Proposed Syllabus and Structure
For
Ph.D.Microbiology

Under
Choice Based Credit System

Ph.D. Course Work (One Semester)
(2022-23)

Date of BoS: 16.02.2022

Department of Microbiology
Dr. Harisingh Gour Vishwavidyalaya (A Central University)
Sagar (M.P.) 470003

About the Department

The pioneering work done in the Microbiology and Mycology laboratory of the Botany department triggered a vision of initiating a full-fledged curriculum in Applied Microbiology and Biotechnology at Dr. Harisingh Gour Vishwavidyalaya, Sagar. The idea conceived by the founder head, Prof. S. C. Agrawal (Head:1996-2004) resulted in the start of this much awaited PG course in Life Science faculty in 1990-91.

Under the able directions and untiring efforts of Late Prof. P.C. Jain (Head: 2004-2012) the department could acquire the present status. Since then department has stood among the front runners in teaching and research in Microbiology and occupies a place of prominence in the field. In last ten years the department has witnessed a great deal of expansion with regards to infrastructure and facilities as a seat of higher learning in Microbiology. With the establishment of Central University in 2009, the department was renamed as Department of Microbiology and became a part of School of Biological Sciences(SBS).
The department offers following courses:

S.No.	Course	Intake
1.	M.Sc. Microbiology	19
2.	Ph.D. Microbiology	12 (maximum) (subject to availability of seats)

The department has published significant number of publications in the leading national and international peer reviewed scientific journals. In past the department has also organized several hand'son workshops, national and international conferences. At the department of Microbiology research is being pursued in both basic and applied areas of Microbiology. With an inclination towards inter disciplinary research, faculty members in the department have forged active collaboration within and outside the university. Recently, laboratories of bioimaging, infection and immunity and host-pathogen interaction have been established. The major research fields encompass microbial hemicellulases, inulinases, L-asparaginase, thermophilic fungi, mycobacteria, host-pathogen interaction, enteric bacteria, bioimaging, biofilm and cancer biology.

Total Credits: 18

- **Credits through course work = 18**
- **3 Courses X4 Credits = 12Credits through course work**
  + 04 Credits from scientific review writing
- **Research and Publication Ethics = 02**

Paper	Code	Title	Credits
Paper 1	MIC CC 141	Research Methodology	4
Paper 2	MIC CC 142	Fundamentals of Biotechnology	4
Paper 3	MIC EC 141	Techniques in Microbiology	4
	MIC EC 142	Microbiology & Human Health	4
Paper 4	MIC CC 143	Reviewing of Literature/ Scientific writing/ Presentations etc	4
Paper 5	CPE-RPE	Research and Publication Ethics	2

MIC CC 141: Research Methodology

Total Credit: 4 60 hrs

Unit-I (12 hrs.)

Hypothesis &testing of hypothesis. Acceptance and rejection regions. Type I and Type II errors and their probabilities. Distribution of the difference of two sample mean and proportions. Comparisons of two means and two proportions including paired Student T-test.

Unit-II (12 hrs.)

Selection of field and the topic for research. Preparation of different components & drafting of synopsis.Essentials of experimental designing, Preparation of protocols and their validation, drafting of data tables, analysis of results and interpretation of results with available literature.

Unit-III (12 hrs.)

Statistical methods for data analysis; Mean, Standard deviation &standard error. Concept of probability and its significance. Most probable number (MPN).

Unit-IV (12 hrs.)

Presentation of data using computer software's, Sigma plot&. Calculation and storage of data, Experimental data register.

Unit-V (12 hrs.)

Concept of Biosafety levels, Biological hazards related to pathogens, genetically modified organisms. Chemical hazards: toxic chemicals and hazardous gases. Good laboratory practices, confinement and disposal of biohazardous waste.

Essential Readings

1) Kothari, C.R. 2004. Research methodology methods and techniques. New Delhi: New Age International Limited
2) Research Design: Qualitative, Quantitative, and Mixed Methods Approaches
3) Statistics: Concepts and Applications by Pal and Sarkar.

Suggested Readings

1. Basic of Statistics by Dhiraj Nagar
2. Seltman, H.J. 2014. Experimental design and analysis. Carnegie Mellon University.

MIC CC 142: Fundamentals ofBiotechnology

Total Credit: 4 60 hrs

Unit-I (12 hrs.)

Microbial Growth: Mathematical nature and expression of microbial growth. Generation time. Growth rate measurement based on nucleotide incorporation and cell numbers.

Unit 2:

Bacterial Technology: Application of bacteria in recombinant DNA technology and expression in bacteria: Concept of gene regulation in bacteria: lac-operon in bacteria (positive and negative regulation), structural gene clusters, role of inducer and repressor. Introduction of pET expression vectors for expression of recombinant proteins in bacteria.

Unit 3: (12 hrs.)

Fungal Technology: Importance of fungal over bacterial expression systems used in recombinant DNA technology. Fungal vector systems. Steps used in cloning of recombinant genes in fungal vectors. Yeast Two Hybrid Systems (YTHS).

Unit 4: (12 hrs.)

Metabolic Engineering: Fundamentals pathways of Pyruvate formation (Embden-Meyerhof pathway (EMP) /glycolytic pathways, Pentose phosphate pathway (PPP) /hexose monophosphate shunt, Entner-Doudoroff pathway). Metabolic engineering of lactic acid bacteria (LAB), Concept of Flavour, aroma and texture of dairy products.

Unit 5: (12 hrs.)

Bio imaging: Properties of Light and Lamps using in bioimaging, components of compound and fluorescence microscope. Types of fluorescent objectives, refractive index, numerical aperture. Introduction to live cell imaging.

Suggested Readings:

1. Microbiology By Pelczar M., Chan E.C.S. and Krieg, N.R. Tata Mc Grew Hill Publishing Co. Ltd., New Delhi.
2. An Introduction to Mycology By Mehrotra , R.S. and K.R.Aneja New Age International Press, New Delhi.
3. Green Fluorescent Protein, By Barry W. Hicks, Humana Press, 10-Nov-2010

Essential Readings:

1) The Microbial World By Stainier R.V., Ingraham, J.L., Wheelis, M.L. and Painter P.R. , Printice-Hall of India (Pvt.) Ltd., New Delhi
2) Methods of Biochemical Analysis, Green Fluorescent Protein: Properties, Applications and Protocols, By Martin Chalfie, Steven R. Kain, John Wiley & Sons, 18-Nov-2005.
3) Principles of Fluorescence Spectroscopy, 2007, 3e, By Joseph R. Lakowicz, Springer Publication

MIC EC 141: Techniques in Microbiology

Total Credit: 4 60 hrs

Unit-I (12 hrs.)

Methods of purification of microbial cultures- pour plate, streak plate, spread plate serial dilution. Culture media: preparation, differential media, selective media, enriched media, basal media, minimal media.

Unit-2 (12 hrs.)

Sterilization: Principle and methods of sterilization- Dry heat, moist heat, radiation, filtration, chemical methods for sterilization, Maintenance and preservation of microbial cultures.

Unit-3 (12 hrs.)

Immunological techniques: Antigen-antibody interaction- RID, DID, Rocket electrophoresis,agglutination- active and passive, measurement of antigen and antibody, preparation anti-sera and antibodies.

Unit-4 (12 hrs.)

Molecular techniques: Principal and applications of electrophoresis, microarray technology, Polymerase Chain Reaction, Transformation, Restriction enzyme, blotting techniques, gene cloning.

Unit-5 (12 hrs.)

Instruments: Incubators, pH meter, balance, centrifuge, Laminar flow, electroporator, spectrophotometer, transilluminator, Microscope, colony counter.

Essential Readings:

1) Biophysical Chemistry by Upadhyay, Upadhyay, and Nath.
2) Cuby Immunology by Kindt, Goldsby and Osborne, W. H. Freeman publication.
3) Immunology by David Male, Jonathan Brostoff, David B Roth and IvonRoit, Lange publication.
4) Manual of methods for general bacteriology By Phillip. G.
5) Microbiology By Pelczar M., Chan E.C.S. and Krieg, N.R. Tata Mc Grew Hill Publishing Co. Ltd., New Delhi.

Suggested Readings:

1. Biochemistry, Stryer 5th edition W.H. Freeman 2001.
2. Principles of Biochemistry, Lehniger, 3rd edition by Nelson and Cox (Worth) 2000. Publisher
3. Genetics By Gardner.
4. Molecular cloning Vol I, II and III Maniatis, Sambrook and Ffritz.
5. Microbial Genetics By David Freifelder.

MIC EC 142: Microbiology& Human Health

Total Credit: 4 60 hrs

Unit-I (12 hrs.)

Public Health Microbiology: Microorganisms of clinical and public health significance. Role of microorganisms to cause diseases (from normal to severe). Factors associated with disease development & transmission.

Unit-2: (12 hrs.)

Isolation, sampling and issues of specimen receiving and processing in lab.Lab diagnosis of infectious agents and antimicrobial susceptibility testing. Laboratory management& novel approaches to detect infectious agents.

Unit-3 (12 hrs.)

Epidemiology of Infectious Disease: Basic methods to studying the epidemiology of infectious diseases and reviews infectious diseases of major public health importance. Principle of disease surveillance &outbreak investigation.Identify research questions and design a project related to epidemiology.

Unit-4 (12 hrs.)

Prevention and control of infectious diseases impacting local, national, and global community health. Epidemiology methods used in disease surveillance and measures used in slowing or preventing spread of disease.

Unit-5 (12 hrs.)

Environment &Human Health. Impact of environmental problems on human health; biological hazards to human health from air and water pollution; radiation; pesticides; noise; problems related to food; occupation and environment of the workplace; accidents.

Essential Readings:

1) Principle of Public Health Microbiology by R S Burlage
2) Principles of Epidemiology in Public Health Practice, Third Edition**;** Richard Dicker, at al. - CDC **,** 2006
3) Foodborne disease outbreaks: Guidelines for investigation and control**;** World Health Organization **,** 2009
4) Essentials Of Environmental Health (Essential Public Health) 2nd Edition;Robert H Farrris-2016

Suggested Readings

1. Public Health Microbiology: Methods and Proto Protocols by John F T Spencer & S P Alecia; Springer Science & Business Media
2. Global Health: A Challenge for Interdisciplinary Research**;** M. Kappas, U. Gross, D. Kelleher (eds.) **–** Universitätsverlag Göttingen**,** 2012
3. Public Health Systems and Emerging Infections**;** Jonathan R Davis, Joshua Lederberg (ed.) **-** National Academies Press**,** 2000

MIC CC 143 Review of Literature

Paper 4	MIC C 143	Reviewing of Literature/ Scientific writing/ Presentations etc.	Credits 4

In this paper, the students are encouraged to write a review on a specific topic to expertise in reading and writing in to the scientific field. They have to present their piece of writing work.

Paper 5	**CPE-RPE**	**Research and Publication Ethics**	**2**

Course structure

• The course comprises of six modules listed in table below. Each module has 4-5 units.

Modules	Unit title	Teaching Hours
Theory		
RPE0l	**Philosophy and Ethics**	**4**
RPE02	**Scientific Conduct**	**4**
RPE03	**Publication Ethics**	**7**
Practice		
RPE04	**Open Access Publishing**	**4**
RPE05	**Publication Misconduct**	**4**
RPE06	**Databases and Research Metrics**	**7**
Total	**30**	**30**

Syllabus in detail

THEORY

RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)

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

RPE 02: SCIENTIFICCONDUCT (5hrs.)

1.Ethics with respect to science and research
2.Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

RPE 03: PUBLICATION ETHICS (7 hrs.)

1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

PRACTICE

RPE 04: OPEN ACCESS PUBLISHING(4 hrs.)

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

RPE 05: PUBLICATION MISCONDUCT (4hrs.)

A. Group Discussions (2 hrs.)

1.Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

B. Software tools (2 hrs.)

Use of plagiarism software like Turnitin, Urkund and other open source software tools

RPE 06: DATABASES AND RESEARCH METRICS (7hrs.)

A. Databases (4 hrs.)

1. Indexing databases

2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics (3 hrs.)

1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
2. Metrics: h-index, g index, ilO index, altmetrics

References

Bird, A. (2006). *Philosophy of Science.* Routledge.MacIntyre, Alasdair (1967) *A Short History of Ethics.* London. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865

National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). *On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition.* National Academies Press.

Resnik, D. B. (2011). What is ethics in research & why is it important. *National Institute of Environmental Health Sciences,* 1-10. Retrieved from https://www.niehs.nih.gov/research/resources/bioethics/whatis /index.cfrn Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. https://doi.org/10.1038/489 l79a

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