

**Central University of Punjab, Bathinda**



**Ph.D. Microbiology**

**Session- 2021**

**Department of Microbiology**

## **Programme Outcomes**

The programme will escalate the skilled scientific manpower with an understanding of research ethics and vast knowledge of microorganisms. Scholar will be equipped with the knowledge of microbial, molecular and cellular processes and their applications which can be utilized for the betterment of society and careers in the industry, agriculture, and applied research.

## Course Structure

<b>Sr. No</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>P</b>	<b>Credits</b>
1	MIC.701	Research Methodology and Computer Applications	4	0	4
2	MIC.702	Advanced Microbiology & Immunology	4	0	4
3	MIC.751	Research and Publication Ethics	2	0	2
4	MIC.752	Teaching Assistantship	0	2	1
5	UNI.753	Curriculum, Pedagogy and Evaluation	1	0	1
		<b>Total Credits</b>			<b>12</b>

**L: Lectures; P: Practical; Cr: Credits**

### **Evaluation Criteria for Theory Courses**

End Semester Examination: Based on Subjective Type Test [100 Marks]

L	T	P	Credits
4	0	0	4

**Course Code: MIC.701**

**Course Title: Research Methodology and Computer Applications**

### **Learning Outcomes**

Students will be able to:

- Illustrate the basic good practices to be followed in research.
- Formulate Classify the principles ethics in research which will help them to understand the set of conduct norms applied in science.
- Interpret the ethical issues involved in human, animals and plants research.
- Judge the misconduct, fraud and plagiarism in research.
- Utilize the computer and bioinformatics tools for analyzing and interpreting the data.

#### **Unit-I**

**15 hours**

**General Principles of Research:** Meaning and importance of research, Critical thinking, Formulating hypothesis and development of research plan, Review of literature, Interpretation of results and discussion. Bibliographic index

**Technical Writing:** Scientific writing, writing synopsis, Research paper, Poster preparation, oral presentations and Dissertations. Reference Management using various softwares such as Endnote, reference manager, Refworks. Communication skills: defining communication; type of communication; techniques of communication.

#### **Unit-II**

**15**

**hours**

**Introduction and Principles of Good Lab Practices:** Good laboratory practices, Biosafety for human health and environment. Biosafety issues for using cloned genes in medicine, agriculture, industry, and eco-protection, Biological containment and physical containment, Biosafety in Clinical laboratories and biohazard management, Physical, Chemical & Biological hazards and their mitigation. Biosafety level/category of pathogens. Biosafety level of laboratories, WHO/CDC/DBT guidelines for biosafety. **Research Ethics:** Ethical theories, Ethical considerations during research, consent. Animal handling/testing, Animal experimental models and animal ethics. Perspectives and methodology & Ethical issues of the human genome project, ICMR guidelines for biomedical and health research. Intellectual property protection (IPP) and intellectual property rights (IPR), WTO (World Trade Organization), WIPO (World Intellectual Property Organization), GATT (General Agreement on Tariff and Trade), TRIPs (Trade Related Intellectual Property Rights), TRIMS (Trade Related Investment

Measures) and GATS (General Agreement on Trades in Services). Patents, Technology Development/Transfer Commercialization Related Aspects, Ethics.

### Unit-III

15 hours

**Computer Application and Biostatistics:** Spreadsheet, Presentation, Image processing and Reference Management software. Internet browsers, World Wide Web: Origin and concepts, internet and its application for quality literature collection and secondary data related to research work. Exploring websites, search engines and Cloud computing. Statistical packages and their applications (Graphpad, Prism, SPSS). Statistical tests: Student's t-test, Paired t-test, Mann-Whitney U-test, Wilcoxon signed-rank, One-way and two-way analysis of variance (ANOVA), Critical difference (CD), Fisher's LSD (Least significant difference), Kruskal–Wallis one-way ANOVA by ranks, Friedman two-way ANOVA by ranks, Chi-square test. Regression and correlation.

### Unit-IV

15 hours

**Bioinformatics:** Biological databases (DNA/RNA/Protein; Predicting features of individual residues), Alignment tools, BLAST, FASTA, multiple sequence alignment, Pathway and molecular interactions, Primers designing (degenerative and gene specific primers), Genome projects (human, *Arabidopsis* and other genome projects), NCBI, UCSC and other database searches. *In silico* approaches for drug designing, Virtual and Quantitative Screening, identification of cell types epitopes for vaccine designing.

### Suggested Reading:

1. Gupta, S. (2010). *Research Methodology and Statistical Techniques*. Deep & Deep Publications (P) Limited, New Delhi.
2. Kothari, C.R., Garg, G. (2019). *Research Methodology: Methods and Techniques*. 4<sup>th</sup> Edition, New Age International (p) Limited. New Delhi.
3. Sahay, Vinaya and Pradumna Singh (2009). *Encyclopedia of Research Methodology in Life Sciences*. Anmol Publications. New Delhi.
4. Kauda J. (2012). *Research Methodology: A Project Guide for University Students*. Samfunds literature Publications.
5. Dharmapalan B. (2012). *Scientific Research Methodology*. Narosa Publishing
6. Norman, G. and Streiner, D. (2014). *Biostatistics: The Bare Essentials*. 4<sup>th</sup> Edition, PMPH-USA Limited.
7. Rao, P. P., S. Sundar and Richard, J. (2009). *Introduction to Biostatistics and Research Methods*. PHI learning.
8. Christensen, L. (2007). *Experimental Methodology*. Boston: Allyn & Bacon.
9. Fleming, D. O. and Hunt, D.L. (2006). *Biological Safety: Principles and Practices*. American Society for Microbiology, USA.

10. Rockman, H. B. (2004). *Intellectual Property Law for Engineers and Scientists*. Wiley-IEEE Press, USA.
11. Shannon, T. A. (2009). *An Introduction to Bioethics*. Paulist Press, USA.
12. Vaughn, L. (2012). *Bioethics: Principles, Issues, and Cases*. 2<sup>nd</sup> Edition, Oxford University Press, UK
13. Lesk, A.M. (2019). *Introduction to Bioinformatics*. 5th Edition, Oxford University Press, UK.
14. Ramsden, J. (2021). *Bioinformatics: An Introduction* (Series: Computational Biology). 4<sup>th</sup> Edition, Springer International Publishing.

L	T	P	Credits
4	0	0	4

**Course Code: LMS.702**

**Course Title: Advanced Microbiology & Immunology**

**Learning Outcomes:**

The students will be able to:

- Outline the concept of epidemiology and various cellular processes during disease development.
- Comprehend the clinical diagnostics and treatment of the different diseases caused by microbes.
- Describe virulence determinants – colonization, toxins, enzymes and invasiveness with varied examples from different pathogens.
- Illustrate facultative or obligate intracellular and describe molecular Koch’s postulates and multiplicity of virulence factors and coordinated regulation of virulence genes.
- Categorise 1-IV secretion systems, importance of biofilms and quorum sensing
- Propose the concepts of antimicrobial, multidrug efflux pumps, extended spectrum  $\beta$ -lactamases, X-MDR Mycobacterial tuberculosis, methicillin-resistant *S.aureus* (MRSA)

**Unit-I**

**15 hours**

**Advanced approaches in host-pathogen interactions:** Molecular basis of immune memory, Cancer immunology and immunotherapy, Antiviral immunity (SARS-CoV-2), Immune response during pregnancy, Transplantation immunology, Vaccines. Genomics, bioinformatics, proteomics and systems biology approaches to study host pathogen interactions. Screening and development approaches for new microbial products, High-content screening methods, antimicrobial *in-vitro* and *in-vivo* screening assays and metagenomics.

**Unit-II**

**15 hours**

**Mechanism of Microbial Pathogenesis:** Microbial colonization and adherence strategies, Microbial invasion strategies, Protein and DNA secreting systems and Pathogenicity Island. Antigenic variation, Biofilms and quorum sensing, modulation of apoptotic processes and microbial toxins. Molecular basis of antimicrobial resistance and its detection. Molecular approaches in clinical microbiology.

### **Unit-III**

**15 hours**

**Pathogenesis of Selected Organisms:** Prevalence, Incidence, epidemic, endemic, pandemic, chronic, acute, DALY, YLL, HALE, Mortality, Morbidity of Spirochetes such as *Treponema pallidum*, *Borrelia burgdorferi* and *Borrelia hermsii*. Intracellular pathogens/Gram-negative bacteria: *Salmonella* and *Helicobacter pylori*. Gram positive bacteria: *Staphylococcus aureus*, *Listeria monocytis*. Myxobacteria: *Mycobacterium tuberculosis*. Swine/Avian virus, MERS-CoV, Ebola and SARS-CoV-2. Disease outbreaks, integrated disease surveillance program by National Centre for disease control. Diverse approaches for tackling outbreaks. WHO Emergencies preparedness and response mechanisms.

### **Unit-IV**

**15 hours**

**Antimicrobial Resistance and Therapeutics:** Mechanisms of action of antimicrobial agents and resistance (Tuberculosis with emergence of MDR, XDR and TDR-TB, *Salmonella* and *E. coli*). Recent advances in the development of antibiotics and vaccines. Human Microbiome and their role in therapeutics. Host directed therapies.

### **Suggested Reading:**

1. Michael F. Cole, (2019) Unifying Microbial Mechanisms: shared Strategies of Pathogenesis by Garland Science, USA
2. Michael Madigan, Kelly Bender, Daniel Buckley, W. Sattley, David Stahl (2018) Brock Biology of Microorganisms, 15th Global Edition Pearson Education, USA
3. Denise G. Anderson, Sarah Salm, Deborah Allen (2015) Nester's Microbiology: A Human Perspective 8th edition McGraw-Hill Education, USA
4. Reba Kanungo (Editor) (2020) Ananthanarayan and Paniker's Textbook of Microbiology, Eleventh Edition Universities Press (India) Pvt. Ltd.
5. Tortora, G.J., Funke, B.R. and Case, C.L. (2016). *Microbiology: An Introduction. 12th Edition* Pearson Education, USA.
6. Abbas, A., Lichtman, A., Pillai S. (2022). *Cellular and Molecular immunology*. Elsevier
7. Murphy, K., Weaver, C. (2016) *Janeway's Immunobiology*. Garland science.
8. Pelczar, M. J., Chan, E.C.S. and Krieg, N.R. (2020). *Microbiology: Concepts and Applications*. McGraw-Hill Inc. USA.

9. Joanne Willey, Kathleen Sandman and Dorothy Wood (2019) *Prescott's Microbiology*. 11<sup>th</sup> Edition, McGraw-Hill Science, USA.
10. Tortora, G.J., Funke, B.R. and Case, C.L. (2016). *Microbiology: An Introduction*. Benjamin Cummings, USA.
11. Research papers and reviews published in international journals from American Society of Microbiology press; Cell Host and Microbe, Cellular Microbiology, Immunity, Molecular Microbiology, Nature Reviews Microbiology, FEMS Microbiology Reviews, Trends in Microbiology, Microbiome etc.

**Course Code: MIC.751**

**Course Title: Research and Publication Ethics**

L	T	P	Credits
2	0	0	2

**Total Hours: 30**

### **Learning Outcomes**

Students will be able to:

- Illustrate the basic good practices to be followed in research and publication.
- Judge the misconduct, fraud and plagiarism in research.
- Utilize various online resources and software to analyze their research output.

### **Unit I Philosophy and Ethics**

**3 hours**

- Introduction to Philosophy : definition, nature and scope, content, branches
- Ethics : definition, moral philosophy, nature of moral judgements and reactions

### **Unit II Scientific Conduct**

**5 hours**

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

### **Unit III: Publication Ethics**

**7 hours**

- 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 behaviour and vice versa, types
- Violation of publication ethics, authorship and contributor ship
- Identification of publication misconduct, complaints and appeals
- Predatory publishers and journals

**Unit IV Open Access publishing**

**4 hours**

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

**Unit V Publication Misconduct**

**(4 hours)**

- Group Discussions: 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 IV Databases and Research Metrics**

**7 hours**

- Databases: Indexing databases; Citation database: Web of Science, Scopus etc.
- Research Metrics: Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score; Metrics : h-index, g-index, i10 index, almetrics

**Course Code: MIC.752**

**Course Title: TEACHING ASSISTANTSHIP**

L	T	P	Credit
0	0	2	1

**Total Hours: 30**

**Learning Outcome:**

- At the end of this skill development course, the scholars shall be able to
1. familiarize themselves with the pedagogical practices of effective class room delivery and knowledge evaluation system
  2. manage large and small classes using appropriate pedagogical techniques for different types of content

**Activities and Evaluation:**

- The scholars shall attend Master degree classes of his/her supervisor to observe the various transaction modes that the supervisor follows in the class room delivery or transaction process one period per week.

- The scholars shall be assigned one period per week under the direct supervision of his/her supervisor to teach the Master degree students adopting appropriate teaching strategy(s).
- The scholars shall be involved in examination and evaluation system of the Master degree students such as preparation of questions, conduct of examination and preparation of results under the direction of the supervisor.
- At the end of the semester, the supervisor shall conduct an examination of teaching skills learned by the scholar as per the following evaluation criteria:
  - The scholars shall be given a topic relevant to the Master degree course of the current semester as his/her specialization to prepare lessons and deliver in the class room before the master degree students for one hour (45 minutes teaching + 15 minutes interaction).
  - The scholars shall be evaluated for a total of 50 marks comprising content knowledge (10 marks), explanation and demonstration skills (10 marks), communication skills (10 marks), teaching techniques employed (10 marks), and classroom interactions (10 ).

**Course Code: UNI.753**

**Course Title: CURRICULUM, PEDAGOGY AND EVALUATION**

L	T	P	Credit
1	0	0	1

**Total Hours: 15**

**Learning outcomes:**

After completion of the course, scholars shall be able to:

- analyze the principles and bases of curriculum design and development
- examine the processes involved in curriculum development
- develop the skills of adopting innovative pedagogies and conducting students' assessment
- develop curriculum of a specific course/programme

**Course Content**

**Unit I Bases and Principles of Curriculum**

**4 hours**

1. Curriculum: Concept and Principles of curriculum development, Foundations of Curriculum Development.
2. Types of Curriculum Designs- Subject centered, learner centered, experience centered and core curriculum. Designing local, national, regional and global specific curriculum. Choice Based Credit System and its implementation.

**Unit II Curriculum Development**

**4 hours**

1. Process of Curriculum Development: Formulation of graduate attributes, course/learning outcomes, content selection, organization of content and learning experiences, transaction process.
2. Comparison among Interdisciplinary, multidisciplinary and trans-disciplinary approaches to curriculum.

**Unit III Curriculum and Pedagogy**

**3 hours**

1. Conceptual understanding of Pedagogy.
2. Pedagogies: Peeragogy, Cybergogy and Heutagogy with special emphasis on Blended learning, Flipped learning, Dialogue, cooperative and collaborative learning
3. Three e- techniques: Moodle, Edmodo, Google classroom

**Unit IV Learners' Assessment**

**4 hours**

1. Assessment Preparation: Concept, purpose, and principles of preparing objective and subjective questions.
2. Conducting Assessment: Modes of conducting assessment – offline and online; use of ICT in conducting assessments.
3. Evaluation: Formative and Summative assessments, Outcome based assessment, and scoring criteria.

**Transaction Mode**

Lecture, dialogue, peer group discussion, workshop

**Evaluation criteria**

There shall be an end term evaluation of the course for 50 marks for duration of 2 hours. The course coordinator shall conduct the evaluation.

**Suggested Readings**

- Allyn, B., Beane, J. A., Conrad, E. P., & Samuel J. A., (1986). Curriculum Planning and Development. Boston: Allyn & Bacon.
- Brady, L. (1995). Curriculum Development. Prentice Hall: Delhi. National Council of Educational Research and Training.
- Deng, Z. (2007). Knowing the subject matter of science curriculum, Journal of Curriculum Studies, 39(5), 503-535. <https://doi.org/10.1080/00220270701305362>
- Gronlund, N. E. & Linn, R. L. (2003). Measurement and Assessment in teaching. Singapore: Pearson Education
- McNeil, J. D. (1990). Curriculum: A Comprehensive Introduction, London: Scott, Foreman/Little
- Nehru, R. S. S. (2015). Principles of Curriculum. New Delhi: APH Publishing Corporation.
- Oliva, P. F. (2001). Developing the curriculum (Fifth Ed.). New York, NY: Longman
- Stein, J. and Graham, C. (2014). Essentials for Blended Learning: A Standards-Based Guide. New York, NY: Routledge.

## **Web Resources**

- [https://www.westernsydney.edu.au/\\_data/assets/pdf\\_file/0004/467095/Fundamentals\\_of\\_Blended\\_Learning.pdf](https://www.westernsydney.edu.au/_data/assets/pdf_file/0004/467095/Fundamentals_of_Blended_Learning.pdf)
- <https://www.uhd.edu/academics/university-college/centers-offices/teaching-learningexcellence/Pages/Principles-of-a-Flipped-Classroom.aspx>
- <http://leerwegdialoog.nl/wp-content/uploads/2018/06/180621-Article-The-BasicPrinciples-of-Dialogue-by-Renate-van-der-Veen-and-Olga-Plokhooij.pdf>