Curriculum Framework

M.Sc. Microbiology LOCF

Department of Microbiology

Faculty of Science

2025-2027

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Background

Considering the curricular reforms as instrumental for desired learning outcomes, all academic departments of Maharaja Ganga Singh University made a rigorous attempt to revise the curriculum of postgraduate programmes in alignment with National Education Policy-2020 and UGC Quality Mandate for Higher Education Institutions-2021. The process of revising the curriculum could be prompted with the adoption of "Comprehensive Roadmap for Implementation of NEP". The Roadmap identified the key features of the Policy and elucidated the Action Plan with well-defined responsibilities and indicative timeline for major academic reforms.

The process of revamping the curriculum started with the series of webinars and discussions conducted by the University to orient the teachers about the key features of the Policy, enabling them to revise the curriculum in sync with the Policy. Proper orientation of the faculty about the vision and provisions of NEP-2020 made it easier for them to appreciate and incorporate the vital aspects of the Policy in the revised curriculum focusing on creating holistic, thoughtful, creative and well-rounded individuals equipped with the key 21st century skills 'for the development of an enlightened, socially conscious, knowledgeable, and skilled nation'.

With NEP-2020 in background, the revised curricula articulate the spirit of the Policy by emphasizing upon- integrated approach to learning; innovative pedagogies and assessment strategies; multidisciplinary and cross-disciplinary education; creative and critical thinking; ethical and Constitutional values through value-based courses; 21st century capabilities across the range of disciplines through life skills, entrepreneurial and professional skills; community and constructive public engagement; social, moral and environmental awareness; Organic Living and Global Citizenship Education (GCED); holistic, inquiry-based, discovery-based, discussion-based, and analysis-based learning; exposure to Indian knowledge system, cultural traditions and classical literature through relevant courses offering 'Knowledge of India'; fine blend of modern pedagogies with indigenous and traditional ways of learning; flexibility in course choices; student-centric participatory learning; imaginative and flexible curricular structures to enable creative combination of disciplines for study; offering multiple entry and exit points, alignment of Vocational courses with the International Standard Classification of Occupations maintained by the International Labour Organization; breaking the silos of disciplines; integration of extra-curricular and curricular aspects; exploring internships with local industry, businesses, artists and crafts persons; closer collaborations between industry and higher education institutions for technical, vocational and science programmes; and formative assessment tools to be aligned with the learning outcomes, capabilities, and dispositions as specified for each course. The University has also developed consensus on adoption of

Blended Learning with 10% component of online teaching and 90% face to face classes for each programme.

The revised curricula of various programmes could be devised with concerted efforts of the Faculty, Heads of the Departments and Deans of Schools of Study. The draft prepared by each department was discussed in series of discussion sessions conducted at Department, Faculty and the University level. The leadership of the University has been a driving force behind the entire exercise of developing the uniform template and structure for the revised curriculum. The Vice Chancellor of the University conducted series of meetings with Heads and Deans to deliberate upon the vital parameters of the revised curriculum to formulate a uniform template featuring Background, Programme Outcomes, Programme Specific Outcomes, Postgraduate Attributes, Structure of Masters Course, Learning Outcome Index, Semester-wise Courses and Credit Distribution, Course-level Learning Outcomes, Teaching-Learning Process, Blended Learning, Assessment and Evaluation, Keywords, References and Appendices. The experts of various Boards of Studies and Faculties contributed to a large extent in giving the final shape to the revised curriculum of each programme.

To ensure the implementation of curricular reforms envisioned in NEP-2020, the University has decided to implement various provisions in a phased manner. Therefore, the curriculum may be reviewed annually so as to gradually include all relevant provisions of NEP-2020.

Programme Outcomes (PO)

On completing Masters in the Faculty of Science, the students shall be able to realize the following outcomes:

PO	Description
PO1	Understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevance in day-to-day life.
PO2	Acquire the skills in planning and performing and handling scientific instruments during laboratory experiments
PO3	Realize how developments in one science subject help in the development of other science subjects and vice-versa.
PO4	Able to think creatively (divergent and convergent) to propose novel ideas in explaining facts and figures or providing new solutions to the problems.
PO5	Learn how an interdisciplinary approach helps in providing better solutions and new ideas for sustainable development.
PO6	Develop scientific outlook not only with respect to science subjects but also in all aspects of life.
PO7	Understand the knowledge of subjects in other faculties that can greatly and effectively influence the evolving new scientific theories and inventions.
PO8	Imbibe ethical, moral and social values in personal and social life
PO9	Develop various communication skills which we will help in expressing ideas and views clearly and effectively.
PO10	Analyze the given scientific data critically and systematically and the ability to draw the objective conclusions.
PO11	The skills of observations and drawing logical inferences from scientific experiments.
PO 12	Develop an overall personality by making them participate in various social and cultural activities voluntarily.
PO 13	Prepare for employment in chosen field
PO 14	Ability to think logically and creatively, and to solve scientific problems
PO 15	Equipped to take up a suitable position in academia or industry or Institutions and to pursue a career in research.

Programme Specific Outcomes (PSO)

On completing M.Sc. Microbiology Programme, the students shall be able to realize following outcomes:

PSO 1	Shall be able to design and execute experiments related to Basic Microbiology, Molecular Biology, Immunology, Recombinant DNA Technology, Biochemistry, Environment, Agriculture, Medical, Industrial, Food Microbiology.
PSO 2	Shall be able to perform minor research projects incorporating techniques of Basic and Advanced Microbiology. The learners will be equipped to take up a suitable position in academia or industry or Institutions and to pursue a career in research if so desired.
PSO 3	Shall be able to compete in national level competitive exams such as NET-JRF or GATE or International exams and can pursue career in higher studies
PSO 4	Shall practice safe microbiology, using appropriate protective, biosafety and emergency procedures.
PSO 5	Shall have in-depth theoretical and practical knowledge of huge diversity of microorganisms, their metabolism & physiology, concepts of molecular genetics and genetic engineering, biosynthetic pathways, enzymology, microbial pathogenicity, role of microbes in food, agriculture and environment, health and disease.
PSO 6	Shall be able to apply scientific methods and hypothesis testing in the design and execution of experiments including the understanding of theoretical background, hypothesis generation, collection and analysis of data, and interpretation and presentation of results.
PSO 7	Shall be able to communicate scientific results to the general public and experts by writing well-structured reports and contributions for scientific publications and posters, and by oral presentations

Post Graduate Attributes

The Post graduate attributes of our students shall be aligned with those of our University in terms of touching “the life of every student through inculcating virtues of empathy, ethics, efficiency, respect for diversity, prudence and creativity with compassion”. We wish to achieve this through rigorous teachings and research efforts, which remains the basic tenet of our teaching-learning philosophy. The following are the Post graduate attributes of the subject:

- Broaden the outlook and attitude, develop the current skills and abilities, learn new ones to excel in studies and career, grow into responsible global citizens.

- Contour the academic career of the students, make them employable, enhance research acumen and encourage the participation in co-curricular and extracurricular activities.
- Instill skills and abilities to develop a positive approach and be self-contained to shape one's life and also that of colleagues and peers.
- Demonstrate behavioral attributes for the enhancement of soft skills, socialistic approach and leadership qualities for successful career and nurture responsible human beings.
- Provide highly skilled and knowledgeable human resources for the agricultural sector, food industry, dairy industry, medical and paramedical field, environment management, space research and research institutes.

Structure of Programme

Paper Code	Paper Name		Lecture	Tutorial	Practical	Total Credits	Maximum Marks		Minimum Passing Marks
							Internal Marks	External Marks	
Semester-I									
Papers									
MIC6.5AECT101	Introduction to Microbiology	AEC	2	0	0	2	-	--	Non-CGPA S/NS*
MIC6.5DCCT102	General Microbiology and Bacteriology	DCC-I	3	1	0	4	20	80	36 %
MIC6.5DCCT103	Microbial Physiology and Biochemistry	DCC-II	3	1	0	4	20	80	36 %
MIC6.5DCCT104	Molecular Biology	DCC-III	3	1	0	4	20	80	36 %
MIC6.5DCCT105	Microbial Genetics and Genetic Engineering	DCC-IV	3	1	0	4	20	80	36 %
MIC6.5DCCP106	Combined Practical	DCC-V	0	0	8	8	40	160	36%
					Total Credits	**26**	**Grand Total**	**600**	
Semester-II									
Papers									
MIC6.5VACT201	National and Human Values	VAC	2	0	0	2	--	--	Non-CGPA S/NS*
MIC6.5DCCT202	Virology	DCC-VI	3	1	0	4	20	80	36%
MIC6.5DCCT203	Bioinstrumentation	DCC-VII	3	1	0	4	20	80	36%
MIC6.5DCCT204	Eukaryotic Microbiology	DCC-VIII	3	1	0	4	20	80	36%
MIC6.5DCCT205	Industrial Microbiology	DCC-IX	3	1	0	4	20	80	36%

MIC6.5DCC P206	Combined Practical	DCC-X	0	0	8	8	40	160	36%
					Credits	26	Total	600	36%
Semester-III									
Papers									
MIC6.5SDC-301(BCS) MIC6.5SDC-301(BCC) MIC6.5SDC-301(SAW)	Basic Communication Skills OR Basic Computer Course OR Seminar & Academic Writing	SDC	2	0	0	2			Non-CGPA S/NS*
MIC6.5DCC T302	Immunology	DCC-XI	3	1	0	4	20	80	36%
MIC6.5DCC T303	Soil and Agricultural Microbiology	DCC-XII	3	1	0	4	20	80	36%
MIC6.5DSE T304(A) 0R MIC6.5DSE T304(B)	Medical Microbiology **OR** Basics of Medical Lab Technology	DSE-I(A) OR DSE-1(B)	3	1	0	4	20	80	36%
MIC6.5DSE T305(A) MIC6.5DSE T305(B)	Microbial Ecology and Environmental Biotechnology **OR** Food and Dairy Microbiology	DSE-II(A) OR DSE-II(B)	3	1	0	4	20	80	36%
MIC6.5DCC P306	Combined Practical	DCC-XIII	-	-	8	8	40	160	36%
Credits						26	Total	600	36%

Semester-IV									
Papers									
MIC6.5AECT401	General Health and Hygiene	AEC	2	0	0	2			Non-CGPA S/NS*
MIC6.5DCCT402	Bioinformatics and Computer Applications	DCC-XIV	3	1	0	4	20	80	36%
MIC6.5DSET403(A) OR MIC6.5DSET-404(B)	Biostatistics OR Microorganisms and Health	DSE-III(A) OR DSE-III(B)	3	1	0	4	20	80	36%
MIC6.5-DRP-404(DPR) MIC6.5-OJT-404(OJT) MIC6.5-DRCC-404(DRCC)	Dissertation-Research Project (DRP) OR Dissertation-Internship/ Apprenticeship (OJT) OR Dissertation-Research Credit Course (DRCC)	(DRP) OR (OJT) OR (DRCC)	0	0	0	10	40	160	36%
MIC6.5DCCP405	Combined Practical	DCC-XV	-	-	4	4	20	80	36%
					Total Credits	**26**	**Total**	**600**	36%

L: Lecture, T: Tutorial, P: Practical

- DCC: Discipline centric compulsory course. AEC: Ability Enhancement course, DSE: Discipline specific elective course, VAC: Value added course, SDC: Skill development course.
- Non-CGPA Courses are practice based courses having 2 Credits each and assessed internally, which shall be completely based on continuous internal assessment (no examination will be conducted by the University). The Credit, Credit Point and Grade will be

reflected separately in the Marksheet under Non-CGPA Courses. The college will send the Satisfactory (S) or Not Satisfactory (NS) credentials of the student to the University.

- S/NS*=Satisfactory or Not satisfactory.
- A candidate shall be required to obtain 36% marks to pass in theory, practical and internals separately.
- For Internal Evaluation of 20 Marks (10 Marks theory paper, 6 marks seminar presentation, 4 marks class performance}
- Internal assessment = Seminar, Logical thinking/application of knowledge, attentiveness and skills, attendance, etc.
- Dissertation-Research Project (DPR)/Dissertation-Internship/Apprenticeship (OJT)/Dissertation-Research Credit Course (DRCC) shall include 10 min presentation/viva voce of each student.

Learning Outcome Index

I. Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

PO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
PO-1	X	X	X	X	X	X	X
PO-2	X	X	X	X	X	X	X
PO-3	X	X	X	X	X	X	X
PO-4	X	X	X	X	X	X	X
PO-5	X	X	X	X	X	X	X
PO-6	X	X	X	X	X	X	X
PO-7	X	X	X	X	X	X	X
PO-8	X	X	X	X	X	X	X
PO-9	X	X	X	X	X	X	X
PO-10	X	X	X	X	X	X	X
PO-11	X	X	X	X	X	X	X
PO-12	X	X	X	X	X	X	X
PO-13	X	X	X	X	X	X	X
PO-14	X	X	X	X	X	X	X
PO-15	X	X	X	X	X	X	X

II. Core Courses (CC):

PSO	CC-1	CC-2	CC-3	CC-4	CC-5	CC-6	CC-7	CC-8	CC-9	CC-10	CC-11	CC-12
PSO-1	X		X	X	X	X		X	X	X	X	X
PSO-2		X	X		X	X	X	X		X	X	X
PSO-3	X		X	X		X	X	X	X		X	X
PSO-4	X	X	X	X	X	X	X		X	X	X	X
PSO-5	X	X	X	X	X		X	X	X		X	X
PSO-6	X	X	X		X	X	X		X	X	X	X
PSO-7	X	X	X		X	X	X	X	X		X	X

III. Elective Courses (EC):

PSO	FSMBCE-303A	FSMBCE-303B	FSMBEO-304A	FSMBEO-304B	FSMBCE-403A	FSMBCE-403B	FSMBEO-403A	FSMBEO-403B
PSO-1	X	X	X		X	X	X	
PSO-2	X		X	X		X	X	X
PSO-3		X	X	X	X	X		X
PSO-4	X	X	X	X	X		X	X
PSO-5	X	X		X	X	X		X
PSO-6	X		X	X		X	X	
PSO-7	X	X	X		X	X		X

M.Sc. MICROBIOLOGY (LOCF)

ELIGIBILITY

Looking at the interdisciplinary nature of Microbiology, the eligibility of candidates for admission to M.Sc. Microbiology shall be as given below:

Bachelor Degree with one of the subject of Life sciences i.e. Botany/Zoology/Microbiology/Biotechnology/Biochemistry/Genetics/ OR B.Sc. Agriculture /B.Sc. Life Sciences with 55% marks.

M.Sc. Microbiology Programme Details:

Semester 1

Marking Scheme for External Exam

Theory Papers	Duration	Max Marks
MIC6.5AECT101 (Internal Non-CGPA)		
MIC6.5DCCT102	3 Hrs	80
MIC6.5DCCT103	3 Hrs	80
MIC6.5DCCT104	3 Hrs	80
MIC6.5DCCT105	3 Hrs	80
MIC6.5DCCT106	3 Hrs	80

MIC6.5AECT101: Introduction to Microbiology

Course Objectives:

The students will be familiarized with the living world, biodiversity and classification. They will learn about various biomolecules found in microorganisms. They will learn the basics of Genetics and Genetic Engineering

Course Level Learning Outcomes:

Upon successful completion of the course, students will have the knowledge and skills to:

CO1	Get familiarized with different types of microorganisms
CO2	Get familiarized with classification systems used for microorganisms
CO3	Will be able to understand basics of Genetics and Genetic Engineering

Course Description

UNIT-I

Development of microbiology as a discipline, Spontaneous generation vs. biogenesis, Endosymbiotic theory, Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. Role of microorganisms in fermentation.

UNIT-II

Germ theory of disease, Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner. Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three domain classification systems and their utility.

UNIT- III

Difference between prokaryotic and eukaryotic cellular structures. General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on their distribution and occurrence, pathogenicity and economic importance.

UNIT-IV

Biomolecules: Chemical constituents of living cells: biomolecules, structure and function of proteins, carbohydrates, lipids, nucleic acids; Enzymes- types, properties, enzyme action. Classical vs modern genetics, recombination in bacteria.

UNIT-V

Cloning and applications of recombinant DNA technology. Molecular Basis of Inheritance: RNA and DNA as genetic material; Structure of DNA and RNA; DNA packaging; Basics of DNA replication, Central Dogma, transcription, genetic code, translation.

RECOMMENDED READINGS:

1. Prescott, M.J., Harley, J.P., and Klein, D.A. Microbiology. 5th Edition. WCB McGraw Hill, New York, (2002).
2. Tortora, G.J., Funke, B.R., and Case, C.L. Microbiology: An Introduction. Pearson Education, Singapore, (2004).

3. Alcomo, I.E. Fundamentals of Microbiology. 6th Edition. Jones and Bartlett Publishers, Sudbury, Massachusetts, (2001).
4. Black, J.G. Microbiology: Principles and Explorations. John Wiley & Sons Inc., New York, (2002).
5. Pelczar, M.J., Chan, E.C.S., and Krieg, N.R. Microbiology. McGraw-Hill.
6. Willey, J., Sherwood, L., Woolverton, C.J. Prescott, Harley, and Klein's Microbiology. McGraw-Hill Publication.
7. Tortora, G.J., Funke, B.R., and Case, C.L. Microbiology. Pearson Benjamin Cummings.
8. Jacquelyn G. Black. Microbiology: Principles and Explorations. John Wiley & Sons Inc.
9. Madigan, M.T., Martinko, J.M., Bender, K.S., Buckley, D.H., and Stahl, D.A. Brock Biology of Microorganisms. Pearson.
10. Besty, T., and Koegh, D.C. Microbiology Demystified. McGraw-Hill.

Scheme of Examination

Internal Assessment: Internal assessment plays a vital role in the broader framework of continuous evaluation within the university and its affiliated colleges. This assessment process may involve a variety of criteria determined by the assessor, such as teachers or heads of departments. The outcomes of these assessments, classified as either satisfactory or unsatisfactory, will be submitted to the university.

MIC6.5DCCT102 : General Microbiology and Bacteriology

Course Objectives:

The course objectives are to provide knowledge on: landmark discoveries and contribution of several Microbiologists in the field of Microbiology, different domains classification, familiarity with the bacterial taxonomy and their conventional and molecular characterization using modern methods, knowledge of their cultivation and growth requirement, life cycles of important groups of bacteria.

Course Level Learning Outcomes:

Upon successful completion of the course, students will have the knowledge and skills to:

CO1	Explain the key concepts in Microbiology and Bacteriology. Students will get the basics and understand the importance of Microbiology.
CO2	Students will be acquainted with the concept of prokaryotes, their taxonomy, and differentiation from eukaryotes. They will understand how Microbiology developed and what is the scope of the various branches of the subject.
CO3	Students will be acquainted with the microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes and also understand the structural similarities and differences among various physiological groups of eubacteria/archaea.
CO4	Students will be able to define and state the principles of various techniques used in microbiology. The course will enable them to understand staining techniques, CFU count and characterization of microbes etc. The students will know various culture media and their applications and also understand various physical and chemical means of sterilization.
CO5	At the end of the course, Bacteriology will provide the better understanding of bacteria and their characteristics in terms of identification, classification, growth and reproduction etc.
CO6	Through the course the students will learn the methods, requirements to grow different type of microorganisms, various physical and chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.
CO7	Students will be able to understand the concept of taxonomy and summarize them with the help of polyphasic taxonomy, numerical taxonomy etc and they will also be able to describe the importance of genetic analysis in taxonomy.
CO8	At the end of the course, the student will be able to describe genomic based methods to study microbial diversity in nature, the mechanisms behind it and general characteristics of important bacteria.

Course Description

UNIT-I

Scope of Microbiology, Culturable and unculturable bacteria. Microbial Taxonomy: Taxonomic ranks, Phenetic and Phylogenetic classification approaches, Numerical taxonomy and Polyphasic classification approaches.

UNIT-II

Major groups of bacteria according to Bergey's manual of systematic bacteriology. Ultra structure, chemistry and function of prokaryotic cells. Autotrophs, heterotrophs, lithotrophs,

chemotrophs and phototrophs. Microbial Growth: Growth factors, Growth curve, kinetics, synchronous growth of bacteria.

UNIT-III

Control of Microorganisms: Sterilization; Dry, Wet, Chemical, Filtration, Radiation. Evaluation of effectiveness of physical and chemical antimicrobial agents. Media preparations, types of media. Differential, Selective and enrichment media. Aerobic and Anaerobic cultivation.

UNIT-IV

General Characters of Important Bacteria- *Escherichia, Salmonella, Vibrio, Proteus, Bacillus, Lactobacillus, Streptococcus, Staphylococcus, Corynebacterium, Treponema, Mycobacterium, Pseudomonas, Klebsiella, Thiobacillus, Rhizobium, Azotobacter, Acetobacter, Streptomyces, Clostridium.*

UNIT-V

Characters of Special groups of organisms as- Archaebacteria, Photosynthetic bacteria, Nitrogen fixing bacteria, Spirochaetes, Mycoplasma, Rickettsia, Bdellovibrio.

Recommended Readings:

1. General Microbiology (5^{th} edition) by Stanier Ingraham Wheelis, Macmillan; 2007.
2. Prescott/Harley/Klein's Microbiology by Willey J., Sherwood L. and Woolverton C. McGraw Hill;2007.
3. Microbiology A laboratory manual by Cappuccino, G. .James, Sherman Natalie, Pearson Education; 2011.
4. Microbiology by Pelczar J. Michael, Chan E.C.S, Krieg R. Noel, Tata McGraw-Hill Publishing Company Limited, 1998.
5. The Prokaryotes. A handbook on the biology of bacteria: ecophysiology, isolation, identification, applications. Volumes I-IV by Balows, A., Truper, H. G., Dworkin, M., Harder, W., Schleifer, K. H. Springer-Verlag, New York; 1992.
6. Principles of Microbiology by R.M. Atlas, Mosby publishers, St. Louis; 1995.
7. Brock Biology of Microorganisms (12th edition) by Madigan and John M. Martinko, Paul V. Dunlap, David P. Clark Benjamin Cummings; 2008.
8. Microbiology: An Introduction by Gerard J., Tortora, Berdell R. Funke, Christine L Case Benjamin-Cummings Publishing Company; 2008.
9. Bacterial Systematics, by Logan, A., Niall A. Logan, Wiley-Blackwell; 1994.

10. Bergey's Manual of Determinative Bacteriology (8th edition) by Breed and Buchanan; 1974.
11. Bergey's Manual of Determinative Bacteriology (9th edition) by Breed and Buchanan; 1982.
12. Bergey's Manual of Systematic Bacteriology (2nd edition) by Breed and Buchanan. (Volumes. 1 – 5); 2001- 2003.

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

MIC6.5DCCT-103: Microbial Physiology and Biochemistry

Course Objectives:

This course deals with characteristics, properties and biological significance of the biomolecules of life. In depth knowledge of the energetic and regulation of different metabolic processes in microorganisms.

Course Level Learning Outcomes:

Upon successful completion of the course, the learner will be able to :

CO1	Conceptual knowledge about growth and physiology of microorganisms with respect to various physical and chemical requirements of microbes and get equipped with various methods of their growth measurement.
CO2	The students will understand different microbial transport systems and their importance in microbial physiology.
CO3	Conceptual knowledge of properties, structure, function of enzymes, enzyme kinetics and their regulation ,enzyme engineering, Application of enzymes in large scale industrial processes
CO4	Understanding the laws of thermodynamics , concepts of entropy, enthalpy and free energy changes and their application to biological systems and various biochemical studies and reactions.
CO5	Conceptual knowledge of aerobic and anaerobic respiration and various intermediary mechanisms involved, oxidative phosphorylation
CO6	Overview of major biomolecules –carbohydrates, lipids, proteins, amino acids, nucleic acids, classification, structure, function of the above mentioned biomolecules
CO7	Discuss the biosynthesis and the degradation pathways involved.

Course Description

UNIT-I

Microbial growth: definition of growth, growth curve; The mathematics of growth-generation time, specific growth rate, batch and continuous culture. Temperature -temperature ranges for microbial growth. pH- pH ranges for microbial growth. Microbial transport **:** diffusion – Passive and facilitated, Primary active and secondary active transport, Group translocation (phosphotransferase system), symport, antiport and uniport.

UNIT-II

Structure of atom, molecules and chemical bonds. Biochemistry of enzymes: classification, nomenclature, specificity, isolation and purification. Enzyme kinetics and inhibition. Co-enzymes. Allosteric and other regulations of enzyme activity, Mechanism of action of enzymes.

UNIT-III

Cell metabolism: anabolic principles and synthesis of fatty acids, lipids, amino acids and proteins in microbes. Studies of biosynthesis of hormones. Synthesis of vitamins and their role as

coenzymes. Basic aspects of bioenergetics, entropy and enthalpy. Electron carriers, artificial electron donors, inhibitors, uncouplers, energy bonds and phosphorylation.

UNIT-IV

Brief account of photosynthetic and accessory pigments. Autotrophic generation of ATP and Fixation of CO_2 in Microorganism, Calvin cycle. Oxygenic and anoxygenic photosynthesis. Microbial Oxidation of Inorganic Molecules: sulphur, iron, hydrogen and nitrogen. Bioluminescence.

UNIT-V

Catabolism of carbohydrates, proteins and lipids; Respiratory pathways: Embden Mayer Hoff Parnas pathway, Entner Doudroff pathway, Glyoxalate pathway, Krebs cycle, oxidative and substrate level phosphorylation, Reverse TCA cycle, Gluconeogenesis, Pasture effect; Fermentation of carbohydrates: homo and heterolactic fermentations.

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

REQUIRED READINGS:

1. Biochemistry by Geoffrey L. Zubay. Fourth Edition, Addison-Wesley educational publishers Inc.,2008.

2. Lehninger: Principles of Biochemistry by David L. Nelson and Michael M. Cox.Fifth Edition, W.H.Freeman and Company; 2008.

3. Biochemistry, (2nd edition) by Voet Donald & Voet Judith G.,John Wiley & sons New York; 1995.

4. Physiology and Biochemistry of Prokaryotes(2nd edition) byWhiteDavid,Oxford University Press, NY;2000.

5. HARPERS ILLUSTRATED BIOCHEMISTRY by RODWELL (2015)

6. Lippincott's Illustrated Reviews - Biochemistry, 2nd South Asian ed. (2024)

RECOMMENDED READINGS:

1. Microbial lipids edited by C. Ratledge and SG Wilkinson, second edition, Academic Press; 1988.
2. Microbial Physiology by Albert G. Moat and John W. Foster. (3rd edition), John Wiley and Sons;2002
3. The Physiology and Biochemistry of Prokaryotes by David White. (2nd edition), Oxford UniversityPress; 2000.
4. Biochemistry by Berg Jeremy, Tymoczko John, StryerLubert 6th Edition, W. H. Freeman, New York.(2001)

MIC6.5DCCT-104: Molecular Biology

Course Objectives:

The purpose of this course is to introduce the student to the basic and advanced concepts in molecular biology. Learner will gain an understanding of molecular mechanisms of prokaryotic and eukaryotic DNA Structure, DNA Kinetics, DNA replication, DNA repair, transcription, translation, Transposition, Antitermination, Global regulatory responses and gene regulation. The student will study the techniques and experiments used to understand these mechanisms.

Course Level Learning Outcomes:

Upon successful completion of the course, the learner will be able to :

CO1	Describe structure of DNA and RNA, organization of genome
CO2	Compare the mechanisms of bacterial and eukaryotic DNA Replication
CO3	Explain concepts in DNA repair mechanisms, and recombination as a molecular biology tool.
CO4	Explain various levels of gene regulation in both prokaryotic and eukaryotic organisms
CO5	Describe Transcription and post-transcriptional Processes
CO6	Describe translation mechanism in prokaryotes and eukaryotes, regulation of translation, and post-translational processing
CO7	Describe mechanism of gene regulation, Antitermination.

Course Description

UNIT-I

Genetic Material : Chemical composition and organization, 3-D structure of DNA, linking number, topological properties, supercoiling of DNA, packaging of DNA in pro & eukaryotes. DNA denaturation and renaturation, Coding and non-coding DNA, repetitive DNA sequences,

UNIT-II

DNA replication and repair mechanism: comparison between prokaryotes and eukaryotes, inhibitors of DNA replication, Various modes of replication, continuous, discontinuous synthesis, various replication enzymes, action of topoisomerases, replication fork and priming, leading and lagging strand, elongation, termination, specific features of replication in prokaryotes and eukaryotes

DNA damage, DNA recombination. Transposons and mechanism of transposition.

UNIT-III

Transcription machinery of prokaryotes, various transcription enzymes and cofactors, initiation, elongation and termination, sigma factors, transcription machinery of eukaryotes. Various forms of RNA polymerase and cofactors, initiation, elongation and termination, promoters, enhancers, silencers, activators. Post transcriptional processing

UNIT-IV

Translation in pro- and eukaryotes, Genetic code. The genetic code and protein structure, Mechanisms of translation in prokaryotes: initiation complex, ribosomes and tRNA, factors, elongation and termination, in vitro translation systems, polycistronic/ monocistronic synthesis, Inhibitors of translation, .Regulation of translation. Post translational modifications: Protein modification, folding, chaperones, transportation.

UNIT-V

Mechanism of gene regulation, catabolite repression, Lac and tryptophan operon, ara operon, cis-acting elements, transacting factors, positive and negative regulation, inducers and co-repressors. Negative regulation; regulation by attenuation. Antitermination - Proteins pN, pQ and nut sites,DNA binding sites, Global regulatory responses: heat shock response, stringent response and regulation by small molecules such as ppGpp(p) and cAMP.

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

REQUIRED READINGS:

1. Gene IX by Benjamin Lewin, Jones and Bartlett Publishers, Sudbury, Massachusetts, 2007.
2. Molecular Biology by R.F. Weaver , 4th edition, McGraw Hill. New York. USA, 2007.
3. Molecular Biology of the Gene by J.D. Watson, T.A. Baker, S.P. Bell, A. Gann, M. Levin, R. Losick, 6th edition, Benjamin Cummings, San Francisco, USA, 2007.
4. Molecular Biology of the Cell by B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, P. Walter, 5th edition, Garland Science, New York and London, 2007.

RECOMMEDED READINGS:

1. Biochemistry (5th edition) by J.M. Berg, J.L. Tymoczko, L. Stryer, W.H. Freeman and Company, New York, USA, 2008.
2. 6. Current Protocols in Molecular Biology Edited by: Fred M. Ausubel; Roger Brent; Robert E. Kingston; David D. Moore; John A. Smith; Kevin Struhl, John Wiley and Sons, Inc. 2007

MIC6.5DCCT105: Microbial Genetics and Genetic Engineering

Course Objectives:

The course objectives are to provide an understanding of the genetic constituents of bacteria with special emphasis on various approaches and methods of genetic engineering and their applications.

Course Level Learning Outcomes:

Upon successful completion of the course, students will have the knowledge and skills to:

CO1	Explain the key concepts of extra chromosomal DNA, plasmid types, classic Luria Delbruck experiment, mutations, and mechanisms of genetic exchange.
CO2	The course teaches students with various approaches of genetic engineering and their applications in biological research as well as in biotechnology industries.
CO3	The course will help the students to appreciate the concepts of gene and relationship between genotype and phenotype. They will gain knowledge in gene concepts, gene expression, and gene regulation and also learn about mutation types.
CO4	Through completion the course the students will acquire the knowledge about different methods in molecular cloning, DNA amplification, DNA sequencing, construction and screening of genomic and cDNA libraries and its applications.
CO5	By the end of study in this course, the student will be able to understand nucleic acid hybridization techniques, restriction mapping and gel electrophoresis.

CO6	On successful completion of the subject the student will learn the gene transfer technologies, expression systems and methods of selection.
CO7	After the course students will be able to discuss the characteristics of various types of cloning vectors, restriction analysis, differentiate cloning vector and expression vector, and describe blue/white and red/white screening, antibiotic selection methods of cloning, and various DNA fingerprinting techniques.
CO8	Through the course students will be able to discuss various DNA modifying enzymes used in genetic engineering. Students will learn to perform PCR assays and explain the application of modern biotechnological tools in cutting-edge research. They will be able to review the various applications of genetic engineering.

Course Description

UNIT-I

Bacterial genome, Plasmids: Structure, classification, copy control, incompatibility, F-factor, col and R plasmids. Gene transfer in bacteria: Transformation, transduction, conjugation (F+, F- and Hfr cells)**,** Genetic map, Genetic mapping of *E. coli.* Mutation *versus* adaptation, Luria Delbruck experiment and significance.

UNIT-II

Mutagenesis: Spontaneous and induced mutations, deletions, insertion and point mutations, physico-chemical agents of mutation, mutant selection. Nucleic Acid Hybridization: Southern, Northern, Western Blotting, DNA fingerprinting, Foot printing, Gel retardation assay, Restriction endonucleases,

UNIT-III

Restriction mapping, Polymerase chain reaction, Gel electrophoresis (DNA, RNA and Protein). DNA and RNA sequencing, (16S-23S rRNA), DNA Probes and their applications, RFLP, RAPD, AFLP, Use of microarrays to study gene expression.

UNIT-IV

Genetic Engineering: Plasmids pBR322, PUC18, phagemids, cosmids, BAC, YAC, Expression vectors, Enzymes (Ligases, topoisomerases, Gyrase, Nuclease), Cloning vehicles, Gene transfer techniques: chemical, electroporation, microinjection, particle bombardment.

UNIT-V

Agrobacterium mediated gene transfer. Screening of recombinants, Reporter genes. Construction of cDNA and genomic library, Site directed mutagenesis. Applications of genetic engineering in agriculture, industry and medical, Biosafety regulations, Intellectual property rights, Patenting laws in India.

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

REQUIRED READINGS:

1. Principles of Gene Manipulation: An introduction to Genetic Engineering by R. W. Old, S. B. Primrose, University of California Press, 1980.
2. Molecular Genetics: An Introductory Narrative by Stent, G.S., Calendar, R. 2nd ed. San Francisco: W.H. Freeman, 1978.
3. Molecular Genetics of Bacteria by Larry Snyder and Wendy Champness, 3rd edition; ASM press; 2007.
4. Fundamental Bacterial Genetics by Nancy Trun and Janine Trempy, 1st edition; Blackwell Science Publishers; 2004.
5. Modern Microbial Genetics by U.N. Streips and R.E. Yasbin, 2nd edition; Wiley Publishers; 2002.

RECOMMENDED READINGS:

1. Microbial Genetics by Stanly R. Maloy, John E. Cronan, Jr. & David Freifelder, 2nd edition; Narosa Publishing House; 1987.
2. Molecular Biology by David P. Clarke, 1st edition; Elsevier Academic Press; 2005.
3. Molecular Cloning: A laboratory manual by Joseph Sambrook& David Russell, 3rd edition; CSHL press; 2001.
4. DNA Technology: The Awesome Skill by I. Edward Alcamo, 2nd edition; Hardcourt Academic Press; 2001.
5. Molecular Biology of the Gene by James Watson, Tania Baker, Stephen Bell, Alexander Gann, Michael Levine & Richard Losick , 6th Edition; CSHL Press; 2007.

PRACTICALS

Isolation and identification of bacteria by phenotypic and biochemical tests.

Enrichment and isolation of members of Rhodospirillaceae: analysis of photopigments.

Induction of *β*-galactosidase gene in *E. coli.*

Staining techniques.

Growth curve analysis.

Media preparation, sterilization, inoculation and incubation methods.

Microbiological studies of air, water and soil.

Evaluation of antimicrobial chemical agents by log reduction method

Effect of following on the growth of microbes-

(a) Temperature, (b) Aeration, (c) pH, (d) Salts, (e) Nutrients.

Quantitative tests for Carbohydrates, fats, proteins, chlorophyll, Nucleic acids

Isolation of carbohydrates, proteins and fats.

Chromatographic separation methods for pigments and amino acids.

Study of Enzyme kinetics

Preparation of biologically important buffers

Protein purification using various column chromatography, SDS-PAGE and NATIVE PAGE analysis.

Identification and screening of autotrophic mutants of *E. coli* by replica plating

PCR amplification of DNA

Electrophoresis of DNA/RNA/Protein.

Isolation of DNA/RNA from plant, animal cell, bacteria.

Transformation and Conjugation in Bacteria

Restriction digestion, ligation of DNA and cloning in bacteria

Randomly Amplified Polymorphic DNA (RAPD) analysis in bacteria

16SrDNA gene amplification analysis for sequencing

Semester II

Marking Scheme for External Exam

Theory Papers	Duration	Max Marks
MIC6.5VACT201 (Internal Non-CGPA)		
MIC6.5DCCT202	3 Hrs	80
MIC6.5DCCT203	3 Hrs	80
MIC6.5DCCT204	3 Hrs	80
MIC6.5DCCT205	3 Hrs	80
MIC6.5DCCT206	3 Hrs	80

MIC6.5VACT201: NATIONAL AND HUMAN VALUES

Course Objectives:

1. To inculcate national and human values in the students.
2. To enable the students to imbibe the Indian cultural ethos.
3. To inculcate the spirit of Patriotism so that the students develop a sense of strong bond with the nation.
4. To enable the students to grow into a citizen possessing civic sense.

Course Outcomes:

1. On the completion of the course the students shall be able to:
2. Attain the civic skills enabling him/her to become a well-behaved citizen of the country.
3. Imbibe and spread the feelings of devotion and dedication.

Course Description

Unit-I

NCC – Introduction, Aims, NCC Flag, NCC Song, NCC Administration, Raising of NCC in Schools/Colleges, NCC: Rank, Honours and Awards, NCC Training, NCC Camps, NCC Examinations, Incentive and Scholarship for Cadets.

Importance of Discipline in life, Aims and Merits of Discipline, Problems related to Indiscipline and Solutions.

Drill – Definition, Principles of Drill, Bad habits in drill, Words of Command, Drill Movements, Arms Drill, Squad Drill, Guard of Honour, Ceremonial Drill, Guard Mounting.

Contribution of NCC in Nation Building.

Unit-II

Armed Forces – Control Command, Organization of Armed Forces, Weapons of Army, Navy and Air Force, Training institutes, Honours and Awards, Recipients of Param Veer Chakra, Badges of Ranks.

Commission in Armed Forces – Recruitment in Armed Forces, Commission in Technical, Non-Technical and Territorial Forces.

Weapon Training – 0.22 Rifle, 7.62 Rifle, 7.62 SLR (Self Loading Rifle), 5.56 MM I.N.S.A.S. Rifle, L.M.G. (Light Machine Gun), Stan Machine Carbine, 2" Mortar, Grenade, Pistol, Various types of Firing, Range Procedure and Range Drill.

Military History and Geography, Field Craft, Field Engineering, Battle Craft.

Unit-III

Obstacle Training. Adventure Training, Self Defence, Physical Posture Training.

Social Service, Disaster Management, Health and Hygiene, First Aid.

Leadership, Personality Development, Decision Making, Motivation, Duty and Discipline, Morale.

Unit-IV

Value system – The role of culture and civilization-Holistic living.

Balancing the outer and inner – Body, Mind and Intellectual level- Duties and responsibilities.

Salient values for life- Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, and inclusiveness.

Self-esteem and self-confidence.

Punctuality – Time, task and resource management, Team work.

Positive and creative thinking.

Unit-V

Universal Declaration of Human Rights.
Human Rights violations.
National Integration – Peace and non-violence (in context of Gandhi, Vivekanand).
Social Values and Welfare of the citizen.
The role of media in value building.
Fundamental Duties.
Environment and Ecological balance – interdependence of all beings – living and non-living.

Assessment and Evaluation

Scheme of Examination

Internal Assessment: Internal assessment plays a vital role in the broader framework of continuous evaluation within the university and its affiliated colleges. This assessment process may involve a variety of criteria determined by the assessor, such as teachers or heads of departments. The outcomes of these assessments, classified as either satisfactory or unsatisfactory, will be submitted to the university.

Suggested Readings:

1. Hand Book of NCC: Major R C Mishra & Sanjay Kumar Mishra
2. National Security: K. Subramanyam
3. ASEAN Security: Air Comdr. Jasjit Singh

4. Indian Political System, Dr. Pukhraj Jain & Dr. Kuldeep Fadiya
5. NCERT, Education in Values, New Delhi, 1992
6. M.G. Chitakra: Education and Human Values, A.P.H. Publishing Corporation, New Delhi, 2003
7. Chakravarthy, S.K.: Values and Ethics for Organizations: Theory and Practice, Oxford University Press, New Delhi, 1999
8. Satchidananda, M.K.: Ethics, Education, Indian Unity and Culture, Ajantha Publications, Delhi, 1991
9. Das, M.S. & Gupta, V.K.: Social Values among Young Adults: A Changing Scenario, M.D. Publications, New Delhi, 1995
10. Bandiste, D.D.: Humanist Values: A Source Book, B.R. Publishing Corporation, Delhi, 1999
11. Ruhela, S.P.: Human Values and Education, Sterling Publications, New Delhi, 1986
12. Kaul, G.N.: Values and Education in Independent India, Associated Publishers, Mumbai, 1975
13. Swami Budhananda (1983): How to Build Character A Primer, Ramakrishna Mission, New Delhi
14. A Cultural Heritage of India (4 Vols.), Bharatiya Vidya Bhavan, Bombay (Selected Chapters Only)
15. For Life, For the Future: Reserves and Remains – UNESCO Publication
16. Values, A Vedanta Kesari Presentation, Sri Ramakrishna Math, Chennai, 1996
17. Swami Vivekananda, Youth and Modern India, Ramakrishna Mission, Chennai
18. Swami Vivekananda, Call to the Youth for Nation Building, Advaita Ashrama, Calcutta
19. Awakening Indians to India, Chinmayananda Mission, 2003

MIC6.5DCCT202: Virology

Course Objectives:

The objectives of this course are to provide basic understanding of the nature of human and plant viruses (including phages), viral classification, cultivation of viruses and viral diseases.

Course Level Learning Outcomes:

Upon successful completion of the course, students will have the knowledge and skills to:

CO1	Learn and explain the nature, structure, general properties and importance of different animal and plant DNA and RNA viruses. They will also learn various physical and chemical methods to assay viruses.
CO2	The students will know about viral transmission, salient features of viral nucleic acids, replication and several diseases caused by viruses.
CO3	Students will be acquainted with the bacteriophage structural organization, lytic and lysogenic cycles and its molecular mechanisms as well as bacteriophage typing.
CO4	Through this course students will know the methods used in studying viruses, discern the replication strategies of representative viruses from the seven Baltimore classes.
CO5	The students will comprehend the intricate interaction between viruses and host cells and will understand the interactions between viruses and the host immune system.
CO6	Students will be acquainted with the terms oncogenes and tumor suppressor genes, and how tumor viruses interact with these products and their intersecting pathways and cause oncogenesis.
CO7	Students will be able to define and explain vaccine strategies and mechanisms of antiviral drugs.

Course Description

UNIT-I

Virology: Brief outline on discovery of viruses, Classification and nomenclature of viruses: distinctive properties and ultrastructure of viruses; DNA and RNA viruses, Replication of different groups of viruses.

UNIT-II

Cultivation of viruses in embryonated eggs, experimental animals and cell cultures. Assay of viruses: physical and chemical methods (Protein, nucleic acid, radioactivity, electron microscopy), Infectivity assay (plaque method, end point method).

UNIT-III

Bacteriophage structural organization; Lytic and lysogenic cycles (molecular mechanisms), bacteriophage typing and its application in bacterial genetics; brief details on M13, T, Lamda and P1 phage.

UNIT-IV

Classifications and nomenclature of plant viruses; brief details of plant viruses like TMV, Cauliflower Mosaic Virus and Potato virus X; transmission of plant viruses. Classification and nomenclature of animal and human viruses.

UNIT-V

Brief details of RNA viruses Picorna, OrthoMyxo, Paramyxo, Toga viruses, Rhabdo, Rota, HIV, Corona and Oncogenic Viruses; DNA viruses; Pox, Herpes, Adeno SV40; Hepatitis viruses, viral vaccines.

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

REQUIRED READINGS:

1. Principles of Virology: Molecular Biology, Pathogenesis and Control of Animal Viruses by S.J. Flint, L.W. Enquist, V.R. Racaniello, and A.M. Skalka 2nd edition, ASM Press, Washington, DC, 2004.
2. Introduction to Modern Virology EPZ by Nigel Dimmock, Andrew Easton and Keith Leppard, 5thedition, Blackwell Publishing, 2005.

3. Human virology by Collier, L H (Leslie Harold), Kellam, Paul; Oxford, J S (John Sidney). 4th ed., Oxford : Oxford University Press, 2011.

RECOMMENDED READINGS:

1. Basic Virology by Edward K. Wanger, Martinez Hewiett, David Bloom and David Camerini, 3rd edition, Blackwell Publishing, 2007.
2. Principles of Molecular Virology by Alan J. Cann, 3rd edition, Elsevier Academic Press, 2001.
3. Plant Virology by Roger Hull, 4th edition, Academic press, 2002.

MIC6.5DCCT-203: Bioinstrumentation

Course Objectives:

To introduce the learner to the basic concept of qualitative and quantitative analysis of various biological samples. Students would be taught about the biophysical and biochemical techniques currently available to investigate the structure and function of the biological macromolecules. Learner would be made aware about the various separation techniques and its instrumentation, principles behind each technique, make them familiar with various methods of analysing the output data and to build a strong foundation in the area of microbiology.

Course Learning Outcomes:

Upon successful completion of the course, the student will able to:

CO1	carry out the analysis of cellular structure using different type of microscopies.
CO2	describe the techniques of vertical electrophoresis under native and SDS conditions.
CO3	describe the techniques of horizontal electrophoresis.
CO4	design a multi-step purification protocol to carry out spectroscopy.
CO5	understand and correctly interpret various chromatographic techniques.
CO6	understand the process of separation through centrifugation.
CO7	perform different immunological and serological testing’s

Course Description

UNIT-I

Microscopy: Principles and use of light microscope, bright-field, dark-field, phase-contrast, fluorescent, electron microscopy (SEM, TEM), confocal microscopy and scanning probe microscopy. Specimen preparation for light microscopy and electron microscopy, staining of specific structures, fixatives and dyes, principle and uses of simple staining and differential staining. Principle and working of instruments used for sterilization.

UNIT-II

Electrophoresis: Principle of Electrophoresis. Moving boundary and Zonal techniques, supporting medium, Agarose Gel Electrophoresis, Polyacrylamide gel electrophoresis: native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis, gradient and two dimensional electrophoresis. Isoelectric focusing. Counter current Electrophoresis, Immuno-Electrophoresis. Southern and Western Blot.

UNIT-III

Interaction of Electromagnetic radiation with matter: scattering and absorption. Spectroscopy: Beer-Lambert relationship, components of a spectrophotometer, type of detectors; UV-Vis spectrophotometry: Instrumentation, Analysis of biomolecules using UV-Vis spectroscopy. Atomic absorption spectroscopy. Colorimetry and turbidometry, Introduction to emission spectroscopy: Fluorescence and Phosphorescence. Applications of spectroscopy.

UNIT-IV

Chromatography: Adsorption Chromatography, liquid Chromatography, Gas- liquid Chromatography, Ion exchange Chromatography, Affinity Chromatography, GC-MS, HPLC. Biological applications of different Chromatographic techniques. pH meter,

UNIT-V

Principles of sedimentation: Boundary and Zone sedimentation; Factors affecting sedimentation velocity and sedimentation co-efficient. Working and Application of Preparative and analytical centrifugation, RCF and sedimentation coefficient. differential centrifugation, isopycnic, density gradient centrifugation and ultracentrifugation and their applications.

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

REQUIRED READING:

1. Principles and Techniques of Biochemistry and Molecular Biology. (6^{th}Edition) by Wilson K. & Walker J. Cambridge University Press. 2008.

2. Biochemistry (6th edition) by Berg J. M., Tymoczko J. L. &Stryer, L. W.H. Freeman and Company, New York; 2007.

3. Foundations in Microbiology (6th edition) by Talaro K. P. &Talaro A. McGraw-Hill College, Dimensi;2006.

4. Analysis of Biological Molecules: An Introduction to Principles, Instrumentation and Techniques, by Potter G. W. H. & Potter G. W. Kluwer Academic Publishers; 1995.

5. Prescott/Harley/Klein's Microbiology by Willey J., Sherwood L. and Woolverton C. McGraw Hill; 2007.

RECOMMENDED READING:

1. “Dynamics of Water and Ions near DNA: Perspective from Time-Resolved Fluorescence Stokes Shift Experiments and Molecular Dynamics Simulation” Him Shweta, Nibedita Pal, Moirangthem Kiran Singh, Sachin Dev Verma and Sobhan Sen* Book Chapter in Reviews in Fluorescence 2017, Springer (DOI: https://doi.org/10.1007/978-3-030-01569-5).

2. “New Family of Fluorescent Probes for Characterizing Depth-Dependent Static and Dynamic Properties of Lipid/Water Interfaces” Moirangthem Kiran Singh, Him Shweta and Sobhan Sen* Book Chapter in Analysis of Membrane Lipids 2020, Springer (DOI: https://doi.org/10.1007/978-1-0716-0631-5_10

MIC6.5DCCT-204: Eukaryotic Microbiology

Course Objectives:

This course deals with detailed general characteristics, life cycle and important agricultural and biotechnological applications of important Fungi, Yeats, Algae and Protozoa.

Course Level Learning Outcomes:

Upon successful completion of the course, the learner will be able to :

CO1	The students will gain knowledge about general characteristics and life cycle of important fungi such as *Dictyostelium, Rhizopus, Saccharomyces, Candida, Trichoderma, Penicillium, Gliocladium* etc.
CO2	The students will gain knowledge about Fungal endophytes of tropical plants and their applications.
CO3	The students will gain knowledge about Agriculturally important toxigenic fungi, their biodiversity, and application of toxigenic fungi in sustainable agriculture.
CO4	The students will gain knowledge about Mycorrhizal fungi: their diversity and importance in agriculture and plant growth in general, and recent advances in the field of mycorrhiza.
CO5	The students will know various biotechnological applications of yeasts.
CO6	The students will understand General Characteristics and Life Cycle of important Algae such as *Volvox, Chlamydomonas, Sargassum, Fucus, Gracileria* and *Gelidium.*
CO7	The students will know various biotechnological applications of algae.
CO8	The students will know the general characteristics and life cycle of various important Protozoa such as *Entamoeba, Trypanosoma, Plasmodium,* and *Coccidia.*

Course Description

UNIT-I

General Characteristics and Life Cycle of important Fungi- *Rhizopus, Saccharomyces, Candida, Trichoderma, Penicillium, Gliocladium, Fusarium, Helminthosporium, Alternaria,*

Albugo. Fungal endophytes of tropical plants and their applications: Endophytic fungi, colonization and adaptation of endophytes.

UNIT-II

Agriculturally important toxigenic fungi: Biodiversity, toxigenic fungi in sustainable agriculture with special emphasis on biopesticides. Mycorrhizal fungi: Diversity of endo- and ectomycorrhizal fungi. Biology of arbuscular mycorrhizal fungi: signaling, penetration and colonization inside roots, culturing and benefits, recent advances in the field of mycorrhiza.

UNIT-III

Biotechnological applications of yeasts: Yeasts as producers of bioactive molecules such as pigments, lipids, organic acids and EPS, yeasts as probiotics, yeasts in bioremediation, yeasts in alcoholic fermentations. Biotechnological applications of filamentous fungi: in the synthesis of chemicals, enzymes, acids, foodstuffs, therapeutics, in construction and as textile materials.

UNIT-IV

General Characteristics and Life Cycle of important Algae- *Volvox* and *Chlamydomonas, Sargassum* and *Fucus, Gracileria* and *Gelidium*. Algal diversity from morphology to molecules: Importance of algae in production of algal pigments, biofuels, hydrogen production, important bioactive molecules, role of algae in sustainable environment.

UNIT-V

General Characteristics with emphasis on distribution and occurrence, morphology and mode of reproduction in Amoeba, Paramecium and Giardia. Life Cycle of important Protozoa- *Entamoeba, Trypanosoma, Plasmodium* and *Coccidia.*

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25

marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

REQUIRED READINGS:

1. Fundamentals of the fungi by Elizabeth Moore, Fourth edition, Benjamin Cummings; Landecker;1996.
2. Mycotechnology: Present status and future prospects. Edited by MahendraRai.I.K., International Publishing House Pvt. Ltd.; 2007.
3. The Yeast Handbook: Biodiversity and Ecophysiology of yeasts by Carlos A. Rosa and Gabor Peter. Springer- Verlag Berlin Heidelberg; 2006.
4. Algae: Anatomy, Biochemistry and Biotechnology by Laura Barsanti and Paolo Gualtieri. Taylor and Francis Group, LLC; 2006.
5. Prescott. Microbiology 14. Joklik W.K., Zinssers. Microbiology. Mc Graw Hill.

RECOMMENDED READINGS:

1. Burnett J.H. Fundamentals of Mycology. Edwar Arnold, Crane Russak.
2. Charlie M. and Watkinson S.C. The Fungi. Academic Press.
3. Moore E. Landeekeer. The Fundamentals of Fungi. Prentice Hall.
4. Venkataraman G.S., Goyal S.K., Kaushik, B.D. and Rouchoudhary, P. Algae-Form and Function.
5. Alexopolous C.J. and Mims C.W. 1979. Introduction to Mycology (3/e). Wiley Eastern, New Delhi.
6. Kotpal R.L. Protozoa.
7. Mehrotra RS and Aneja KR 1990. An introduction to Mycology. New Age Int Pub.
8. E. Moore & Lendecker Fundamentals of the fungi
9. I.K. Ross Biology of the fungi
10. Alan T. Bull. Microbial Diversity and Bioprospecting. ASM press. Washington, D.C.

11. Stanier RY, Ingraham J.L., Wheelis M.L., Painter P.R. 1999. General Microbiology. MacMillan Education Ltd., London.
12. Schlegel. General Microbiology. Cambridge University Press, Cambridge.

MIC6.6DCCT-205: Industrial Microbiology

Course Objective:

This course elaborates on various processes and instruments used in Industrial and food Microbiology. It deals with different types of industrially important microorganisms, their growth and preservation methods and their application in different processes related to industrial and food microbiology.

Course Level Learning Outcomes:

Upon successful completion of the course, the learner will be able to :

CO1	Comprehend the theoretical and practical understanding of industrial microbiology
CO2	Know how to screen and isolate microorganisms of industrial importance from the environment
CO3	Know about design of bioreactors and factors affecting their growth and production.
CO4	Understand the rationale in medium formulation & design for microbial fermentation, sterilization of instrument medium and air.
CO5	Appreciate the different types of fermentation processes
CO6	Identify techniques applicable for Improvement of microorganisms based on known biochemical pathways and regulatory mechanisms
CO7	Comprehend the techniques and the underlying principles used in downstream processing.
CO8	Understand the role of microorganisms in food spoilage and preservation.

Course Description

UNIT-I

Introduction to fermentation processes, history of fermentation process.

Bioreactors: Design and components- vessel materials, baffles, impellers, inoculation and sampling devices, biosensors etc., biohazard and containment. Types of bioreactors: airlift, fluidized bed, micro-carrier, photo-bioreactor, stirred bioreactor.

UNIT-II

Isolation, selection, screening, preservation and maintenance of industrially important microorganisms. Formulation of fermentation media: energy source, water, nitrogen source, minerals, chelators, growth factors, buffers, precursors, inhibitors and antifoam agents, Optimization of media. Media and air sterilization.

UNIT-III

Types of fermentation processes with Growth kinetics: Batch, continuous and fed batch. Downstream processing: foam separation, cell disruption, industrial scale centrifugation, liquid-liquid extraction, solvent recovery, chromatography, two phase aqueous extraction, drying and crystallization.

UNIT-IV

Production process for Yeast (Bakers, food and fodder), Single cell protein (SCP), Single cell and Single cell oil (SCO), lactic acid, Beer, Wine, Whisky, Sauerkraut, Bread, amylases and proteases, penicillin, streptomycin, Riboflavin.Immobilization of cells and its industrial application (Pharmaceutical, food and chemical industries).

UNIT-V

Production of non-microbial products through GEMs: insulin, cell growth factors, tissue plasminogen activator. Bioplastic (PHB, PHA), Steroid transformation. Production of bioinsecticides. Vaccine types: live, attenuated and recombinant and their production.

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each

question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

REQUIRED READINGS:

1. Biotechnology: A Text Book of Industrial Microbiology by W. Crueger & A. Crueger, Panima Publishing Corporation, New Delhi/Bangalore, 2000.

2. Principles of Fermentation Technology by P.F. Stanbury, W. Whitaker &S.J. Hall, Aditya Books (P) Ltd., New Delhi, 1997.

3. Modern Industrial Microbiology & Biotechnology by N. Okafer, Scientific Publishers, Enfield, USA.,2007.

4. Fermentation Microbiology and Biotechnology by El Mansi & Bryce, Taylor & Francis, London, Philadelphia, 1999.

5. Fermentation Biotechnology by O.P. Ward, Open University Press, Milton Keynes, U.K., 1989

6. Industrial Microbiology: An Introduction by Waites, Morgan, Rockey& Highton, Blackwell Science, 2001.

7. Biochemical Engineering and Biotechnology by B. Atkinson & F. Mavituna , The Nature Press, 1982

8. Microbial Biotechnology: Fundamentals of Applied Microbiology by Glazer & Nikaido , W.H. Freeman and Co., New York, 1995.

9. Modern Food Microbiology, 4th edition by J.M. Jay, Springer, 2006.

10. Fundamental Food Microbiology, 3rd edition by B. Ray., CRC press, 2006.

11. Food Microbiology: Fundamentals and Frontiers, 2nd edition by Michael P. Doyle, Larry R. Beuchat, Thomas J. Montville, ASM press, 2001.

12. Food Microbiology by M.R. Adams & M.O. Moss., Royal Society of Chemistry, 2000.

RECOMMENDED READINGS:

1. Modern Industrial Microbiology & Biotechnology by N. Okafer, Scientific Publishers, Enfield, USA., 2007.
2. Fermentation Microbiology and Biotechnology by El Mansi & Bryce, Taylor & Francis, London, Philadelphia, 1999.
3. Fermentation Biotechnology by O.P. Ward, Open University Press, Milton Keynes, U.K., 1989

4. Industrial Microbiology: An Introduction by Waites, Morgan, Rockey & Highton, Blackwell Science, 2001.
5. Biology of Industrial Microorganisms A.L. Duncun
6. Microbial Biotechnology A. N. Glazer and H. Nikaido
7. Molecular Industrial Mycology Leong & Berka
8. Manual of Industrial Microbiology and Biotechnology, Demain & Davies, 2nd ed.
9. Microbial Biotechnology A. N. Glazer and H. Nikaido
10. Biotechnology An Introduction Susan R. Barnum 22. Topics in Enzyme & Fermentation Biotechnology Volumes by Wisemen

PRACTICALS

Mounting and staining of fungal specimens, microscopic examination of bacteria, fungi, protozoa and nematodes
Chick embryo inoculation for viruses.
Estimation of infectivity titre of a virus sample using Plaque assay.
Production of purified virus stock and its quantification.
Study of virus infected plant material.
Isolation of Probiotic bacteria from milk and curd
Study of dimorphism in yeast
Testing of milk by MBRT.
Isolation and cultivation of fungi and protozoa.
Microbial examination of food and milk
Sample collection and biomass determination for small scale fermentation
To determine the specific growth rate and generation time of a bacterium during submerged fermentations.
To determine R: S ratio of bacteria by CFU counts.
To determine phenol coefficient
To determine Thermal death time and thermal death point.
To check the calibration of spectrophotometer
To check and verify Lambert- Beer Law
To find out the λ-max (absorption spectra) of $K_2Cr_2O_7$, $CuSO_4$, proteins and nucleic acids.
To grow yeast and fungus in artificial medium and to calculate the yield and productivity of biomass produced.
To make wine from different juices by fermentation.
To demonstrate production of sauerkraut and cheese.
To investigate heavy metals/pesticides etc. in the given food and water sample.

Semester 3

Marking Scheme for External Exam

Theory Paper	Duration	Max. Marks
MIC6.5SDC301 (BCS) or MIC6.5SDC301 (BCC) or MIC6.5SDC301 (SAW)		NON CGPA
MIC6.5DCCT302	3 Hrs.	80
MIC6.5DCCT303	3 Hrs.	80
MIC6.5DSET304 (A) or MIC6.5DSET304 (B)	3 Hrs.	80
MIC6.5DSET305 (A) or MIC6.5DSET305 (B)	3 Hrs.	80
MIC6.5DCCP306	6 Hrs.	160

MIC6.5SDC301 (BCS)

Basics of Communication Skills

Course Objectives

- **T**o familiarize learners with the work-place culture and employability skills
- To equip learners with verbal and non-verbal communication skills which will help them to deliver audience-appropriate presentation using the strategies learnt
- To boost student's self-confidence through honing their interpersonal skills like team management skills, and leadership skills, time management skills, negotiation skills, problem solving skills and critical thinking skills.
- To develop and enhance the linguistic and communicative competence of the students
- To apply the skills of reading, writing, listening, and speaking
- To exposed the students to various forms of personal and professional communication
- To enhance effective communication skills in a modern, globalized context

Course Level Learning Outcomes

On the successful completion of the Course, the students shall be able to

- Develop awareness of their professional and ethical responsibilities.
- Demonstrate verbal and non-verbal communication skills that will enable them to deliver presentations effectively.
- Demonstrate the ability of self-management with confidence by developing behavioural skills and interpersonal skills.
- Communicate effectively with their peers/companions/others
- Enhance speaking, listening and writing skills
- Effectively write blogs, speech, reviews and draft letters, memos, reports. etc

Course Description

Unit I

Orientation

- Introduction to Soft Skills
- Difference between Hard skills and soft skills
- Need and Significance of Soft skills
- Soft skills and Social, Academic and Professional Career
- Understanding job market requirements

Unit II

Communicating at work

a. Verbal Communication

- Introducing oneself professionally
- Face to Face interaction
- Appreciation and constructive Feedback (giving and responding)
- Telephone etiquettes
- Effective listening
- Social media Etiquette
- Video conferencing Etiquette

b. Non-verbal Communication

- Visual presentation and perception
- Body language (Kinesics)
- Touch (Haptics), space (Proxemics) and time (Chronemics)
- Communicating Confidence non-verbally
- Non-Verbal professional/business and social etiquettes

c. Communicating at Job interviews

- Types of interviews
- Preparatory steps for job interviews
- Dos and Don'ts of Job interviews

Unit III

- Personal & Emotional Management
- Goal Setting & Motivation
- Managing your time
- Resilience skills
- Teamwork
- Managing conflict and appreciating/respecting differences
- Decision making & effective negotiation
- Leadership
- Problem solving

Unit IV

Language Skills and Communication

(A) Listening: Types of listening, Purpose of listening

(B) Speaking: An Acquaintance with English Sounds – Vowels and Consonants, English in Situations

(C) Reading Skills: Seen and Unseen Comprehension Passages & Poems, Skimming, Scanning, Extensive Reading, Intensive Reading

Unit V

- Writing Skills
- Report Writing
- Book Review
- CV/Resume/Biodata
- Notice
- Meeting Minutes
- Email Writing
- Note – Making and Note -Taking

Required Readings

1. Pease, Allan. 1998. *Body Language:* How to Read Others Thoughts by their Gestures. Suda Publications. New Delhi.
2. Peter, Francis. *Soft Skills and Professional Communication.* New Delhi: Tata McGraw Hill.2012
3. Singh, Prakash and Raman, Meenakshi. *Business Communication.* New Delhi: Oxford UP.2006.
4. Bailey, Edward P. *Writing and Speaking at Work*: A Practical Guide for Business Communication. Pennsylvania: Prentice Hall. 2007.
5. Pease, Allan and Peas, Barbara. *The Definitive Book of Body Language*. New York: Random
6. House. 2006.
7. Johnson, D.W. (1997). Reaching out – Interpersonal Effectiveness and Self Actualization. 6th ed. Boston: Allyn and Bacon.

Suggested Readings

1. Hemphill, Phyllis Davis, Donald W. McCormick, and Robert D. Hemphill. Business Communication with Writing Improvement Exercises. Pearson College Division, 2001.
2. Locker, Kitty O., and Stephen Kyo Kaczmarek. Business Communication: Building Critical Skills. New York: McGraw-Hill Irwin, 2014.
3. Murphy, Herta A., Herbert William Hildebrandt, and Jane Powel Thomas. Effective Business Communications. New York: McGraw-Hill, 1997.
4. Raman, Meenakshi, and Sangeeta Sharma. Technical Communication: Principles and Practice. New Delhi: Oxford University Press, 2015.
5. Kaul, A. Effective Business Communication. Prentice-Hall of India, 2015.
6. Ghosh, B. N. Managing Soft Skills for Personality Development. Tata McGraw-Hill, 2017.
7. Burke, Daniel. Improve Your Communication Skills. Maanu Graphics Publishers, 2012.
8. Maxwell, John C. The 17 Indisputable Laws of Teamwork: Embrace Them and Empower Your Team. HarperCollins Leadership, 2013.
9. Tulgan, Bruce. "Bridging the Soft-Skills Gap." Employment Relations Today 42.4 (2016): 25-33.

10. Higgins, Jessica. 10 Skills for Effective Business Communication: Practical Strategies from the World's Greatest Leaders. Tycho, 2018.
11. Mitra, Barun K. Personality Development and Soft Skills. Vol. 156. Oxford University Press, 2011.
12. Kumar, Sanjay and Pushp Lata. Communication Skills. Oxford University Press, 2013.
13. C.S.G. Krishnamacharyulu and R. Lalitha. Business Communication. Himalaya Publishing House, 2013.
14. Quintanilla, Kelly M., and Shawn T. Wahl. Business and Professional Communication: Keys for Workplace Excellence. Sage Publications India, 2011.
15. Daniel G. Riordan, Steven E. Pauley. Biztantra: Technical Report Writing Today, 8th Edition. 2004.
16. Bovee, Courtland L., John V. Thill, and Barbara E. Schatzman. Business Communication Today: Seventh Edition. Delhi: Pearson Education, 2004.
17. Lesikar, Raymond V., and Marie E. Flatley. Basic Business Communication: Skills for Empowering the Internet Generation: Ninth Edition. New Delhi: Tata McGraw-Hill Publishing Company Ltd., 2002.
18. Pease, Allan and Barbara Pease. The Definitive Book of Body Language. New Delhi: Manjul Publishing House, 2005.
19. Lesikar, Raymond V., and John D. Pettit. Report Writing for Business. Boston: McGraw-Hill, 1998.
20. Ruesh, Jurgen, and Weldon Kees. Nonverbal Communication: Notes on Visual Perception of Human Relations. Berkeley: University of California Press, 1966.

Scheme of Examination

Internal Assessment: Internal assessment plays a vital role in the broader framework of continuous evaluation within the university and its affiliated colleges. This assessment process may involve a variety of criteria determined by the assessor, such as teachers or heads of departments. The outcomes of these assessments, classified as either satisfactory or unsatisfactory, will be submitted to the university.

MIC6.5SDC301 (BCC)

Basic Computer Course

Course Objectives:

CO1. To understand the characteristics of computers

CO2. To know about the generations of computers

CO3. To have knowledge about computer languages

CO4. To understand the basics of an operating system

CO5. To be acquaint with word processor, spreadsheet, and presentation

CO6. To understand and apply the concept of algorithms and algorithm analysis

CO7. To know about some unsolved problems of computer science

Learning Outcomes:

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

LO1. Understanding of the characteristics of computers

LO2. Know about the generations of computers

LO3. Having knowledge of computer languages

LO4. Understanding of the basics of operating system

LO5. Acquaintance with word processor, spreadsheet, and presentation

LO6. Understanding and ability to design algorithms

LO7. Know about some unsolved problems of computer science

Unit I

Basics: Block Diagram, characteristics, generations of computers, classification of computers; Binary number system, Limitations of Computers, Primary and secondary memory, Input and output devices.

Unit II

Computer languages: Machine language, assembly language, higher-level language, 4GL. Introduction to Compiler, Interpreter, Assembler, System Software, Application Software. Operating System: Features of Windows, Linux, Macintosh, Android. Open-source software: concept and examples.

Unit III

Word Processing software: different formats for saving a word document, creating, and editing documents and related operations, formatting features and associated operations, spelling and grammar checker, headers and footers, creating and managing tables; printing, macros, mail merge, equation editor.

Unit IV

Spreadsheet Software: Workbook, worksheets, data types, operators, cell formats, freeze panes, editing features, formatting features, creating formulas, using formulas, cell references.

Unit V

Presentation Graphics Software: Templates, views, formatting slides, slides with graphs, animation, using special features, presenting slide shows.

Scheme of Examination

Internal Assessment: Internal assessment plays a vital role in the broader framework of continuous evaluation within the university and its affiliated colleges. This assessment process may involve a variety of criteria determined by the assessor, such as teachers or heads of departments. The outcomes of these assessments, classified as either satisfactory or unsatisfactory, will be submitted to the university.

Recommended Readings:

1. P.K Sinha, Computer Fundamentals, BPB Publications.
2. Rajaraman, Fundamentals of Computers, Fourth Edition, Prentice-Hall India Pvt. Limited.

Suggested Readings

3. Peter Norton, Introduction to Computers, 4th Edition, TMH Ltd, New Delhi.
4. R.G. Dromey, how to solve it by Computers, Pearson Publishers, New Delhi.
5. Dorothy House, Microsoft Word, Excel, and PowerPoint: Just for Beginners.

Web resources:

1. Computer Fundamentals Tutorial Index
2. Excel Tutorial

3. MS Word Tutorial - W3schools
4. PowerPoint tutorial - W3schools

MIC6.5SDC301 (SAW)

Seminar and Academic Writing

Scheme of Examination: To assess and evaluate a Student Seminar and Academic Writing Course, criteria should include content mastery, presentation skills, and academic writing proficiency.

Internal Assessment: Internal assessment plays a vital role in the broader framework of continuous evaluation within the university and its affiliated colleges. This assessment process may involve a variety of criteria determined by the assessor, such as teachers or heads of departments. The outcomes of these assessments, classified as either satisfactory or unsatisfactory, will be submitted to the university.

MIC6.5DCCT-302: Immunology

Course Objectives:

The objective of this course is to provide a detailed overview of the immune system to the learners. The learner will understand structure, organization and functions of various components of the immune system like antigen, antibody, organs, MHC, cytokines and others in the defence system of the body. It would also make them understand the concepts of innate and adaptive immunity, immune diversity and specificity, autoimmunity, hypersensitivity, transplantation and others.

Course Level Learning Outcomes:

Upon successful completion of the course, the learner will be able to :

CO1	describe the fundamental bases of immune system and immune response
CO2	explain about the importance of innate immunity and acquired immunity
CO3	describe the structure and organization of various components of the immune system
CO4	describe the genetic basis for the expression of immune cell receptors and generation of immunological diversity, complement system
CO5	understand the operation and the mechanisms which underlie the immune response
CO6	explain knowledge of various diseased conditions generated due to interplay of immune system components.

CO7	perform different immunological and serological testings

Course Description

UNIT-I

Fundamental concepts in immunology: Specificity, discrimination of self from non-self and memory. Historical background: Louis Pasteur, Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, MacFarlane Burnet, Rodney Porter etc.

Humoral and Cellular components of the immune system. Innate Immunity: Skin & mucosal surface, Physiological Barriers, Phagocytic barriers, Inflammation, Adaptive immunity.

UNIT-II

Immunological Cells: Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell etc.

Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT.

Detailed structure and development of B cell (Ig) and T cell (TcR) receptors; Structure of CD4 and CD8

Antigens: Structure, properties, types, epitopes, haptens. Immunogens, Adjuvants.

UNIT-III

Antibodies: Structure, function and diversity, antibody mediated functions, classes and biological activities. Antigen-Antibody Interaction. Hybridoma technology and monoclonal antibodies,

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells. Antibody-dependent cell-mediated cytotoxicity.

Cytokines (Properties, receptors, antagonism & secretion).

UNIT-IV

Organization of MHC locus; Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways).

The complement system: Classical, Lectin and Alternative pathway; functions, components, activation, regulation and deficiencies.

Diversity of key immunological molecules like Antibody, TCRs and MHC

UNIT-V

Hypersensitive reactions (Type I,II,III and delayed type (DTH). Immune response to infectious diseases: viral, bacterial and protozon. Vaccines.Immuno-deficiencies.

Transplantation; Graft rejection, mechanism and prevention, HLA and disease**.**

Autoimmunity; Organ specific and systemic,Autoantibodies, experimental models

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

REQUIRED READINGS:

1. Kuby Immunology by Kindt TJ, Goldsby RA, Osborne BA, Kuby J: 6th edition. New York. WHFreeman; 2006.

2. Cellular and Molecular Immunology by Abbas AK, Lichtman AH, Pillai S: Saunders Elsevier; 2007.

3. Immunobiology: The immune system in health and disease by JanewayCA,TraversP,Walport M,Shlomchik MJ: 6th edition. New York. Garland Science Publishing; 2005.

4. Medical Microbiology and Immunology by Levinson W, Jawetz E: Lange publication; 2001.

5. Fundamental Immunology by Paul WE: 4th edition. New York. Raven Press; 2000.

6. Roitt's Essential Immunology by Delves PJ, Martin SJ, Burton DR, Roitt IM; 11th

edition. Blackwell Publishing/Oxford Univ. Press; 2006.

RECOMMENDED READINGS:

1. Clark W.R. 1991. The experimental foundations of modern immunology. John Wiley
2. Mackie & McCartney. Medical Microbiology. 14/e.
3. Bailey & Scott's Diagnostic Microbiology.
4. Franklin TJ, Snow GA. 1981.Biochemistry of antimicrobial action. Chapman & Hall, New York.
5. Roitt IM. 1995. Essential Immunology. Blackwell Sci. Oxford.
6. Roth J.A. 1985. Virulence mechanisms of bacterial pathogens. American Society for Microbiology. Washington D.C.
7. Smith CGC. 1976. Epidemiology and infections. Medowfief Press Ltd. Shildon, England.
8. Stiem F. 1980. Immunological disorders in infants and children. W.B. Saunders & Co. Philadelphia. Page 19 of 27
9. Todd IR. 1990. Lecture notes in immunology. Blackwell Sci. Pub. Oxford.
10. Roitt IM, Brostoff and Male 1995. Immunology 4/e Gower Medical Pub Co..
11. Kuby J 1994. Immunology. 2/e. W.H. Freeman and Co., New York.

MIC6.5DCCT303

Soil and Agricultural Microbiology

Course Objective

This course elaborates on soil, its types, formation and its characteristics. It describes and discusses the role of microorganisms in nutrient re-cycling, microorganisms associated with different parts of the plants and their role in plant health and diseases.

Course Level Learning Outcomes:

Upon successful completion of the course, the learner will be able to :

CO1	Appreciate the diversity of microorganism and microbial communities inhabiting soil.
CO2	Learn the occurrence, abundance and distribution of microorganisms on various surfaces of plants and also learn different methods for their detection and characterization.

CO3	Competently explain various aspects of agriculture microbiology and to become familiar with current research in soil and agricultural microbiology.
CO4	Understand various biogeochemical cycles – Carbon, Nitrogen, Phosphorus cycles etc. and microbes involved.
CO5	Understand various plant microbes interactions especially rhizosphere, phyllosphere and mycorrhizae and their applications especially the biofertilizers and their production techniques
CO6	Understand the role of microorganisms in promoting plant growth and their protection from pathogens.
CO7	Understand the role of microorganisms in causing different plant diseases and their cure.
CO8	Learning the application of microorganisms as biopesticides and their mass production techniques.

Course Description

UNIT-I

Soils: Origin and evolution, soil profiles. Major physiochemical and biological characteristics. Soil microflora: distribution and contribution to ecosystem.

Biogeochemical cycles: Carbon cycle, Nitrogen Cycle, Phosphorus cycle, Sulphur cycle, Iron and Manganese cycle. Bioleaching and biomining.

UNIT-II

Agricultural and urban waste compost, vermicompost, mushroom compost, silage, methane production, biogas plants. Microbiology of Rhizospheres, phyllosphere and spermosphere.

Plant Diseases: Physiology of parasitism, mechanism of disease resistance, host parasite relationship.

.UNIT-III

Symptomatology and control measures of various diseases:

Viral diseases: TMV, Yellow vein mosaic of Bhindi, and Papaya leaf curl.

Bacterial diseases: Citrus canker, Crown gall

Fungal diseases: Green ear of bajra, Wheat rusts and Loose and Covered smuts.

Mycoplasmal diseases: Witches broom of potato, Stripe disease of sugarcane

UNIT-IV

Biofertilizers: Production technology, standards, storage and application methods for *Rhizobium, Azotobacter, Azospirillium*, Cyanobacteria, *Azolla.* Biological nitrogen fixation - nitrogenase enzyme - nif genes; symbiotic nitrogen fixation - (*Rhizobium, Frankia*)- non-symbiotic microbes- *Azotobacter- Azospirillium* PSM, Cellulolytes, VAM and PGPR.

UNIT-V

Microbial pesticides: biology and chemistry of the biocidal component, mode of action, effect on target organisms, production technology. Microbial insecticides; advantages of microbial insecticides, limitations-Mass production techniques; fermentation, formulation of insecticides, carrier materials quality control etc.

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

REQUIRED READINGS:

1. Plant Pathology by Agrios G. N. Academic Press, San Diego;1997.

2. The Nature and practice of Biological Control of Plant Pathogens by Cook R. J. & Baker K. F.; 1983.

3. American Phytopathological Society Press, St. Paul, MN.

4. Environmental Biotechnology by Forster C. F. & John D.A. Ellis Horwood Ltd. Publication;2000.

5. A Manual of Environmental Microbiology by Christon J. H. ASM Publications;2001.

6. Soil Microbiology by Rao, N.S.S. Oxford & IBH Publishing Co., New Delhi;1999.

RECOMMENDED READINGS:

1. Erneasst WC 1982. The environment of the deep sea. Vol.II J.G. Morin Rubey.
2. Norris JR and Pettipher GL 1987. Essays in agricultural and food microbiology. John Wiley & Sons, Singapore.
3. Burges A and Raw F 1967. Soil Biology. Academic Press, London.
4. Vanghan D and Malcolm RE. 1985. Soil Organic Matter and Biological Activity. Martinus Nighoff W. Junk Pub.
5. Buckman H. and Brady N.C. The nature and properties of soil. Eurasis Pub. House (P.) Ltd. New Delhi.

MIC6.5DSET304 (A)

Medical Microbiology

Course objectives:

The course objectives are to impart knowledge on infectious disease epidemiology and outbreaks. It deals with the knowledge of pathogenic microorganisms (viruses, bacteria, fungi), their characterization, pathogenesis, control and treatment.

Course Level Learning Outcomes:

Upon successful completion of the course, students will have the knowledge and skills to:

CO1	Understand and explain the various stages of infectious diseases, describe various modes by which infections spread in community, describe various methods that can be adopted to control spread of infection in community, understand and explain various hospital borne, air borne and water-borne diseases
CO2	By the end of this course, the students will be able to safeguard themselves and society and can work in diagnostics laboratories and hospitals. They will be able to classify and characterize diseases causing organisms like bacterial, fungal, viral etc.
CO3	Through this course students will learn the role of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.

CO4	They will acquire a clear understanding about host pathogen interaction, normal microflora in the human body and different sample collection and analysis.
CO5	Students will be able to understand the pathogenesis, epidemiology of diseases and their causative agents. They also learn about the diagnosis of various microbial diseases.
CO6	Through this course the students will also learn about the antimicrobial agents, their characteristics, mode of action etc.
CO7	The student at the end of the course will be able to gain knowledge about vaccination, screening of various diseases.

Course Description

UNIT-I

Early discovery of pathogenic microorganisms. Pathogenicity and virulence; Quantitative measures of virulence: minimal lethal dose (MLD), LD 50 , ID 50, TCID 50. Normal microbial flora of the human body; role of the resident flora. Nosocomial infection, common types of hospital infections and their diagnosis and control, Molecular diagnosis of diseases: basic principles and techniques involving nucleic acid in relation to laboratory evaluation of disease.

UNIT-II

Important diseases of human beings (short description of causal agent, pathogenesis, diagnosis and treatment). Bacterial diseases: Typhoid, Syphilis, Cholera, Gonorrhoeae, Tuberculosis, Diphtheria, Tetanus, Plague, Botulism, Meningitis, Pneumonia, Enteritis.

UNIT-III

Important diseases of human beings (short description of causal agent, pathogenesis, diagnosis and treatment). Viral diseases: Influenza, Herpes, AIDS, Rabies, SARS, Human Pox, Yellow fever, Mumps and Measles. Fungal diseases: Ringworm, Toxoplasmosis.

UNIT-IV

Important diseases of human beings (short description of causal agent, pathogenesis, diagnosis and treatment). Important bacterial (Anthrax, Black quarter, Tuberculosis, Brucellosis) and viral

(Foot and mouth disease, Rinderpest, Cowpox, Rabies) diseases of domestic animals, their causal agents, epidemiology, pathogenesis, diagnosis, vaccine and treatment).

UNIT-V

Antimicrobial therapy; Antibiotics and their classification, mode of action, Antimicrobial resistance: Multidrug efflux pumps, X- MDR *M. tuberculosis*, Methicillin-resistant *S. aureus* (MRSA), various methods of drug susceptibility testing. Brief account on available vaccines and schedules. Coordinated regulation of virulence genes, two component signal transduction systems, secretion systems, biofilms and quorum sensing.

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

REQUIRED READINGS:

1. Jawetz, Melnick, & Adelberg's Medical Microbiology by Brooks GF, Butel JS, Morse SA, Melnick JL,Jawetz E, Adelberg EA . 23rd edition. Lange Publication. 2004.
2. Cellular Microbiology by Cossart P, Boquet P, Normark S, Rappuoli R eds. 2nd edition. American Society for Microbiology Press. 2005.
3. Bacterial Pathogenesis: A molecular approach by Salyers AA and Whitt DD eds. American Society forMicrobiology Press, Washington, DC USA. 2002.

4. Pathogenomics: Genome analysis of pathogenic microbes by Hacker J and Dorbindt U. ed. Wiley-VCH.2006.
5. Molecular Microbiology: Diagnostic Principles and Practice by Persing DH, Tenover FC, Versalovic J,Tang Y, Unger ER, Relman DA, White TJ eds. American Society for Microbiology Press, 2004.
6. Infectious Disease Epidemiology: Theory and Practice by Nelson KE, Williams CM, Graham NMH eds. An Aspen Publication. 2001.

RECOMMENDED READINGS:

1. Morag C. and Timbury M.C. 1994. Medical virology. X/e. Churchill Livingstone, London.
2. Topley and Wilson 1995. Text book on Principles of Bacteriology, Virology and Immunology. Edward Arnold, London
3. Mackie and McCartney. 1996. Medical Microbiology. Vol.1. Microbial Infection, Vol. 2. Practical Medical Microbiology. Churchill Livingstone.
4. Shanson DC. Wright PSG1982. Microbiology in Clinical Practice.

MIC6.5DSET304(B): Basics of Medical Laboratory Techniques (BMLT)

Course Objectives:

The course objectives are to provide knowledge and skills to understand the chemical properties of the biomolecules, their functions and biomedical importance, basic understanding of diseases and their pathogenesis, laboratory diagnostics, safety measures and various types of laboratory tests.

Course Learning Outcomes:

Upon successful completion of the course, students will have the knowledge and skills to:

CO1	Work efficiently in medical laboratories in India and abroad under different specialties and practice analytical testing processes.
CO2	Follow prescribed procedures, and with adequate orientation, perform routine testing in chemistry, microbiology, immunohematology, hemostasis, and molecular diagnostics.
CO3	Conduct analysis of body fluids/samples to diagnose different diseases.

CO4	Conduct molecular analysis of chromosomal aberrations in leukemias and lymphomas, molecular diagnosis of genetic diseases and practice established safety measures.
CO5	Demonstrate working of various instruments, processes and formats of reporting in medical laboratory technology laboratory.
CO6	Manage and maintain laboratory operations and human resources to ensure cost-effective, high-quality laboratory services
CO7	Understand the application of molecular methods in clinical microbiology, and antimicrobial resistance.
CO8	Practice quality assurance and performance improvement techniques for optimum laboratory analysis. Utilize information management systems to provide timely and accurate reporting of laboratory data.

Course Description

UNIT-I

Analysis of amino acids, screening tests, quantitative tests, tests for specific amino acids, determination of proteins in serum, plasma and CSF, determination of glucose in body fluids, glucose tolerance test, analysis of ketone bodies.

UNIT-II

Method of estimation of lactate, pyruvate and glycated hemoglobin in blood. Analytical methods for estimation of triglycerides, high density lipoproteins, low density lipoproteins, apolipoproteins.

UNIT-III

Laboratory application of nucleic acid technologies to elucidate, diagnose, monitor disease state and to evaluate non-disease status. Basic principles and techniques involving nucleic acid in relation to laboratory evaluation of disease.

UNIT-IV

Clinical testing process, quality assurance, clinical validation and accreditation. Molecular analysis of chromosomal aberrations in leukemias and lymphomas, molecular diagnosis of genetic diseases, application of molecular methods in clinical microbiology.

UNIT-V

Antimicrobial therapy, Antimicrobial resistance, historical aspects, advantage of DNA over traditional serology, DNA degradation and environmental damage, quality assurance, standard, databank, legal challenge.

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

REQUIRED READINGS:

1. Methods in Molecular Biology: Amino Acid Analysis Protocols By Catherine Cooper, Nicolle Packer and Keith Williams. Publisher: Humana Press
2. Medical Biochemistry [Paperback] By John Van Pilsum. Publsher: University of Minnesota Press.
3. Clinical Biochemistry: Metabolic and Clinical Aspects [Paperback] By William J. Marshall and Stephen K. Bangert. Publisher: Churchill Livingastone.

4. Clinical Chemistry: Techniques, Principles, Correlations (Bishop, Clinical Chemistry) [Hardcover] By Michael L Bishop, Edward P Fody and Larry E Schoeff. Publisher: Lippincott Williams and Wilkins
5. Nucleic Acid Amplification Technologies: Application to Disease Diagnosis [Hardcover] By H Olsvik (Editor), S Morse (Editor), O Lee (Editor). Publisher: Eaton Publishing, USA.
6. Chromosomal Alterations: Methods, Results and Importance in Human Health [Hardcover] By Gunter Obe and Vijayalaxmi. Publisher: Springer
7. Handbook of Hematologic Pathology (Diagnostic Pathology) [Hardcover] By Harold R. Schumacher, Sanford A. Stass and William A. Rock. Publisher: Marcel Dekker Inc.
8. Molecular Diagnosis of Genetic Diseases (Methods in Molecular Medicine) (Methods in Molecular Biology) (v. 1) [Hardcover] By Rob Elles. Publisher: Humana Press.
9. Color Atlas and Textbook of Diagnostic Microbiology [Hardcover] By Elmer W Koneman, Stephen D Allen, William M Janda, Paul C Schreckenberger and Washington C Winn. Publisher: Lippincott
10. Molecular Diagnostics: Promises and Possibilities [Hardcover] By Mousumi Debnath, Godavarthi B.K.S. Prasad and Prakash S. Bisen. Publisher: Springer

RECOMMENDED READINGS:

1. Henry, John Bernard, Todd Sanford and Davidson, 2002. Clinical diagnosis and management by laboratory methods. W.B. Saunders& Co.
2. Fischbach Francis A, 2003. Manual of laboratory and diagnostic tests. Philadelphia,J.B. Lippancott &Co, N.Y.
3. Gradwohls, 2000. Clinical laboratory methods and diagnosis ed.Alex.C. Sonnenwirth & Leonard Jarret.M.D.B.I.Publications, New Delhi.
4. Sood, R, 2005, Medical Laboratory methods and interpretation, Jaypee brothers medical publications, New Delhi.

MIC6.5DEST305(A)

Microbial Ecology and Environmental Biotechnology

Course Objectives:

The main objective of this course is to impart the basic and advanced knowledge about the microbial communities inhabiting diverse environments, their role in environment and ecosystem

wellness and interaction with various types of pollutants. The learner will be acquainted with the concepts of aquatic microbiology, aero microbiology, use of microbial population in microbial waste recycling and bioremediation, rumen microbiology and other related topics.

Course Level Learning Outcomes:

Upon successful completion of the course, the learner will be able to :

CO1	Explain various concepts of aero and aquatic microbiology.
CO2	Describe advances in the field of environmental microbiology and the role of microbes in mitigating environment pollution.
CO3	Prepare and perform sampling and microbial analyses to determine the microbial community composition in various environments.
CO4	Describe Inter specie interactions among the microbes.
CO5	Understand the role of microbes in bio-deterioration and biodegradation of various natural and manmade things and apply this concept in the field.
CO6	Describe the role of microbes in solid and liquid waste management, gaining knowledge of various methods employed in sewage treatment and solid waste treatment.
CO7	Understand the concept of rumen microbiology, microorganism based Oxidative transformations.

Course Description

UNIT-I

Aero Microbiology : Droplet nuclei, aerosol, assessment of air quality, solid - liquid impingement methods, assessment of air quality, brief account of air- borne microbes – bacteria, fungi, and viruses, their diseases and preventive measures.

Aquatic microbiology: Water ecosystems - types, fresh water (ponds, lake, streams) - marine habitats (estuaries, mangroves, deep sea, hydrothermal vents, saltpans, coral-reefs). Potability of Water - microbial assessment of water quality- water purification. Eutrophication. Brief account of major water borne diseases.

Extreme environments and extremophilic microbes: Habitats, diversity, adaptations and potential applications of oligotrophs, thermophiles, psychrophiles, metallophiles, acidophiles, alkaliphiles and halophiles.

UNIT-II

Inter species interactions-microbial behavior in ecosystems: Microbial Antagonism, competition, commensalisms, synergism, parasitism and predation. Gause and Hardin's principles of competition.

Interactions within microbial communities: quorum sensing, syntrophy and antibiotics.

Rumen microbiology, digestion, fermentation and detoxification by microbes, factors influencing rumen microbes.

Understanding microbial diversity in the environment by culture-dependent and culture-independent approaches. Subterranean microbes

UNIT-III

Waste water treatment : Wastes - types- solid and liquid wastes characterization. BOD and COD. Sewage treatments methods - physical, chemical, biological (aerobic- anaerobic); primary, secondary and tertiary treatments (trickling; activated sludge, oxidation pond, oxidation ditch). Treatment of industrial effluents (distillery, textile, pulp and paper), methods to detect various pollutants (metals, sediments, toxin and organic matters).

Solid Waste management: Sources and types of solid waste, methods of solid waste disposal (composting and sanitary landfill)

UNIT-IV

Bioremediation. Biodeterioration and biodegradation of paints, plastics, rubber, paper, leather, wood, wool, degradation of xenobiotics, pesticides and polymers.

Microbial leaching and oxidation of minerals (copper bioleaching, cobalt bioleaching, Uranium bioleaching, biooxidation of gold ores, Nickel leaching, acid mine drainage). Microbial enhanced oil recovery.

Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin

Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction Phosphorus cycle:

Phosphate immobilization and solubilization. Sulphur cycle: Microbes involved in Sulphur cycle

Other elemental cycles: Iron and manganese

UNIT-V

Plant-microbe symbiosis, microbial antagonism, biofilms and their biotechnological applications. Bio-fertilizers and Biopesticides, carriers for inoculants: types and characteristics, strain selection of bacteria. Plant growth promoting rhizobacteria, (PGPR), biocontrol agents.

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

REQUIRED READINGS:

1. Microbial Ecology By Atlas R.M., Bartha R., Benjamin Cummings Publishing Co, Redwood City, CA.,1993.
2. Environmental Microbiology by A.H. Varnam & M.G. Evans, Manson Publishing Ltd., 2000.
3. Manual of Environmental Microbiology by Christon J. Hurst, Ronald L. Crawford, Jay L. Garland, DavidA. Lipson, Aaron L. Mills, ASM Press, 2007.
4. Environmental Microbiology by W.D. Grant & P.E. Long, Kluwer Academic Publishers, 1981.
5. Assessing Ecological Risks of Biotechnology Lev R. Ginzburg
6. Environmental biotechnology G. M. Evans and J. C. Furlong
7. Environmental biotechnology A. Scragg, Oxford
8. Environmental Microbiology – A Laboratory Manual Pepper et. Al
9. Genetic control of environmental pollutants Gilbert & Alexander

RECOMMENDED READINGS:

1. Experimental ecology R.M. Atlas
2. Handbook of water and waste water treatment Technology Paul
3. Waste Water Treatment Arceivala
4. Environmental Microbiology by A.H. Varnam & M.G. Evans, Manson Publishing Ltd., 2000.
5. Manual of Environmental Microbiology by Christon J. Hurst, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, ASM Press, 2007.
6. Environmental Microbiology by W.D. Grant & P.E. Long, Kluwer Academic Pu
7. Ewesis ET. Al. 1998. Bioremediation Principles. Mcgraw Hill.
8. Dart. R.K. and Shettron R.J. 1980. Microbiological aspects of pollution control. 2 ed.

MIC6.5DSET305(B)

Food and Dairy Microbiology

Course Objectives:

The students will be familiarized with the apparatus and equipment used in a microbiology laboratory, how to maintain aseptic conditions in microbiological experiments. They will learn to prepare culture media, isolate and culture bacteria and fungi and to extract nematodes. They will learn to study the general morphological features of different microorganisms.

Course Level Learning Outcomes:

Upon successful completion of the course, students will have the knowledge and skills to:

CO1	Are able to describe the role of microorganisms in the production of food, its spoilage, including their role in homemade fermented foods.
CO2	Are able to understand different intrinsic and extrinsic factors responsible for food spoilage.
CO3	Are able to identify the role of microorganisms in the causation of the diseases and how to protect against food-borne pathogens.
CO4	Developed experimental skills for testing the milk and different foods for the presence of microorganisms

Course Description

UNIT-I

Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market. Utilization and disposal of dairy by-product – whey.

UNIT-II

Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general. Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods.

UNIT-III

Principles of food preservation: temperature, canning, drying, irradiation, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO_2, citrates, benzoates, nitrite and nitrates etc.

UNIT-IV

Food borne diseases (causative agents, foods involved, symptoms and preventive measures)- Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins; Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni.

UNIT-V

Cultural and rapid detection methods of food borne pathogens in foods. Food sanitation and control; HACCP, Indices of food sanitary quality and sanitizers.

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall

be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

REQUIRED READINGS:

1. Banwart, GJ. Basic Food Microbiology. CBS Publishers and Distributors, Delhi. (1989).
2. Hobbs BC and Roberts D. Food poisoning and Food Hygiene. Edward Arnold (A division of Hodder and Stoughton) London.
3. Joshi. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2.
4. John Garbult. Essentials of Food Microbiology. Arnold International.
5. John C. Ayres. J. Orwin Mundt. William E. Sandinee. Microbiology of Foods. W.H. Freeman and Co.

RECOMMENDED READINGS:

1. Stanbury, PF., Principles of Fermentation Technology. Whittaker, A and Hall, S.J 2nd Edition. Pergamon Press (1995).
2. Photis Papademas.Dairy Microbiology: A Practical Approach. CRC Press
3. Rao M.K..Food and Dairy Microbiology. Manglam Publishers
4. William Frazier. Food Microbiology. McGraw Hill Education
5. Jay, James M., Loessner, Martin J., Golden, David A. Modern Food Microbiology.Springer

PRACTICALS

Study of coliform bacteria in water samples from different sewage sources

Study of decolouration of distillery or textile industrial waste.

Study of microbial degradation of hydrocarbons(s) or pesticide(s).

Study of fungal degradation of wood.

Study of Bacterial interactions (antagonism etc)

Isolation and cultivation of *Azotobacter, Rhizobium, Azospirillum, Cyanobacteria, Actinomycetes, Mycorrhiza.*

Biofertilizer production using *Rhizobium*

Biofertilizer production using Mycorrhiza

Soil analysis for various parameters like moisture content, water holding capacity, Micro and macronutrients like carbon, nitrogen, carbonates etc

Determination of following enzyme activities in the soil sample: amylase, cellulose, xylanase, protease and phosphatase.

Laboratory methods for studying soilborne diseases

a. Isolation of soilborne pathogen

c. Chemical control of soilborne pathogens using acylanilide and alkyl phosphonates.

Bacterial diseases of food plants

a. Isolation of pathogenic bacteria from rotten vegetables and fruits

b. Biochemical and physiological tests for detection of pathogens in vegetables and fruits

To study normal micro-flora of Skin, Respiratory tract, Gastro-intestinal tract, uro-genital tract.

To study cultural characteristics of pathogenic bacteria on various selective and differential media.

To study pathogenicity of *Staphylococcus aureus* by coagulase test.

To study antimicrobial susceptibility using an octadisc.

To determine the minimal inhibitory concentration (MIC) of an antibiotic on bacteria and fungi

Determination of Blood group and Rh factor.Blood cell counts. Serological tests: Radio immuno-diffusion, Immuno-electrophoresis, DOT ELISA, Sandwich ELISA,

Ochterlony double diffusion, agglutination test, Fluorescent Antibody test.

Monitoring blood pressure, pulse rate, clotting time, bleeding time.

Haemoglobin estimation, erythrocyte sedimentation rate, packed cell volume. Prothrombin time, differential count.

Total red blood cell count, total white blood cell count, platelet count, eosinophilic count, reticulocyte count.

Monitoring blood sugar, urea, uric acid, creatinine.

Monitoring cholesterol, triglyceride, high density liporoteins, low density lipoproteins, very low density lipoproteins.

Estimation of sodium, potassium, calcium, chloride, bicarbonate, phosphorus and magnesium in biological fluids.

Collection of urine and blood, types of preservative, physical examination; volume, colour, odour, appearance, specific gravity and pH.

Reducing sugar-benedict test, protein: heat and acetic acid test, and sulfosalicylic acid method, ketone bodies-roth era's test, bile pigment (fouchet method), bile salt (hay's test), urobilinogen-ehrlich aldehyde test and bence jones protein test, renal clearance test-urea, creatine, test for mucin.

Antigen antibody assay, ELISA tests, immuno- electrophoresis.

Semester 4

Papers	Duration	Max. Marks	
MIC6.5AECT-401		**3 Hrs.**	**80**
MIC6.5DCCT402		**3 Hrs.**	**80**
MIC6.5DSET403(A) OR (B)		**3 Hrs.**	**80**
MIC6.5DRP404 (DPR) Or (OJT) Or (RCC)		**Viva-voce**	**160**
MIC6.5DCCP405:			
Combined Practical		**1 Day (6Hrs)**	**80**

MIC6.5AECT-401

GENERAL HEALTH AND HYGIENE

Course Overview

This course aims to provide students with a foundational understanding of health and hygiene, emphasizing the importance of maintaining a healthy lifestyle. It will cover essential topics related to nutrition, health policies, hygiene practices, and community health initiatives. By the end of the course, students will recognize the significance of health and hygiene in their daily lives and understand how to apply this knowledge to promote well-being in themselves and their communities.

Learning Objectives

- To understand the basic concepts of health and hygiene.
- To recognize the importance of nutrition for overall health.
- To learn about various health care programs in India.
- To understand the role of personal and community hygiene.
- To develop awareness of communicable and non-communicable diseases.

- To explore the impact of mental health, physical activity, and social factors on well-being.
- To introduce students to digital tools that promote health awareness.

Course Outcomes

CO1-Upon completion of this course, students will be able to:

CO2-Define what constitutes a healthy diet.

CO3-Identify ways to optimize their dietary choices using available information.

CO4-Understand the relationship between nutrition and a healthy life.

CO5-Recognize that dietary needs may vary among individuals.

CO6-Demonstrate awareness of disaster management related to health crises.

CO7-Assess the impact of health policies on community hygiene practices.

CO8-Utilize mobile applications to enhance public awareness about health.

Unit I

Nutrition Basics: Definition, importance, good nutrition vs. malnutrition; understanding balanced diets and meal planning.
Nutrients:
Carbohydrates: Functions, dietary sources, effects of deficiency.
Lipids: Functions, dietary sources, effects of deficiency.
Proteins: Functions, dietary sources, effects of deficiency.
Vitamins and Minerals: Overview of vitamins-functions, food sources, and deficiency effects; macro (Calcium, Potassium) and micro minerals (Iron, Iodine, Zinc)-functions and sources.
Water: Importance in nutrition-functions, sources, requirements, and effects of deficiency.

Unit II

Health Concepts: Definition of health; determinants of health; key health indicators; understanding public health and environmental health.
Health Policies in India: Overview of the National Health Policy 2017; roles of key organizations like NIN (National Institute of Nutrition) and ICMR (Indian Council of Medical Research).
National Health Mission: Frameworks for National Rural Health Mission (NRHM) and National Urban Health Mission (NUHM).
Women & Child Health Care Schemes: Overview of programs such as RMNCH+ (Reproductive Maternal Newborn Child Health), JSSK (Janani Shishu Suraksha Karyakaram), and RKSK (Rashtriya Kishor Swasthya Karyakram).

Unit III

Hygiene Fundamentals: Definition and importance; types of hygiene—personal, community, medical, and culinary hygiene; introduction to WASH (Water, Sanitation, Hygiene) programs.

Community Health Initiatives: Roles within village health sanitation & nutritional committees; functions of ASHA (Accredited Social Health Activist); activities on Village Health Nutrition Day.

Unit IV

Communicable vs. Non-Communicable Diseases: Understanding different disease types; prevention strategies for common diseases affecting children.
Public Awareness Campaigns: Importance of community education on hygiene practices; exploring government initiatives through mobile apps like Arogya Setu and Swasth Bharat Abhiyan.

Unit V

Utilizing Technology for Health Awareness: Introduction to various mobile applications developed by the Government of India aimed at promoting health awareness among communities.
Disaster Management in Health Contexts: Understanding the role of public response during pandemics and epidemics; guidelines for personal safety during health crises.

Suggested Readings:

1. Ghai, O.P., Gupta, P., & Ghai, B. (2010). Textbook of Nutrition and Dietetics. 7th Edition. CBS Publishers & Distributors.
2. Mahan, L.K., & Escott-Stump, S. (2017). Krause's Food & the Nutrition Care Process. 14th Edition. Elsevier.
3. Kumar, V., Abbas, A.K., & Aster, J.C. (2018). Robbins & Cotran Pathologic Basis of Disease. 9th Edition. Elsevier.
4. Ghosh, D. (2016). Fundamentals of Public Health. 1st Edition. PHI Learning.
5. Murray, C.J.L., & Lopez, A.D. (1996). The Global Burden of Disease. Harvard University Press.
6. Sharma, R., & Gupta, V. (2018). Health Education: A Comprehensive Approach. 1st Edition. Sage Publications.
7. Bamji, M.S., Krishnaswamy, K., & Brahmam, G.N.V. (2009). Textbook of Human Nutrition. 3rd Edition. Oxford & IBH Publishing Co. Pvt. Ltd.
8. Swaminathan, M.S. (1995). Food & Nutrition. Vol I. The Bangalore Printing & Publishing Co Ltd.
9. Srilakshmi, B. (2010). Food Science. 5th Edition. New Age International Ltd.
10. WHO (World Health Organization). (2020). Guidelines on Hygiene Practices in Health Care Settings. World Health Organization.
11. UNICEF (2020). Water, Sanitation and Hygiene: A Global Perspective. UNICEF.
12. National Health Mission (NHM) India Website: nhm.gov.in – An excellent source for current health initiatives and programs in India.

Web Resources

- National Health Mission: nhm.gov.in
- National Rural Health Scheme: NHM NRHM

- National Urban Health Scheme: NHM NUHM

Scheme of Examination

Internal Assessment: Internal assessment plays a vital role in the broader framework of continuous evaluation within the university and its affiliated colleges. This assessment process may involve a variety of criteria determined by the assessor, such as teachers or heads of departments. The outcomes of these assessments, classified as either satisfactory or unsatisfactory, will be submitted to the university.

MIC6.5DCCT402

Bioinformatics and Computer Applications

Course Objectives:

The objectives of this course are to provide theory and practical experience of the use of common computational tools and databases which facilitate investigation of biological molecules (DNA, RNA and protein) and evolution-related concepts.

Course Level Learning Outcomes:

Upon successful completion of the course, students will have the knowledge and skills to:

CO1	At the end of the course, the student will be able to apply basic principles of biology and computer science to address complex biological sequence problems. This allied course introduces the students various concepts to assess and analyze biological data.
CO2	It deals with understanding the molecular aspects of biology. It majorly emphasizes the concepts of central dogma of molecular biology spanning from DNA replication till protein synthesis and reverse transcription.
CO3	The course talks about primary, secondary and tertiary databases used in bioinformatics and will train the students in the use of databases for finding and retrieval of biological sequences.
CO4	Students should be able to develop an understanding of the theory of various computational tools used in bioinformatics and will gain working knowledge of these computational tools and methods.
CO5	This course will help students to learn the basics of mapping, genome sequencing, and genome sequence assembly, genome annotation and whole genome alignment.

CO6	The course is a skill based paper that introduces the students to the basics of computer operations. The student is imparted with knowledge on both hardware and software and operating systems. The student has a better understanding on the use of computers for various microbiological/biological applications.

Course Description

UNIT-I

Bioinformatics: Introduction, objectives. Bioinformatics and data analysis. Database concept, types of databases. Microbiological and Virology databases.

UNIT-II

Metabolic pathway engineering. Finding and retrieving sequences from databases. Sequence alignment: pairwise and multiple sequence, evolutionary basis, sequence homology versus sequence similarity, sequence similarity versus sequence identity.

UNIT-III

Protein structural visualization, protein structure comparison, protein expression analysis, protein sorting, Gene phylogeny versus species phylogeny, forms of tree representation, why finding a true tree is difficult. phylogenetic tree construction methods and programs.

UNIT-IV

Functional Genomics: Sequence-Based Approaches, Microarray-Based Approaches, Comparison of SAGE (Serial Analysis of Gene Expression) and DNA Microarrays. Proteomics: Protein Expression Analysis, Protein Sorting, Protein–Protein Interactions

UNIT-V

Computers and their organization, hardware, software, operating system, Introduction to programming languages, Application packages for microbiologists, genome mapping, genome sequencing, genome sequence assembly, genome annotation.

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

REQUIRED READINGS:

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Baxevanis A.D. and Ouellette, Third Edition. John Wiley and Son Inc., 2005.
2. Bioinformatics Sequence and Genome Analysis by Mount D.W., CSHL Press, 2004.
3. Introduction to Bioinformatics by Tramontano A., Chapman & Hall/CRC, 2007.
4. Understanding Bioinformatics by Zvelebil, M. and Baum, Chapman & Hall/CRC, 2008.
5. Bioinformatics: Methods Express By: Paul H Dear, Scion Publishing Ltd, 2007
6. Bioinformatics: Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory, 2004.

RECOMMENDED READINGS:

1. W.J. Ewens, Gregory Grant,(2005). Statistical Methods in Bioinformatics: An Introduction (Statistics for Biology & Health), Springer
2. Bryan Bergeron,(2003).Bioinformatics Computing First Indian Edition, Prentice Hall
3. Cynthia Gibas & Per Jambeck (2001). Developing Bioinformatics Computer Skills: Shroff Publishers & Distributors Pvt. Ltd (O'Reilly), Mumbai
4. HH Rashidi & LK Buehler (2002). Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London
5. Des Higgins & Willie Taylor (2002). Bioinformatics: Sequence, structure and databanks, Oxford University Press

MIC6.5DSET-403(A)

Biostatistics

Course Objective

This paper develops concepts about types of data observed in biological experiments, its handling and processing. It develops concepts of hypothesis and formulation of experiments. It gives understanding of various statistical operations needed to carryout and process the biological data.

Course Level Learning Outcomes:

Upon successful completion of the course, the learner will be able to :

CO1	Able to collect, handle, process and present the biological data.
CO2	Apply the principles of statistics on biological experiments.
CO3	Learn about how to collect data using different sampling methods
CO4	Learn to present data in various forms like tabular, graphical, pictorial, etc.
CO5	Learn the use of Simple Probability methods, Regression and Correlation, and simple linear regression in biological research.
CO6	Learn the use of partial correlation and partial covariance in biological research.
CO7	Understand about Count data: examples of count data (bacterial cell count, radioactivity, colony and plaque counts), statistical treatment to count data
CO8	Statistical basis of biological assays: Response-Dose relationship, direct and indirect assay, statistical analysis of LD50.

Course Description

UNIT-I

Definition of statistics, symbols, notations and terminology of statistics: Sampling and estimation of population parameters, Random sampling, Sampling size in random sampling, stratified two stage cluster and sequential sampling, Bias in sampling.

UNIT-II

Presentation of research results, Graphic presentation. Interval Data: Construction of a histogram, interpretations of histogram, the normal distribution, the mean, mode, median; variance and standard deviation, representing the normal curve, Chi square test, goodness of fit.

UNIT-III

Count data: examples of count data (bacterial cell count, radioactivity, colony and plaque counts), statistical treatment to count data. Bionomial and Poisson distribution, Standard error, confidence limits of counts.

UNIT-IV

Simple Probability: Regression and Correlation, simple linear regression, Coefficient of determination. Brief introduction to the need and application on curvilinear and multiple regression. Use of partial correlation and partial covariance.

UNIT-V

Statistical basis of biological assays: Response-Dose relationship, direct and indirect assay, statistical analysis of LD50.

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

REQUIRED READINGS:

1. Sampling Techniques by Cochran W. G., Wiley eastern Ltd, New Delhi.
2. Fundamentals of Biostatistics, by Irfan Ali Khan and Atiya Khanum, (2nd edition). Ukaaz Publications, Hyderabad.
3. Introduction to probability theory and its applications, by Felller W., Asia Publishing House, Mumbai.
4. An introduction to Biostatistics by Glover T. and Mitchell K., McGraw-Hill , N.Y; 2002.
5. Fundamentals of statistics. Goon, Gupta and Dasgupta- World Press, Kolkota.
6. Design and analysis of experiments by Montgomery D. C., John Wiley and Sons.
7. Biostatistics, a foundation for analysis in the health Sciences, (7^{th} edition), Wayne Daniel; 2007.

RECOMMENDED READINGS:

1. Scrimshaw NS and Gleason GR 1992. Rapid assessment procedures. Quantitative methodologies for planning and evaluation of health related programs. International Nutrition Foundation for Developing Countries, Boston.
2. Van Maanen 1983. Quantitative methodology. Sage publications.
3. Cook TD and Reichardt CS 1979. Qualitative and quantitative methods in evaluation research. Sage Pub., London.
4. Creswell J 1994. Research design: Qualitative and quantitative approaches. Thousand Oaks. CA, Sage Pub.
5. Denzin NK and Lincoln YS 1994. Handbook of qualitative research. Sage pub.
6. Mienert CL 1986. Clinical trials: Design, conduct and analysis. Oxford Univ Press, New York.
7. Arora PN & Malhon PK (1996). Biostatistics Himalaya Publishing House, Mumbai.
8. Sokal & Rohif (1973). Introduction to Biostatistics, Toppan Co. Japan.
9. Stanton A & Clantz, Primer of Biostatistics (2005). The McGraw Hill Inc., New YorK

MIC6.5DSET-403(B)
Microorganisms and Health
Course objectives:

This course gives basic knowledge about the microorganisms and their role in the life of human beings. It provides information about the locations of microorganisms in the environment. It also gives information about how microbes are exploited for human well being.

Course Level Learning Outcomes:

Upon successful completion of the course, the learner will be able to :

CO1	Able to understand the basics of microorganisms.
CO2	Able to know about the habitats of microorganisms.
CO3	Learn about life, various places where living organisms are found and limits of Life on earth.
CO4	Learn to understand the role of Human microbiome in good health and prevention of infectious diseases.
CO5	Know about the biological (Germs) terror, its origin, consequences and possible control through vigilance and Laws.
CO6	Learn about how to prevent infectious diseases through vaccination.
CO7	Learn about Antibiotic resistance and its control

Course Description

Unit I

What is life? Where can life exist? Limits of Life on earth. Invisible life. Microorganisms, what are they? Types of Microorganism, Where do they live? What do they do? Microorganisms and man, the friends and foes.

Unit II

Microbial Diversity and Human Health: Overview of beneficial and pathogenic microorganisms; Normal human microbiota: composition, functions, and dynamics. Pathogenicity and Virulence: Concepts of infection and colonization, Mechanisms of microbial pathogenesis, Factors affecting microbial virulence. Human Immune System Overview: Innate and adaptive immunity, Interaction between microbes and host immune defenses

Unit III

Overview of Microbial Diseases: Bacterial, viral, fungal, and parasitic diseases; Emerging and re-emerging infectious diseases; Zoonotic infections. Epidemiology: Principles and methods of

epidemiological studies; Outbreak investigation and disease surveillance. Antimicrobial Resistance (AMR): Mechanisms of AMR; Impact of AMR on global health.

Unit IV

Microbial Contributions to Health: Gut microbiota and its role in digestion, metabolism, and immunity; Microbiota-brain axis: implications for mental health; Probiotics and prebiotics in maintaining health. Microbial Dysbiosis and Diseases: Links between microbiota alterations and chronic diseases; Microbial biomarkers for disease diagnosis.

Unit V

Microorganisms in Medicine: Antibiotics, antivirals, and antifungals: discovery and applications; Phage therapy: principles and applications; Immunotherapies involving microbes. Microbial Biotechnological Applications: Microbial production of vaccines and biopharmaceuticals, Microbial enzymes in diagnostics and therapeutics, Genetically engineered microbes in health applications.

Scheme of Examination

Maximum Marks: 100 (80 External + 20 Internal)

Duration: 3 Hrs

Minimum Passing Marks: 36%

External

A course will contain 5 units. The question paper shall contain three sections. Section A (10 marks) shall contain 10 questions two from each Unit. Each question shall be of 1 mark. All the questions are compulsory. Section A will be prepared such that questions i to v are multiple-choice questions, while questions vi to x will be fill-in-the-blank questions. Section B (25 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words. Section C (45 marks) shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

Internal

The internal exam shall comprise Theory Exam (10 marks), Seminar Presentation (6 marks) and Class Performance (4 marks).

MIC6.5RP-404(DRP)

Dissertation-Research Project

Course Objectives:

To develop the skills of preparing and conducting independent research and/or reviewing the research work done on the selected topic.

Course level learning outcomes:

This will develop the students' ability to apply the tools and techniques of microbiology in conducting independent research/review.

Scheme of examination

The student shall prepare a report of his/her work carried out as mentioned below and shall present it to the external examiner. The examiner will evaluate the work carried out and shall award the marks accordingly.

Maximum Marks: Total 200 (External 160 and Internal 40)

Minimum Passing Marks: 36%

The student will select a topic of research in consultation with his/her supervisor/guide to do a research work, write a review or carry out a case study on any topic related to microbiology or allied subjects.

MIC6.5OJT-404(OJT)

Dissertation-Internship / Apprenticeship

Course Objectives:

To develop the skills and provide entry-level, career-related experience, and workplace competencies that employer's value when hiring new employees.

Course level learning outcomes:

Students will get industrial hands-on training.

Provides the student with an opportunity to gain knowledge and skills from a planned work experience in the student's chosen career field.

Scheme of examination

The student shall prepare a report of his/her internship carried out explaining about the tasks performed and learned on the job and shall present it to the external examiner. The examiner will evaluate the work carried out and shall award the marks accordingly.

Maximum Marks: Total 200 (External 160 and Internal 40)

Minimum Passing Marks: 36%

MIC6.5DRCC-404 (DRCC)

Dissertation - Research Credit Course

RESEARCH CREDIT COURSE

Course Objectives:

To familiarize the students to the principles of scientific methodology, to develop analytical skills of research, and to develop the skills for scientific communications.

Course level learning outcomes:

The student will be able to Understand the basic concepts of research and its methodologies, and be able to apply them to define and solve research problems.

Scheme of examination

The student shall prepare a report of his/her work carried out as mentioned below and shall present it to the external examiner. The examiner will evaluate the work carried out and shall award the marks accordingly.

Maximum Marks: Total 200 (External 160 and Internal 40)

Minimum Passing Marks: 36%

REQUIRED READINGS:

1. Stanier RY, Ingraham J.L., Wheelis M.L., Painter P.R. 1999. General Microbiology. MacMillan Education Ltd., London.
2. Schlegel. General Microbiology. Cambridge University Press, Cambridge.
3. Topley and Wilson 1995. Text book on Principles of Bacteriology, Virology and Immunology. Edward Arnold, London.
4. Ananthnarayanan R and Jayaram C.K. 1997.Textbook of Microbiology. Orient Longman.
5. Mackie and McCartney. 1996. Medical Microbiology. Vol.1. Microbial Infection, Vol. 2. Practical Medical Microbiology. Churchill Livingstone.
6. Shanson DC. Wright PSG1982. Microbiology in Clinical Practice. 6. Baron EJ, Peterson LR and Finegold SM. 1990. Bailey and Scott's Diagnostic Microbiology. Mosby

RECOMMENDED READINGS

1. Adams MR and Moss MO 1995. Food Microbiology. Royal Society of Chemistry Pub., Cambridge.
2. Robinson RK. 1990. Dairy Microbiology. Elsevier Applied Sciences, London.
4. Banwart GJ 1989. Basic Food Microbiology. CBS Pub and distributors, Delhi.
5. Hobbs BC and Roberts D 1993. Food Poisoning and Food Hygiene. Edward Arnold (A division of Hodder and Stoughton) London.