



Shri Vile Parle Kelavani Mandal's

**MITHIBAI COLLEGE OF ARTS, CHAUHAN INSTITUTE OF SCIENCE
& AMRUTBEN JIVANLAL COLLEGE OF COMMERCE AND
ECONOMICS
(AUTONOMOUS)**

NAAC Reaccredited "A" grade, CGPA: 3.57,

Granted under FIST-DST & Star College Scheme of DBT, Government of India

**Affiliated to the
University of Mumbai**

Program: M.Phil./Ph.D. Course work

Course: Microbiology ()

**Credit Based Semester and Grading System (CBSGS) with effect from
the academic year 2019-'20**

PREAMBLE

Research centre of the microbiology department of SVKM's Mithibai College of Arts, Chauhan institute of science and Amrutben Jivanlal college of Commerce and Economics(Autonomous) is well established centre with well experienced faculty and good facility for the research.

The grant of autonomy has provided a platform for designing a curriculum for M.Phil. & Ph.D. that will help research scholar to be ready to start Ph.D. project . The course content is multidisciplinary which will help the research scholar to understand multidimension approach in research.

This course is designed as pre M.Phil. & Pre Ph.D. research requirement as per the UGC University Grants Commission for Minimum Standards and Procedure as adopted by governing body of Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce and Economics(autonomous).

The Course is of 12 credit. The students will complete the credits in first two semester. This is divided in three papers 4 credit each. It comprises course on research methodology, advanced subject related content essential for the research, instrumentation and IPR. Two units in paper focuses on skill enhancement. This course also includes non-credit topics such as communication skills, computer skills. These will help students in their publication, conference presentation and proper scientific way of thesis writing.

At the end of two semester student will be ready to initiate research project.

Attendance Requirements

Research scholars shall be required to attend all the lectures and participate in journal club activity, guest lectures, seminars, workshops and industrial visit either arranged by the college or by the research centre. The attendance will be as per the rules and regulation as described in examination and evaluation guidelines of the college.

The research scholar shall not be allowed to take up any assignments outside the college during the course work during the coursework.

Examination & passing standard

Written as well as practical examination will be conducted by the research centre as given along description of the paper.

All the research scholars admitted to the M.Phil./Ph.D programme shall be required to complete the coursework prescribed by the Department within first two semesters.

All M.Phil/ Ph.D. scholars has to obtain a minimum of 55% of marks or its equivalent grade in the UGC 7-point scale (or an equivalent grade/CGPA in a point scale) in the coursework in order to be eligible to continue in the programme.

Coursework Exemption and Rules

As per the rules and regulation as described in examination and evaluation guidelines.

Details about the Papers in Coursework

Paper No.	Papers	Total hours	Credits	Total Marks	Mode of assessment
101	Research Methodology	60	4	100	100 marks Examination at the end of course
102	Area specific basic paper	60	4	100	100 marks Examination at the end of course
103	Skill development	30 + 60*	4	50 +50	50 marks written Examination for two units at the end of course for two units 50 marks examination For unit-3 & 4 in from Practical assessment/viva voce/seminar/ written literature review on any topic related to advancement in area of research,and viva voce on assignment
	Soft skills Communication skill Presentation skills, Computing skills (use of software relevant	30	(non-credit)	Compulsory completion	Completion certificate from research guide

	to research) e.g. use of Microsoft EXCEL, Microsoft Access. SPSS, SAS, Corel draw				

*-seminars/workshops/Journal club/visit to research institute

- 1 credit- **15 hours of classroom learning and 30 hours of practicals(if any)**
- Journal club/seminars/guest talks/research organisation visits -**30 hrs 1 credit**
- Paper-101 & 102 course work can either be completed in Research centre or student can register and complete the course from SWAYAM, MOOC, NPTEL, Coursera equivalent to course work credit. Credit will be assigned only on the basis of submission of certificate.
- From Paper-102 Student can select any four modules. These modules shall account for required credits assigned for the course.
- Student can also acquire additional credit and enhance skills required for research work by completing above mentioned courses in addition to the course work of research centre.

Paper-I (Course No. _			
UNIT NUMBER		NUMBER OF Hours	NUMBER OF CREDITS
UNIT I	<p>1. RESEARCH METHODOLOGY</p> <p>1.1. Strategies, planning and analysis</p> <p>1.1.1. Scientific problem</p> <p>1.1.2. Objectives of research</p> <p>1.1.3. Short term and long term goals</p> <p>1.1.4. Research conditions</p> <p>1.1.5. Research design- characteristics of a good research design, types of research design</p> <p>1.1.6. Repeatability, reproducibility and reliability</p> <p>1.1.7. Experimental protocols</p> <p>1.2. Literature search</p> <p>1.2.1. Information literacy</p> <p>1.2.2. Systematic literature search</p> <p>1.2.3. How to formulate a query: PICO</p> <p>1.2.4. Search techniques</p> <p>1.2.5. Methodology filters</p> <p>1.2.6. Critical appraisal</p> <p>1.2.7. Impact factor</p> <p>1.2.8. Medical and scientific internet</p> <p>1.2.9. Principal bibliographic databases</p> <p>1.2.10. Citation style</p> <p>1.2.11. Reference management software e.g. Mendeley, Zoreto</p> <p>1.3. Ethics in science</p> <p>1.3.1. Introduction to ethics</p> <p>1.3.2. Scientific conduct and misconduct</p> <p>1.3.3. Authorship issues</p> <p>1.3.4. Plagiarism</p> <p>1.4. Basic principles of human research ethics- international regulation</p> <p>1.5. Ethics of animal research- CPCSEA, Institutional ethics committee, OECD guidelines</p>	15	01
UNIT II	<p>2. BIostatISTICS- INTRODUCTION</p> <p>2.1. Introduction- definition, scope and limitations</p> <p>2.2. Sampling-sampling frame, importance of probability sampling, simple random sampling, systemic sampling, stratified random sampling, cluster sampling</p> <p>2.3. Collection of data, classification & tabulation-diagrammatic & graphical representation</p>	15	01

	<p>2.4. Measurement scales, variables & their measurements</p> <p>2.5. Measures of central tendency -mean, median, mode, geometric mean</p> <p>2.6. Measures of dispersion- Range, Q.D., M.D., variance, standard deviation</p> <p>2.7. Correlation and Regression analysis: Correlations and regressions-: Relation between two variables, scatter diagram, definition of correlations & their equations, interpretation of regression coefficients, principles of least squares, Two regression lines, curve fitting Karl Pearson's coefficient of correlation, Spearman's coefficient of correlation</p>		
UNIT III	<p>3. THEORY OF PROBABILITY</p> <p>Random experiments, sample space of an experiment, event, mutually exclusive events, exhaustive events, independent events, additional theory(statement only), conditional probability, multiplication theorem(statement only), Bayes' theorem.</p> <p>Discrete distribution- Binomial distribution, Poisson distribution</p> <p>Continuous distribution- Normal distribution and its properties</p>	15	01
UNIT IV	<p>4.</p> <p>4.1. HYPOTHESIS TESTING</p> <p>4.1.1. Null and alternate hypothesis</p> <p>4.1.2. Type-I & Type-II errors</p> <p>4.1.3. Level of significance,</p> <p>4.1.4. Power of test</p> <p>4.1.5. p value</p> <p>4.2. PARAMETRIC TESTS</p> <p>4.2.1. Large sample Tests</p> <p>4.2.1.1. Testing significance of single population mean</p> <p>4.2.1.2. Testing significance of single population proportion</p> <p>4.2.1.3. Testing significance of two population mean</p> <p>4.2.1.4. Testing significance of two population proportion</p> <p>4.2.2. Small sample Tests</p> <p>4.2.2.1. Testing significance of single population mean</p> <p>4.2.2.2. Testing difference between two independent normal population mean</p> <p>4.2.2.3. Testing difference between two correlated normal population mean</p>	15	01

	<p>4.2.2.4. Testing significance of correlation coefficient</p> <p>4.2.3. χ^2 test</p> <p>4.2.3.1. Testing single population variance</p> <p>4.2.3.2. Testing Goodness of fit</p> <p>4.2.3.3. Testing association between two attributes</p> <p>4.2.4. F-test- Testing equality of variance</p> <p>4.2.5. ANOVA- one-way classification, two way classification</p> <p>4.3. INTRODUCTION TO NON-PARAMETRIC TESTS</p> <p>4.3.1. The Wilcoxon signed-Rank test for location</p> <p>4.3.1.1. Testing single population mean</p> <p>4.3.1.2. Testing difference between correlated (match pair) population means</p> <p>4.3.1.3. Testing difference between two independent population means</p> <p>4.3.2. The Mann-Whitney Test (Mann-Whitney-Wilcoxon test -for equality of medians)</p> <p>4.3.3. The Kolmogorov-Smirnov Goodness- of -Fit Test</p> <p>4.3.4. The Kruskal-Wallis One-Way Analysis of Variance by Ranks</p> <p>4.3.5. The Friedman Two-Way Analysis of Variance by Ranks</p>		
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	Paper-II	NUMBER OF HOURS (60)	CREDIT (04)
Unit-I	Cell biology	15	1
	Cell biology	08	
	1.1.1 Cell cycle and control: Check points, Cyclins and CDKs and apoptosis 1.1.2 Cancer biology- Cell cycle regulation, apoptosis, autophagy, senescence, Hallmarks of cancer. 1.1.2.1. angiogenesis and metastasis. 1.1.3. Oncogenes and tumor suppressors 1.1.4 epigenetics. 1.1.6 cancer biomarkers; 1.1.7 cell culture, primary cell lines, continuous cell lines, maintenance of cell lines, cell toxicity assays 1.1.7 Cell analysis- Flow Cytometry; Cell proliferation assays, Cell death analysis, immunohistochemistry, blotting techniques, comet assay		
Unit-II	Molecular biology techniques and bioinformatics	07	
	2.1. PCR: Basics, factors affecting PCR, applications, variations in PCR, nucleic acid sequence based amplification assays (NASBA) and transcription – mediated amplification assay (TFA); Real Time PCR 2.2. nucleotide sequencing: Chemical and enzymatic methods, Pyrosequencing, Automated DNA sequencing, PCR fragment analysis, Next Generation sequencing 2.3. Microarray Technology 2.4. Proteomics 2.5. Metagenomics 2.6. Use of bioinformatics tools in research(Hands on training /practical learning)sequence alignment, global, local, multiple, phylogenic analysis(use of 16srDNA technique). Molecular docking using software		
Unit-III	Bioprocess and enzyme technology	15	1
	3.1 Enzymes: commercial applications; Production of industrially important enzymes, medically important enzymes such as diagnostic, therapeutic enzymes. 3.2 Enzyme purification techniques- conventional and advance 3.3. Recombinant enzymes-kinetics 3.4. Upscaling of production of enzymes 3.5. Enzyme immobilisation- kinetics of immobilisation, development of new techniques, application 3.6. Microbial products. 3.7 System biology		

Unit-IV	Medical microbiology and immunology	15	1
	4.1 Medical microbiology- antibiotics resistance, newer approaches in antimicrobial therapeutics 4.2 Antibody engineering 4.3 Immunological techniques: ELISA, RIA, immunofluorescence, RAST, RIST, MLR, flow cytometry and fluorescence, FACS; immunohistochemistry		
Unit-V	Nanotechnology	15	1
	5.1 Types of nanoparticles-classification 5.2 Methods for synthesis of nanoparticles-Methods, assembly, stabilisation 5.3 Characterisation of nanoparticles 5.4 Applications		
Unit-VI	Introduction to Pharmacology 6.1 Physico-chemical properties of drug, drug-receptor interaction, Pharmacokinetics, Pharmacodynamics, Pharmacotherapeutics, Drug interactions 6.2 Nature and sources of Drugs, Drug nomenclature and dosage forms 6.3 Routes of drugs' administration; advantages and disadvantages of different routes 6.4 Drug discovery and development 6.5 Drug regulatory affairs 6.6- Herbal drugs- Methods of extraction of active constituents, standardisation of herbal drugs, regulatory issues with herbal drugs, regulatory requirement in herbal drugs in India 6.7 Drugs for various systems 6.8 Drug Toxicity- OECD guidelines Acute, sub-acute and chronic toxicity studies , Carcinogenicity, teratogenicity, genotoxicity, mutagenicity, Definition of Toxicological Dose Descriptors (LD50, LC50, EC50, NOAEL, LOAEL, NOEC, DT50)		

	Paper-III SKILL DEVELOPMENT & ENHANCEMENT IN RESEARCH	NUMBER OF HOURS 30 + 60	CREDIT (04)
UNIT-1	INSTRUMENTATION 1.1 Good laboratory practices 1.2 Separation analytical techniques – 1.2.1 chromatographic techniques, conventional and advance techniques, TLC, GC, affinity, ion exchange, size exclusion, supercritical fluid, HPTLC 1.2.2. electrophoretic technique- 1.2.3. spectroscopic techniques- UV, FTIR, ESR, NMR, Circular Dichroism, Raman, ORD, Atomic absorption spectrometry, MALDI-TOF-MS, SELDI-TOF, Tandem MS	15	1
UNIT- II	Intellectual property rights 2.1 Patents- Introduction to patents, patent databases, Preparation of Patent documents, patent examination, Patent infringement, recent development in patent system. 2.2 Geographical indications 2.3 Trademarks 2.4 Copy rights 2.5 Management of intellectual property 2.6 Business & Intellectual property	15	1
UNIT- III	Communication skill Presentation skills, Journal club, seminars, Skill enhancement workshops, visit to research institutes/industries	30	1
Unit-IV	Computing skills (use of software relevant to research) e.g. use of Microsoft EXCEL, Microsoft Access. SPSS, SAS, Corel draw,	30	1

Reading Resources

1. Research Methodology: A guide for Researchers in Agricultural Science, Social Science and other related fields. Pradip kumar Sahu. Springer 2006
2. Ranjit Kumar, 2005 Research Methodology- A step-by-step Guide for beginners, 3rd edition, Sage publications.
3. Fundamentals of Research methodology and statistics- Yogesh Kumar Singh, New Age International Publishers
4. Biostatistics: A foundation for analysis in health sciences. Daniel WW, Cross CL. 10thEdn, Wiley.2013
5. Biostatistical Analysis. Zar JH. 5th Edition Pearson Education.2010.
6. Principles of Biostatistics. Pagano M., Gauvreau K., 2ndEdn. Cengage Learning, 2010
7. Fundamentals of Biostatistics. Rosner B. 7thEdn. Duxbury Thomson 2011
8. Introductory Applied Biostatistics D'Agostino RB., Sullivan LM., Beiser AS., Thomson Brooks/Cole 2006
9. Molecular Biology of the Cell – Albert, Johnson, Lewis, Raff, Roberts &Walter, 3rd edition
10. Molecular Cell Biology. Lodish, Birk, and Zipursky. 6th edition Freeman
11. Cooper, G.M., Hausman R.E. (2009) The Cell: A Molecular Approach- 5th edition. ASM Press.
12. Karp G. (2002). Cell and Molecular Biology: Concepts and Experiments. 3rd edition. John Wiley & Sons.
13. Culture of animal cells : Ian Freshney, 5th edition, John Wiley & Sons.
14. Clive R. Newton, Alex Graham. (1997) PCR; BIOS Scientific Publishers.
15. **Nanotechnology: Principles and Practices: Kulkarni**, Sulabha K, 3rd edition, Springer
16. Mount, D. W. (2001) Bioinformatics: sequence and genome analysis. Cold Spring Harbor Laboratory Press, New York.
17. Introduction to Bioinformatics T.K. Attwood and D.J Perry-Smith
18. 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
19. Communications Skills: Sanjay Kumar & PuspLata, 2nd edition, Oxford University Press
20. An Introduction to Professional English and Soft Skills by B.K. Das et al., Cambridge University
21. Skoog, Holler and Nieman, Principles of Instrumental Analysis, 5th Ed. Australia, Thomson Brock/Cole.
22. Wilson K., and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology, Seventh Edition; Cambridge University Press
23. Pharmacokinetic in Drug Discovery and Development. Schoenwald RD. CRC Press. 2010.
24. Principles and Methods of Toxicology. Hayes W, Kruger CL. CRC Press – Taylor & Francis Group. 2013.
25. An Introduction to Medicinal Chemistry. Patrick GL. 5thEdn. Oxford University Press. 2013.
26. Good Laboratory Practice: Nonclinical Laboratory Studies Concise Reference. Allport-Settle MJ. PharmaLogika. 2010

27. Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets. Bouchoux D. 3rdEdn. Delmar Cengage Learning. 2009.
28. Office of the Controller General of Patents, Designs & Trade (CGPDTM): Manual of Geographical Indications Practice and Procedure
29. Office of the Controller General of Patents, Designs & Trade (CGPDTM): Manual of Patent Office Practice and Procedure
30. Office of the Controller General of Patents, Designs & Trade (CGPDTM): Manual of Designs Practice and Procedure
31. Office of the Controller General of Patents, Designs & Trade (CGPDTM): Revised Draft Manual of Trademarks Practice and Procedure
32. WIPO : WIPO Guide To Using Patent Information
33. WIPO : Intellectual Property (IP) Audit
34. WIPO : WIPO Patent Drafting Manual
35. WIPO : The Value of Intellectual Property, Intangible Assets
36. Any other reference sources as recommended by the course instructor.