course, a student must have had the subject Microbiology/ Industrial Microbiology in three years Undergraduate level degree**
5	**Course Learning outcomes (CLO)**	• **Student will be equipped with the knowledge to handle microbes and basic biochemical and cell biology practices used in microbiological laboratory.** • **Various basic techniques to isolate, characterize the microbes morphologically will be known to them.** • **and the knowledge can be applied for advanced research.**
6	**Credit Value**	**04**
7	**Total Marks**	Max. Marks: 40+60 / Min. Passing Marks:40

Part B- Content of the Course

Total No. of Lectures-Tutorials-Practical (120 hours):
L-T-P:

Practical	Topics	Hrs
Part A- Cell Biology:	1. Observing cheek cells morphology under microscope 2. observing onion epidermis cells morphology under microscope 3. Observing cell division stages in growing onion tips. 4. Isolation of chloroplast from spinach leaves. 5.Counting of RBC and WBC in Neubars chamber 6. Differential leukocyte count using Leishman stain. 7. Whole genomic DNA isolation from blood. 8. Agarose gel electrophoresis of DNA. 9. Estimation of purity of DNA spectrophotometerically. 10.Isolation of Lymphocytes by Histopaque	**120**

Part B Biochemistry	1. Estimation of protein by spectrophotometery at 280 nm. 2. Estimation of protein by Lowery method, 3. estimation of protein by Biuret method. 4. Recording the absorption spectra of Tryophan, tyrosine, Phnylalanine 5. Recording the absorption spctra of protein and determining lamda max. 6. Estimation of carbohydrate by DNS method 7.Estimation of carbohydrate by Dubois method. 8.Estimation of DNA by DPA method. 9. Estimation of RNA by orcinol method. 10. Estimation of Starch by iodine KI method. 11. Estimation of activity of salivary amylase by using iodine KI method 12. Study of effect of pH on salivary amylase activity 13. Study of effect of temperature on Amylase activity. 14. Determination of km and V max of salivary amylase. 15. Preparation of different buffers and finding their buffering capacity. 16.Demonstration of SDS PAGE. 17. Demonstration of western blotting. 18. Isolation of casein from milk and its quantitation. 19. Demonstration of gel filtration using kit. 20. demonstration of NATIVE PAGE using casein. 21. Perform modules related virtual lab experiment from different web labs.	
Keywords/Tags: *Absorption spectra, protein, carbohydrate*		

Part C-Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. "Laboratory Manual in Biochemistry" by J. Jayaraman
2. "Practical Biochemistry" by R. N. Sawhney&Randhir Singh
3. "Principles and Techniques of Biochemistry and Molecular Biology" by Keith Wilson & John Walker
4. Microbial Metabolism & Biotechnology: E-Book http://www.twinamasiko.com/IOBB/Eublications/Biotechnology Lc Book.pdf
5. Physiology and Biochemistry of Prokaryotes: David White Bacterial Physiology and Metabolism: BH Kim and GM Gadd
6. Bacterial Metabolism: Gerhard Gottschalk
7. Bacterial Metabolism: HW Doelie
8. Micro rial Energetics: EA Dawe
9. Analytical techniques: Holme and Peck
10. Analytical Instrumentation handbook: Jack Gazes, CRC press
11. Analytical techniques in Biochemistry and Molecular biology: R Katoch
12. Biological Instrumentation and methodology: PK Bajpai

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Suggestive digital platforms web links https://about.labxchange.org/types/virtual-lab-simulations

Suggested equivalent online courses: https://www.mooc.org, https://swayam.gov.in, https://nptel.ac.in

Part D-Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	10	Viva Voce on Practical	10
Attendance	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	20	Table work / Experiments	40
TOTAL	40		60

Any remarks/ suggestions:

Syllabus of Theory Paper

Part A Introduction				
Program: 1 year PG diploma/ 2 year PG Programme		Class`: M Sc	Year: First year (Semester-I)	Session: 2025-26
Subject: Industrial Microbiology				
1	Course Code	CC - 12		
2	Course Title	Microbial Metabolism and Physiology		
3	Course Type (Core Course)	Core		
4	Pre-requisite (if any)	To study this course, a student must have had the subject Microbiology/ Industrial Microbiology in three years Undergraduate level degree programme.		
5	Course Learning outcomes (CLO)	On completion of this course, learners will be able to demonstrate a knowledge and understanding of: • Microbial growth and its nutrients requirements. • Concept of Nitrogen cycle and its applications and • Concept of bioenergetics and transport across membrane. • Provides a clear understanding about the biosynthesis and degradation pathways involved. • Addresses the fixation of molecular nitrogen into usable form by microorganism		
6	Credit Value	06		
7	Total Marks	Max. Marks: 40+60	Min. Passing Marks:40	

Part B- Content of the Course		
Total No. of Lectures-Tutorials-Practical (90 hours): **L-T-P:**		
Unit	**Topics**	**No. of Lectures (in Hrs)**
I	1.1 Contribution of Indian sages in development of ancient Microbiology. Significance of microorganisms under Bhartiya Gyan Parampara. 1.2 Growth of Bacteria - Phases of Growth. Growth Kinetics Batch Culture, Continuous Culture and Synchronous Culture. 1.3 Factors Affecting Growth - Nutrition, Aeration, Temperature and pH. 1.4 Nutritional Types - Autotrophy, Heterotrophy, Chemotrophy, Phototrophy, Lithotophy and Organotropy. Nutrition - Essentiality of Major and Minor Elements. 1.5 Chemotrophism and their Importance, Chemoheterotrophism - Acetogens, Methanogens, Methanogenenesis and its Importance.	**18**
II	2.1 Bacterial Photosynthesis - General Types of Microbial Photosynthesis, Oxygenic and Anoxygenic. 2.2 Structure of Photosynthetic Pigments - Chlorophylls, Bacteriochlorophyll, Carotenoids and Phycobilins. Green Sulphur and Purple. 2.3 Mechanism of Photosynthesis Non-Cyclic and Cyclic. 2.4 ElectronTransport, Photo Phosphorylation. 2.5 Microbial Stress Responses - Osmotic Stress and Osmoregulation, Aerobic to Anaerobic Transitions, Oxidative Stress, pH Stress	**18**
III	3.1 Aerobic Respiration - TCA Cycle - Intracellular Location and Reactions, Amphibolic Reactions. Glyoxalate Cycle. 3.2 Mechanisms of Substrate - Level Phosphorylation. 3.3 Respiratory Electron Transport in Mitochondria and Bacteria. 3.4 Mechanism of Oxidative Phosphorylation. 3.5 Anaerobic Respirations - Sulphate, Nitrate, Carbonate Respirations and their Ecological Significance.	**18**
IV	4.1 Nitrogen Metabolism - Nitrogen Cycle. 4.2 Ammonification, Nitrification, Denitrification and Nitrogen Fixation. 4.3 Nitrogenase Enzyme, 4.4 Physiology of Nitrogen Fixation in Symbiotic and free Living Bacteria. 4.5 Protein metabolism.	

V	5.1 Bioenergetics - Entropy, Enthalpy, Electron Carriers. 5.2 Artificial Electron Donars, Inhibitors, Uncouplers, Energy Bond and Phosphorylation. 5.3 Transport Across Membrane - Diffusion, Osmosis, Active Transport and Group Translocation. 5.4 Types of transport systems, PEP system of transport, ABC super family of transporters, OMPs, Ionophore antibiotics 5.5 Quorum Sensing - Mechanism and Signaling Molecules.	**18**

Activities:

- *Listing charts of different atmospheric cycles.*
- *Industrial visit/ field visit to observe mass scale production of microbial culture*
- *Preparation of charts and models related to modules*
- *Registration of Virtual labs for activities related to modules from different web labs.*

Keywords/Tags: *Visible, invisible microorganisms, enzymes, proteins, cell signalling*

Part C-Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

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3. Bacter ial Metabolism: Gerhard Gottschalk
4. Bacter ial Metabolism: HW Doelie
5. Microbial Energetics: EA Dawes
6. Biochemistry by Geoffrey L. Zubay. Fourth Edition Addison-Wesley educational publishers Inc.,2008.
7. Lehninger Principles of Biochemistry by David L. Nelson and Michael l,f. Cox. Fifth Edition, W.H. Freeman and Compary, 2008

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Metabolism and Physiology	1. Biochemical Test 2. Qualitative and quantitative estimation of Carbohydrates 3. Qualitative and quantitative estimation of Proteins 4. Qualitative and quantitative estimation of Lipids 5. Perform Iron Agar Test 6. Perform Nitrogen reductase Test 7. Perform Urease Test 8. Perform Catalase Test. 9. Observe Culture Characteristics of Microorganism 10. Quantitative estimation of any one enzyme 11. Isolation and Identification of Symbiotic nitrogen Fixer (*Rhizobium*) from root nodules 12. To study catalase activity of given microbial culture. 13. To study oxidase activity of given microbial culture. 14. To study ability of microorganisms to hydrolyse casein 15. To demonstrate phenylalanine deaminase activity of given bacterial culture. 16. To demonstrate L-lysine decarboxlylase activity of bacterial culture. 17. To demonstrate carbohydrate metabolism (oxidation and fermentation of Glucose) microorganisms . 18. To demonstrate Fat hydrolysis (lipase activity) by bacteria 19. To study ability of microorganisms to hydrolyze gelatin. 20. To demonstrate degradation of sulphur containing amino acids by bacteria 21. Perform modules related virtual lab experiments from different web labs.	**120**
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