



**BHARATI VIDYAPEETH DEEMED UNIVERSITY,**  
**PUNE (India)**

**Faculty of Science: Doctor of Philosophy (Ph.D.)**  
**Syllabus for Ph.D. Course Work in Microbiology (2017)**

**PAPER I: RESEARCH METHODOLOGY**

**For subjects under the Faculty of Science**  
**(Physics, Chemistry, Botany, Zoology, Microbiology ,**  
**Environmental Sciences & Biotechnology)**

**PAPER II: ADVANCES IN MICROBIOLOGY**

**BHARATI VIDYAPEETH DEEMED UNIVERSITY, PUNE-38.**

**Faculty of Science**  
**Choice Based Credit and Grading System Coursework for Doctor of Philosophy (Ph.D.)**  
**(To be implemented from June, 2017)**  
**Course Structure in MICROBIOLOGY**

Paper- I:	Research Methodology	04 Credits
Paper- II:	Recent Advances in MICROBIOLOGY	04 Credits
Paper- III:	Review Writing and Oral Presentations	
	Part A: Review Writing ( 02 Credits)	
	Part B: Oral Presentations ( 02 Credits)	
		04 Credits

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**Total: 12 Credits**

**Rules & Regulations:**

1. The duration of the coursework will be of one semester.
2. There will be a written examination for Paper-I and II at the end of the semester.
3. Each paper will contains 5 questions carrying 20 marks each and questions may have internal options.
4. A researcher should secure minimum 50% marks in each paper to qualify for the further research.
5. Part-A of Paper-III will be supervised by respective guide and Part-B will be coordinated by the Head of the Institution.

Faculty of Science

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Syllabus for Ph.D. Course Work (2017)

For subjects under the Faculty of Science

(Physics, Chemistry, Botany, Zoology, Microbiology, Environmental Sciences & Biotechnology)

**Paper I: RESEARCH METHODOLOGY**

Credits 4

Total No. of Lectures (60)

**1. QUANTITATIVE METHODS (15)**

i. **Collection of Data:** Introduction, Primary and secondary data, methods of collecting primary data, Drawing or framing the questionnaire, Sources of secondary data, Precautions in the use of secondary data.

ii. **Classification and Tabulation:** Introduction: Organization of data, Classification, Frequency distribution, Basic principles for forming a grouped frequency distribution, Cumulative frequency distribution, Bivariate frequency distribution, Tabulation meaning and importance

iii. **Graphic Representation of Data:** Introduction, Difference between diagrams and graphs, Diagrammatic representation, Graphic representation of data, Limitations of diagrams and graphs.

iv. **Correlation Analysis:** Introduction, methods of studying correlation, scatter diagram method, Karl Pearson's method of correlation (covariance method), probable error, correlation in bivariate frequency table, rank correlation method, method of concurrent deviations, coefficient of determination, lag and lead correlation.

v. **Linear Regression Analysis:** Introduction, Linear and non linear regression, Lines of Regression, Coefficient of regression, To find the mean value from the two lines of regression, To find the regression coefficients and the correlation coefficient from the two lines of regression, Standard error of an estimate, Regression equations for a bivariate frequency table, Correlation analysis vs Regression analysis

**2. COMPUTER APPLICATIONS**

(15)

**i. Computers in research:**

- i. Role of computers in Conceptual phase: role of computers in literature review.
- ii. Role of computers in Design and planning phase: role of computers in sample size calculations.
- iii. Role of computers in Empirical phase: Data storage.
- iv. Role of computers in Analytical phase: Data analysis
- v. Role of computers in Dissemination phase: Research publishing
- vi. References and computer

**ii. Research Methodology and Computer applications:**

Introduction, source of data, experimental technique, methods of data collection, measurement of scaling techniques, sampling methods, probability, probability distribution, estimation and testing, nonparametric tests, contingency tests, computer applications

**3. Review of Literature relevant field, Research ethics:**

(15)

i. **Research ethics:** What is ethics, The development of ethics, The growth of ethics, Ethics in the 21<sup>st</sup> century, Making decisions.

ii. **Environmental ethics:** Two current themes in environmental ethics.

Three current issues in environmental ethics: Terrestrial and aquatic pollution, Global climate change, Environmental degradation and loss of biodiversity.

### iii. How to write a Thesis

#### a. What is PhD

**b. Introduction:** Status of a thesis, Get advice, Read before you write, Time table and mile stones, content of a thesis, What belongs into which section, Time: past and present tense, Graphs and figures, Tables, Format, Further information

**c. Writing a thesis:** Structuring the thesis, Signposting, Code of practice for research, Content Chapters The Exit strategy, Front matter, back matter and appendices, Notation, glossary and index, Look and feel, tone, grammar and style,

**d. The viva:** Role of the participants, Selecting the examiners, Preparing for viva, On the Day, Corrections if any

#### iv. Proposals to various funding agencies

**a. Developing a grant proposal:** Preparation, Initial proposal development, Developing Ideas for the community support, Identification of a funding resource, Getting organized to write the proposal, Review, Criticism, Signature, Neatness, Mailing.

**b. Writing the grant proposal:** The Basic components of a proposal, The Proposal summary: Outline of project, Introduction: Presenting a credible applicant or organization, The problem statement: stating the purpose at hand, Project objectives: Goals and desired outcome, Program methods and program design: A Plan of action, Evaluation: product and process, Future funding: long-term project, The proposal budget: planning the budget, Guidelines and literature.

#### 4. Training and field work:

(15)

##### i. Biosafety:

a. General principles, b. Biosafety guidelines, c. Basic laboratories – Biosafety Levels 1 and 2  
d. The containment laboratory – Biosafety Level 3, e. The maximum containment laboratory – Biosafety Level 4, f. Guidelines for laboratory/facility commissioning, g. Guidelines for laboratory/facility certification, h. Laboratory biosecurity, i. Laboratory biosecurity concepts, j. Laboratory equipment  
k. Safety equipment, l. Good microbiological techniques, m. Laboratory techniques, n. Contingency plans and emergency procedures. Chemical, fire and electrical safety, p. Hazardous chemicals, q. Additional laboratory hazards, r. Safety organization and training, s. Safety for support staff, t. Training programmers, u. Safety checklist.

##### ii. Plagiarism:

a. Introduction: Forms of plagiarism, Why does plagiarism matter? Why should you avoid plagiarism? What happens if you are thought to have plagiarised? Does this mean that I shouldn't use the work of other authors? Does every statement in my essay have to be backed up with references?

Does this only matter in exams?, Unintentional plagiarism, Examples of plagiarism

B. Understand what plagiarism is and why it happens

c. Fully reference and acknowledge the work of others

d. Use your own words and develop your own writing style

e. Organize and structure your work in your own way

f. Don't be afraid to express your own views

g. Managing references in your thesis

h. Use of published work within research degree theses,

i. Penalties for plagiarism

### iii. Patent:

**a. Introduction:** IPR, Governing laws in India for IPR, What is an innovation or invention, The patent system, Novelty and inventiveness, Commercialization of invention, Disclosing an invention, Academic research, Applying for patent, Patent specifications, Patent Examination, Infringement.

**b. About the patent:** What is a patent, Term of patent, Territorial scope, What is patentable, Patentability searches, Information required for conducting research, Why one should go for patent, Who can apply for patent, What is not patentable invention, Documents required for filing a patent, What is patent specification.

**c. FAQs:** What does a patent application contain: Bibliographic, Background of the invention or state of art, Description of the invention, Claims. What is the Date of priority, What happens to the application after filing, How does a patent get expired, What is traditional knowledge, What is prior information content, What is Patent cooperation treaty,

### BOOKS RECOMMENDED

1. Anekwe, T.D. 2010. Plagiarism and ghostwriting: The case of medical ghostwriting. *Bioethics* 24(6): 267–272.
2. Baždarić, K., L. Bilić-Zulle, G. Brumini, and M. Petrovečki. 2012. Prevalence of plagiarism in recent submissions to the Croatian Medical Journal. *Science and Engineering Ethics* 18: 223–239.
3. Brogan, M. 1992. Recycling ideas. *College and Research Libraries* 52(5): 453–464.
4. Bruton, S.V. 2014. Self-plagiarism and textual recycling: Legitimate forms of research misconduct. *Accountability in Research: Policies and Quality Assurance* 21(3): 176–197.
5. Butler, D. 2010. Journals step up plagiarism policing. *Nature* 466(7303): 167.
6. Chandrasoma, R., C. Thompson, and A. Pennycook. 2004. Beyond plagiarism: Transgressive and nontransgressive intertextuality. *Journal of Language, Identity and Education* 3(3): 171–193.
7. Couzin-Frankel, J., and J. Grom. 2009. Plagiarism sleuths. *Science* 324(5930): 1004–1007.
8. DeVoss, D., and A.C. Rosati. 2002. "It wasn't me, was it?" Plagiarism and the web. *Computers and Composition* 19: 191–203.
9. Gupta, S.C. (2013) *Fundamentals of statistics*. Himalaya Publishing House
10. Khan, B.A. 2011. Plagiarism: An academic threat. *International Journal of Pharmaceutical Investigation* 1(4): 255.
11. Kothari, C.R. *Research Methodology and Techniques*, 2nd edition
12. Mahajan, B.K. *Methods in Biostatistics: For Medical students and Research workers*, 6th edition
13. Pecorari, D. 2012. Textual plagiarism: How should it be regarded? *Office of Research Integrity Newsletter* 20(3): 3, 10.
14. Rathod, S.D. 2012. Plagiarism: the human solution. *Office of Research Integrity Newsletter* 20(3): 1, 7.
15. Roig, M. 2006. Avoiding plagiarism, self-plagiarism, and other questionable writing practices: A guide to ethical writing. *Office of Research Integrity* 2006.
16. Samuelson, P. 1994. Self-plagiarism or fair use. *Communications of the ACM* 37(8): 21–
17. Sox, H. C. 2012. Plagiarism in the digital age. *Office of Research Integrity Newsletter* 20(3): 1, 6.
18. Sun, Y.C. 2012. Does text readability matter? A study of paraphrasing and plagiarism in English as a foreign language writing context. *The Asia-Pacific Education Researcher* 21(2): 296



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**Paper II- RECENT ADVANCES IN MICROBIOLOGY**

**credits 4**

**Total No. of Lectures (60)**

**1. MICROSCOPY**

**(05)**

Differential interference contrast microscopy, Confocal microscopy,  
Scanning acoustic microscopy, Scanning tunneling microscopy,  
Atomic force microscopy

**2. ANALYTICAL TOOLS :**

**(46)**

**i. Radioisotopic Techniques:**

**(04)**

Radioactivity, Detection and measurement of radioactivity, Geiger Muller Counter,  
Scintillation Counter, Tracer Studies, Applications of radioisotopes in biological sciences

**(04)**

**ii. Centrifugation Techniques :**

Separation methods in preparative ultracentrifuges, Performing density gradient  
separations, Analysis of sub cellular fractions, some applications of the analytical  
ultracentrifuge

**(04)**

**iii. Chromatographic Techniques:**

High performance liquid chromatography, Ion-exchange chromatography, Affinity  
chromatography, Gas-liquid chromatography, Thin-layer (Planar) chromatography,  
Selection of a chromatography system, Calculations

**(04)**

**iv. Electrophoretic Techniques:**

Electrophoresis of Proteins, Electrophoresis of nucleic acids, Capillary Electrophoresis

**(04)**

**v. Spectrophotometric Techniques:**

Ultraviolet and visible light spectrophotometer, Atomic spectrophotometer, NMR,  
Fluorimetry, Spectrofluorimetry, GCMS, Luminometry. Mass spectrophotometer

**(04)**

**vi. Genetic Methods:**

G+C %, Tm Value, DNA – DNA homology, DNA – RNA Homology, 16 S RNA sequencing

**(04)**

**vii. Sequencing and mutagenesis:**

Basic DNA sequencing. Whole genome sequencing. Analyzing sequence data.  
Changing genes, site directed mutagenesis

**(04)**

**viii. Blotting techniques**

**(06)**

**ix. Tools and techniques ,**

PCR, LCR, RAPD, HGP, RFLP, STRP, AFLP. Genomics, Proteomics, Metagenomics,  
Metabolomics, Protein Engineering.

**(04)**

**x. Immunological Techniques:**

FAT, ELISA, Autoradiography, Radioimmunoassay, Rocket Electrophoresis, Techniques  
based on Agglutination and precipitation reactions.

**(04)**

**xi. Techniques of measurement of cell number and cell growth.**

Microbial, Plant and Animals-dead and living. Flow Cytometry.AFM.

(05)

### 3. SUSCEPTIBILITY TESTING:

- i Use of liquid and solid media, . Factors affecting susceptibility testing, CLSI guidelines.
- ii Dilution methods – agar dilution technique, gradient plate techniques, E-test, Kirby Bauer method, Stokes method.
- iii Susceptibility testing for: Anti-mycobacterial agents, Anti-fungal agents , Anti-protozoal agents, Anti-viral agents

(04)

### 4 INTERPRETATION OF DATA OF ANALYTICAL TOOLS:

#### BOOKS RECOMMENDED

1. Alberts. B.; Johnson. A, Lewis J. Ra , M. Roberts. K. and P. Walter (2002) Molecular Biology of the cell 4<sup>th</sup> Edition. Garland Science, Taylor & Francis Group.
2. Bergey's Manual of Systematic bacteriology (2<sup>nd</sup> Ed.), Volume, 1 to 5, Springer.
3. Boyer. R. (2000) Modern Experimental Biochemistry. 3<sup>rd</sup> Edition. Pearson Education Asia.
4. Cruse J and R. Lewis (2004) Atlas of Immunology 2<sup>nd</sup> Edn. CRC Press
5. David Male, Jonathan Brostoff, David B Rlvn Roi .(2006).Immunology 7<sup>th</sup> edition.
6. Frank H. Stephenson (2003) Calculations for Molecular Biology and Biotechnology. A guide to Mathematics in the laboratory Academic Press an imprint of Elsevier.
7. Freshney R.I. (2000) Culture of Animal cells. A Manual of Basic Technique. 4<sup>th</sup> Edn. Publ: Wiley – Liss:
8. Goldsby R.A. Kindt T.S. and B.A. Osborne Kuby (2000) Immunology Fourth Edition W.H. Freeman & Co New York
9. Irwin H. Segel (1976) Biochemical Calculations 2<sup>nd</sup> Edition John Wiley & Sons.
10. Lewin B. (2004) Genes VIII – International Edition. Pearson. Prentice Hall. Pearson Education International.
11. Lewin. B. (2000) Genes VII. Oxford University Press.
12. Pierce.B.A, (2005) Genes A Conceptual Approach 2<sup>nd</sup> Edition.W.H.Freeman and Company,New York
13. Primrose. S.B. and R.M. Twyman and R.W. Old (2003). Principles of Gene Manipulation. 6<sup>th</sup> Edn. Blackwell Science.
14. Purohit S.S. (2004) Plant tissue culture Published by Student Edition, Jodhpur.
15. Ranga M.M. (2002) Animal Biotechnology – 2<sup>nd</sup> Edn. Publ: Agrobios India, Jodhpur.
16. Reed, R; Homes, D; Weyers, J. and A. Jones.(1998) Practical skills in Biomelecular Sciences. Addison Wesley Longman Limited.
17. Sambrook J and D.W. Russel (2001) Molecular Cloning. A Laboratory Manual 3<sup>rd</sup> Edition Vol.1,2,3 Cold Spring Laboratory Press.
18. Sambrook J, E.F.Fritsch and T. Maniatis, (1989) Molecular Cloning. A Laboratory Manual 2<sup>nd</sup> Edition Vol.1,2,3 Cold Spring Laboratory Press.
19. Simpson R.J. (2004) Purifying Proteins for Proteomics. A laboratory Manual.Cold spring Harbor laboratory press.
20. Sneath, P.H.A. Mair : N. S. Sharpe : M.E. and J. G. Holt (Eds) (1986),

- Bergey's manual of Systematic bacteriology Vol. II Williams and Wilkins, Baltimore, London, Tokyo.
21. Staley J. T. Bryant : M. P. Pfenning : N and J. G. Holt (Eds) (1989) Bergey's Manual of Systematic bacteriology Vol. III Williams and Wilkins, Baltimore, London, Tokyo.
  22. Tizard; I.R. (1995) Immunology an Introduction 4<sup>th</sup> Edn. Saunders College Publishing. Harcourt Brace College Publishers
  23. Watson J.D. Baker T.A., Bell S.P. Gann A, Levine M. and R. Losick. (2004) Molecular Biology of the Gene. 5<sup>th</sup> Edn. Low Price edition. Pearson Education.
  24. Williams S. T. Sharpe : M.E. and J. G. Holt (Eds) (1989) Bergey's Manual of Systematic Bacteriology, Vol IV Williams and Wilkins, Baltimore, London, Tokyo.
  25. Wilson and Walker (2000) 5<sup>th</sup> edition Practical Biochemistry Principles and Techniques, Cambridge University Press
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Scanning acoustic microscopy, Scanning tunneling microscopy,  
Atomic force microscopy

**2. ANALYTICAL TOOLS :**

**(46)**

**i. Radioisotopic Techniques:**

**(04)**

Radioactivity, Detection and measurement of radioactivity, Geiger Muller Counter,  
Scintillation Counter, Tracer Studies, Applications of radioisotopes in biological sciences

**(04)**

**ii. Centrifugation Techniques :**

Separation methods in preparative ultracentrifuges, Performing density gradient  
separations, Analysis of sub cellular fractions, some applications of the analytical  
ultracentrifuge

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**iii. Chromatographic Techniques:**

High performance liquid chromatography, Ion-exchange chromatography, Affinity  
chromatography, Gas-liquid chromatography, Thin-layer (Planar) chromatography,  
Selection of a chromatography system, Calculations

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**iv. Electrophoretic Techniques:**

Electrophoresis of Proteins, Electrophoresis of nucleic acids, Capillary Electrophoresis

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**v. Spectrophotometric Techniques:**

Ultraviolet and visible light spectrophotometer, Atomic spectrophotometer, NMR,  
Fluorimetry, Spectrofluorimetry, GCMS, Luminometry. Mass spectrophotometer

**(04)**

**vi. Genetic Methods:**

G+C %, Tm Value, DNA – DNA homology, DNA – RNA Homology, 16 S RNA sequencing

**(04)**

**vii. Sequencing and mutagenesis:**

Basic DNA sequencing. Whole genome sequencing. Analyzing sequence data.  
Changing genes, site directed mutagenesis

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**viii. Blotting techniques**

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**ix. Tools and techniques ,**

PCR, LCR, RAPD, HGP, RFLP, STRP, AFLP. Genomics, Proteomics, Metagenomics,  
Metabolomics, Protein Engineering.

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**x. Immunological Techniques:**

FAT, ELISA, Autoradiography, Radioimmunoassay, Rocket Electrophoresis, Techniques  
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**xi. Techniques of measurement of cell number and cell growth.**

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