SHRI GURU RAM RAI UNIVERSITY

Patel Nagar, Dehradun-248001, Uttarakhand, India

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s 2(f) of UGC Act 1956]

Syllabus

Pre Ph.D. Course Work (Microbiology)

Effective from Academic Session
(2017-2018)

&

Revised in 2025 onwards

Course Structure and the Assessment scheme of Pre Ph.D. Course Work Syllabus

S.N.	Paper Code	Subject	Credits L:T:P	Total credit	Total marks (External + Internal)	Minimum marks to be scored for successful completion
1.	**PRMC 101**	Research methodology	2:1:1	4	80 (60+20)	40
2.	**RPEC 102**	Research & Publications Ethics	1:1:0	2	40 (30+10)	20
3.	**PMBC 103**	Subject Specific (core paper): Microbial Ecology)	2:1:1	4	80 (60+20)	40
4.	**PMBE 104-107**	Subject Specific (elective paper) one out of 4	2:1:1	4	80 (60+20)	40
5.	**PMBF 108**	Field work	0:2:2	4	80 (00+80)	40
			Total	**18**	**360**	**180**

Paper-I: Research Methodology (Compulsory),
Code: PRMC-101

Credit: 04

Course Outcome:

1. To develop understanding of the basic framework of research process.
2. To develop an understanding of various research designs and techniques.
3. To identify various sources of information for literature review and data collection.
4. To develop an understanding of the ethical dimensions of conducting applied research
5. Appreciate the components of scholarly writing and evaluate its quality.

Unit I-Concept & Types of Research **01**

Meaning and importance of Research, Types of Research, Selection and formulation of Research Problem, Research Design, Classification of Research, Pure and Applied Research, Exploring or Formulative Research, Descriptive Research, Diagnostic Research/Study, Evaluation research/Studies, Action Research, Experimental Research, Historical Research.

Unit II –Methods Research **01**

General Survey of various Methods including Survey Method, Interdisciplinary Method, Case Study Method, Sampling Method, Observation Method, Interview Method, Schedule Method, Questionnaire Method, Documentary Method, Library Method, Historical Method and Scientific Method. Characteristic Features of Scientific Method; Empirical Verifiable, Cumulative, Self - Correcting, Deterministic, Ethical & Ideological neutrality (Value Free).

Unit III - Data Collection and Data Analysis **01**

Collection, Objectives and Classification of Data, Aims, Methods and Objects of Tabulation of Data, Forms and Processes of Interpretation and Presentation of Data, Primary, Secondary and Tertiary Data, Construction and adaptation of instruments, administration of questions and tests, Data organization in SPSS & Excel, Graphical representation of data, Testing of Hypothesis: Logical and Statistical Techniques.

Unit IV: Report Writing **01**

Locating Information on a Topic of Interest, Acquiring Copies of Articles of Interest, The Nature of Scientific Variables, Conceptual Versus Operational Definitions of Variables, Levels of Measurement, Various Paradigms, The Basic Format for a Research Report, Identification of the Parts of a Research Report, Citation and Referencing Styles, Essentials of Report Writing, Aids for Writing Good Research Report.

References:

1) Bagchi, Kanak Kanti (2007) Research Methodology in Social Sciences: A Practical Guide, Delhi, Abijeet Publications.

2) Kothari, C.R (2004) Research Methodology: An Introduction, Delhi, New Age.

3) Cooper, R. Donald and Pamela S. Schindler (2003) Business Research Methods, Delhi, Tata McGraw-Hill.

4) Flyvbjerg, Bent (2001) Making Social Science Matter: Why Social Inquiry Fails and How it can Succeed Again, United Kingdom, Cambridge University Press.

5) Goodde and Hatte (1952) Methods in Social Research, New York, McGraw – Hill.

Paper-II: Research & Publication Ethics (Compulsory), Code: RPEC-102

Credit: 02

Course Outcome:

1. To develop an understanding of research ethics, publications misconduct and plagiarism.
2. To develop Intellectual honesty and research integrity.
3. To identify various sources of information for data bases and research matrices.
4. To develop an understanding of Open access publications and initiatives.
5. Appreciate the components of scholarly writing and evaluate its quality.

Unit I-Philosophy and Ethics **0.2**

Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition moral philosophy, nature of moral judgements and reactions.

Unit II-Scientific Conduct **0.3**

Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconducts: Falsification and Plagiarism(FFP), Redundant publication: duplicate and overlapping publication, salami slicing, Selective reporting and misrepresentation of data.

Unit III-Publication Ethics **0.5**

Publication ethics: definition, introduction and importance, Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types, violation of publication ethics, authorship and contributor ship, Identification of publication misconduct, complaints and appeals, Predatory publishers and journals Practice.

Unit IV-Open Access Publishing **0.25**

Open access publications and initiatives, SHERPA / RoMEO online resource to check publisher copyright and self-archiving policies, Software tools to identify predatory publications developed by SPPU, Journal finder / journal suggestion tools viz. JANE, Elsevier journal Finder, Springer, Journal Suggester, etc.

Unit V-Publication Misconduct **0.25**

Group Discussion, Subject specific ethical issues, FFP, authorship, Conflicts of interest, Complaints and appeals: examples and fraud from India and abroad. Software tools, Use of plagiarism software like Turnitin, Urkund and other open source software tools.

Unit VI-Databases and Research Metrics **0.5**

Databases, Indexing databases, Citation databases: Web of Science, scopus, etc., Research Metrics, Impact factor of journal as per journal Citation report, SNP, SJR, IPP, Cite score,Metrics: h-index, g index, i10 index, altmetrics.

Paper III: Microbial Ecology (Core paper)

Code: PMBC-103

Credit-04

Course Outcome:

Upon successful completion of the course students will be able to:
1. Understand the basic principles of ecology.
2. Explore the diversity of microorganism.
3. Analyze the concept of metagenomics.
4. Gain knowledge about microbial interactions with environment.
5. Apply the knowledge of microbial communication in community dynamics.

Unit I

Ecological principles: Distribution, Abundance, Frequency, Ecological Niche and guild. Substrate groups and nutritional strategies. Resource partitioning and successions. Biomonitoring. Ecological indicators and Biomarkers. Biomagnification. Pollution and its indicators.

Unit II

Introduction to microbial diversity. Conventional and molecular methods of studying microbial diversity.

Measures of diversity. Species richness versus Diversity Index. Unculturable and culturable bacteria.

Unit III

Abiotic-abiotic and abiotic-biotic interactions. Symbiosis of bacteria- protozoa, algae- invertebrates, Bacteria-plants, insect endosymbionts. Rumen microbiology. Theory of Endosymbiogenesis. Parasitism, mutualism, competition.

Unit IV

Stress and strain. Constant and fluctuating stress. Strategies to survive stress. Density dependent and density independent stresses. Life strategies: r- and K- selection. Stresses in arid soils and rocks.

Unit V

Microbial communication (e.g. quorum sensing, fruiting body formation). Biofilm formation, how biofilms work. Spatial patterning– spatial scale, biogeography. Temporal patterns, microbial community dynamics. Microbial response to disturbance, Microbial response to land use (investigating legacy effects) and Microbial response to biological invasions

Suggested Readings:

1. Odum E.P. Basic Ecology.
2. Cowld D. 1999. Microbial diversity.
3. Atlas & Bartha. Microbial Ecology.

Paper IV: Biogeochemistry and Extremophiles (Elective)

Code: PMBE-104

Credit-04

Course Outcome:

Upon successful completion of the course students will be able to:

1. Understand the classification of microorganism on the basis of nutrition and physiology.
2. Analyze the role of various elements in biogeochemical cycles.
3. Execute the knowledge of various biogeochemical cycles.
4. Apply the knowledge of survival of microorganism in extreme conditions.

Unit I

Nutrition of microorganisms: Classification of microorganisms and nutrients, elemental composition of biomass, requirement and physiological functions of principle elements (H, O, N, P, S, major catons and trace elements). Concept of the limiting nutrient, design and analysis of defined minimal growth media, experimental verification.

Unit II

Oxidation-reduction reactions in biological system, introduction to biogeochemical cycles, major forms of C, N, S and iron, their importance in biogeochemical cycling. Carbon Cycle: Photo and chemoautotrophy in prokaryotic world, ecology and microbiology. Methanogens: diversity and phylogeny, habitats, physiology and biochemistry. Methylotrophs: Significance, aerobic and anaerobic methylotrophs, methylotrophic yeast. Iron metabolism: Iron uptake, intracellular "free" and stored iron, iron in primary fueling reactions, iron and pathogenicity.

Unit III

Nitrogen cycle: Dinitrogen fixation, biochemistry and microbiology, ecology of nitrogen fixation. Assimilation and ammonification. Nitrification: biochemistry and microbiology of NH_4^+ oxidation, NO_2^- oxidation, ecology of nitrification, heterotrophic nitrification. Denitrification: biochemistry and microbiology, ecology of denitrification, primary controlling factors of denitrification. Sulfur cycle: Microbial sulfate reduction, microbial sulfur oxidation, transformation of sulfur compounds, sulfur cycling within ecosystem, its environmental consequences.

Unit IV

Extremophiles: definition, ecology and biotechnology of extremophiles. Hyperthermophiles: temperature classes, habitat and microorganisms, biochemistry and physiological adaptations.
Habitats, biochemistry and physiological adaptations of psychrophiles and extreme acidophiles.

Unit V

Habitats, biochemistry and physiological adaptations of Barophiles, Halophiles, Alkaliphiles, Oligotrophs and Radiation resistant microorganisms.

Suggested Readings

1. Stanier, R.Y., J.L. Grahm, M.L. Wheelis & P.R. Painter. General Microbiology. 1986. McMillan.
2. Caldwell, DR. Microbial Physiology & Metabolism. 1995. Brown Publishers.
3. Moselio Schaechter. The desk encyclopedia of microbiology. Elsevier.

Paper V:Plant Pathology and Pathogen Interaction (Elective)
Code: PMBE-105

Credit-04

Course Outcome:

Upon successful completion of the course students will be able to:

1. Gain knowledge about plant pathogens and establishment of plant diseases.
2. Understand the plant defense mechanism.
3. Learn about various diseases affecting economically important crops.
4. Apply the knowledge of disease control mechanism.
5. Execute the production and application of biofertilizers in crop improvement.

Unit I

Types of plant pathogens, mode of infection, pathogenesis strategies –fungus, bacteria, nematodes, nonhost pathogens, viruses, subviral agents viroids, satellite viruses, satellite RNAs.
Initial establishment, multiplication and spread of pathogens, symptoms host ranges

Unit II

Nature, causes and classification of plant pathogen; Dissemination and methods of preservation and control of plant diseases, Host-parasite relationship, plant defense mechanism.

Unit III

Fungal disease of plant crops- rice, wheat, maize, sugarcane, cotton and groundnut; fruit crops- apple, peach, mango, citrus and grapes; vegetable crops- crusifers, tomato, potato and brinjal; other crops- tobacco, turmeric and coriander.

Unit IV

Bacterial diseases of field crops, vegetable, fruits and other economically important plants. Viral diseases of field crops, vegetable, fruits and other economically important plants. Nematode disease of plants: a knowledge of some important nematode disease of economically important crops.

Unit V

Application of biofertilizers in production of healthy and vigorous transplants in nursery. Role of mycorrhiza in growth of plants.

Suggested Reading:

1. Mehrotra, RS. 1980. Plant Pathology. Tat McGrawHill.
2. Singh, RS. 1998. Plant Disease. Oxford & IBH Publ.
3. Bilgrami, KS. & Dubey, H.C. 1976. Vikas Publ. House, New Delhi.

Paper VI:Medical Microbiology (Elective)
Code: PMBE-106

Credit-04

Course Outcome:

Upon successful completion of the course students will be able to:

1. Gain knowledge about role of normal flora in human body.
2. Understand the mechanism of infection of pathogens and role of various enzymes in pathogenicity.
3. Explore medically important microorganism.
4. Apply the knowledge of various human infections in its prevention.
5. Analyze bacterial sensitivity to antibiotics.

Unit I History of medical microbiology. Normal microbial flora of human body and its role. Sources, vehicles and reservoirs of infection. Exogenous and endogenous infection. Mechanism of bacterial adhesion, colonization and invasion of mucous membranes of respiratory, enteric and urogenital tracts. Establishment of infection, spreading, tissue damage and anti-phagocytic factors.

Unit II Role of aggressins (Hyaluronidase), coagulase, fibrinolysins or kinase, depolymerizing enzymes (Mucinase, lipases, proteases, nucleases, collagneases, neuraminidase), organotropisms, variation and virulence. Mode of spread of infection.

Unit III Respiratory, skin, wound and burn infection, venereal infections, alimentary tract infection, arthropod-borne blood infections and laboratory infections. Pathogenesis: Microbial pathogenicity, transmissibility, infectivity and virulence. Opportunistic pathogens, Toxigenicity. Invasiveness. Immune response to bacterial infection in man.

Unit IV Classification of medically important microorganisms. Causal organisms, diagnosis, symptoms, toxic components, etiology and disease development in man by bacteria, fungi and viruses. Causal organisms, symptoms and diagnosis of New Castle (Ranikhet), bird flue, and salmonellosis in poults, rinderpest, anthrax, foot and mouth disease, mastitis and tympany in cattle. Hog cholera.

Unit V Antimicrobial therapy. Antibiotics and their classification, mode of action. Drug resistance. Methods of drug susceptibility testing. Antibiotic assay in body fluids. Brief account on available vaccines and schedules. Passive prophylactic measures. Nosocomial infections. Common types of hospital infections, their diagnosis and control. Principles of disinfection. Disinfectants and their mode of action

Suggested Readings:

1. Ananthnarayanan R and Jayaram C.K. 1997.Textbook of Microbiology. Orient Longman.
2. Mackie and McCartney. 1996. Medical Microbiology. Vol.1. Microbial Infection, Vol. 2. Practical Medical Microbiology. Churhill Livingstone.
3. Shanson DC. Wright PSG1982. Microbiology in Clinical Practice.
4. Baron EJ, Peterson LR and Finegold SM. 1990. Bailey and Scott's Diagnostic Microbiology. Mosby.
5. Mims CA. 1987. The Pathogenesis of Infectious disease. Academic Press.
7. Murrey, P.R., Rosenthal, K.S., Kobayashi, G.S. & Pfaller, M.A. Medical Microbiology. Mosbay.

Paper VII: Basic and Applied Statistics (Elective)

Code: PMBE-107

Credit-04

Course Outcome:

Upon successful completion of the course students will be able to:

1. Tabulate and graphically represent the data.
2. Apply to apply the knowledge of statistical tools in result analysis.
3. Describe the process of fitting of various distribution and their utility in practical life.
4. Explain the concept of survey sampling and analysis of variance.
5. Apply the concept of probability, permutations and combinations in experimental designs.

Unit I

Introduction, Data Tabulation, Diagrammatic and Graphical Representation: Definition, Aims, Limitation, Classification, Tabulation, Types of Tabulation, Types of Diagrams, Graphical Representations, Utility and Limitations. Measures of Central Tendency and Dispersion:
Characteristics of Satisfactory Average, Arithmetic, Geometric, Harmonic, Weighted Mean,
Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Coefficient of variation, Standard Error.

Unit II

Test of Significance and Goodness of Fit: Statistical Hypotheses, Parametric and Non-Parametric Hypothesis, Null Hypothesis, Statistical Significance, Levels of Significance, Degrees of Freedom, Student's t test, Goodness of Fit, χ^2 -Test, Conditions for the Application of χ^2 - Test.
Regression and Correlation**:** Bivaiate universe or population, Arrays and Correlation,
Measurement of Corre lation, Intra-class, Rank, Partial and Multiple Correlations, Lines of Regression, Regression Coefficients, Limits and Range of γ- Correlation Coefficient expressed in terms of Regression Coefficients.

Unit III

Probability **:** Introduction, Definitions, Mathematical and Experimental Approach, Simple and Compound Events, Independent and Dependent Events, Laws of Composition of Events, Certainity and Impossibilty, Limiting values and Range of Probability, Permutation and Combinations. Principles of Experimental Design and Analysis of Variance and Covariance:
Validity, Soil Heterogeneity and Uniformity Trial, Precision and Accuracy, Basic Principles of Field Experimentation, Experimental Technique.

Unit IV

Sampling: Aims of Sampling, Types of Population, Choice of Sampling Methods, Multi-stage and Multi-phase Sampling. Completely Randomized, Randomized Block and Latin Square Design: Description, Treatments, Randomization, Statistical Analysis, Merits and Demerits.
Split-plot Design: Description, Relation to the Confounded Factorial Designs, Structure of
Analysis of Variance, Standard Error in Split -plot Experiments, Testing the Significance of the Differences among the treatment means, Statistical Analysis, Advantage and Disadvantage.

Unit V

Statistics and Computer: Calculation in Statistics, Software in Aid to Statistics, Working with Useful Software to Agricultural Researches.

Suggested Readings:

1. Wardlaw, A.C. 1985. Practical Statistics for Experimental Biologists. John Wiley.
2. Holmes D., Moody, P. Dine D. 2006. Research Methods for the Biosciences. Oxford University Press.

Paper VIII: Field work
Code: PMBF-108

Credit-04

Assessment will be based on work assigned by head of the department like to attend or present research paper/s in Seminar/ conference, write up on review literature and field visits for sample collection/tour report submission etc.