

## Ph.D. Course work

Course work consist of three papers

Paper No.	Title	Credit
Paper-I	Research Methodology	4
Paper-II	Subject specific	4
Paper-III	Skill enhancement	4

**1 credit- 15 hours of theory class or 30 hours of Practical class**

### Incorporation of two additional credits in Pre-Ph.D. course work.

As per the UGC circular of December, 2019, it is mandatory for every research centre to conduct two credit courses for awareness about publication ethic and publication misconducts entitled “Research and Publication Ethics (RPE)” for all Ph.D. students for pre-registration course work

#### About the course

Course code: CPE-RPE

Overview- course is of 6 units

Focus- -

- on basics of basics of philosophy of science and ethics, research integrity, publication ethics.
- Hands- on-sessions are designed to identify research misconduct and predatory publication.
- Indexing and citation databases, open access publications, research metrics (citations, h-index, impact factor etc.)
- Introduction of plagiarism tools
- **Pedagogy-** class room teaching, guest lectures, group discussions and practical sessions
- **Evaluation-** continuous assessment through tutorials, assignments, quizzes, and group discussion. Weightage to be given for active participation and the final written examination is to be conducted at the end of the course

Modules	Unit title	Teaching hours
Theory		
RPE01	Philosophy and Ethics	04
RPE02	Scientific conduct	04
RPE03	Publication Ethics	07
Practice		
RPE 04	Open Access Publishing	04
RPE05	Publication Misconduct	04
RPE06	Databases and Research Metrics	07

	Total	30
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**Passing Standards for Course work:**

Passing criteria for each course of Pre Ph.D. will be 55%. The examination for Pre-Ph.D. course will be annual basis. The guidelines for clearing Pre-Ph.D. course work are as under

Sr. No.	Internal assessment	Term end examination	Aggregate Passing/Failing	Result treatment
1	completed	Fail	Fail	Such students will be required to re-register for the respective courses/s in which he/she failed to pass, after completion of the stipulated period of entire pre. Ph.D. course work. Such student, thereafter should complete the requirement of the respective course ab initio. Only one additional attempt will be allowed to the student. However, students who have failed to pass in more than two courses, will have to take re-admission for the entire programme.
2	Not completed	Not eligible for term end examination	Fail	Such students will be required to re-register for respective courses/ in which he/she has failed to pass after completion of the stipulated period of entire Pre-Ph.D. course work. Such students, thereafter should complete the requirement of the respective course ab initio which he/she has failed. However, students who have failed to pass in more than two courses, will have to take re-admission for the entire programme.
3	Completed	Absent in term end examination due to exceptional circumstances e.g., hospitalization, death in family, official work etc.		Special re-examination to be conducted only after recommendation by the Head of the Research Centre and the Principal. These recommendations will be on a case-to-case basis.

Proportionate course fee will be applicable for such students who fail to pass and re-register for the respective course/s.

6 Monthly Review Presentation- Ph.D. Programme

Name of the Candidate :

Date & time of presentation :

Title of the project proposal :

Members of the Committee:

<b>Sr. No.</b>	<b>Name</b>	<b>Signature</b>
1		
2		
3		
4		

Remarks: \_\_\_\_\_

Principal



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  
Best College, University of Mumbai 2016-17

Affiliated to the  
**UNIVERSITY OF MUMBAI**

Program: PhD

Course: ENGLISH

**Credit Based Semester and Grading System (CBSGS) with effect  
from the academic year 2020-21**

## **PREAMBLE**

The research centre of the Department of English of SVKM's Mithibai College of Arts, Chauhan Institute of Science and Amrutben Jivanlal College of Commerce and Economics (Autonomous) is a well-established centre with qualified and skilled faculty along with the latest infrastructure for research.

The grant of autonomy has provided a platform for designing a curriculum for Ph.D. that will help research scholars to be prepared to undertake Ph.D. research work. The course content has been designed to be multidisciplinary to equip the scholars to investigate and explore from various fields to draw required resources for their research.

This course is designed as 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 carries 12 credit. Students will have to complete the credits in first two semesters. The course is divided into three papers of 4 credits each: Course on Research Methodology, Advanced Subject Related Content Essential for the Research, IPR. Two units in the paper focus on skill enhancement. This course also includes non-credit topics such as communication skills and computer skills which will help the scholars with their publication, conference presentation and thesis writing. At the end of the two semesters, the students will be trained and geared to initiate the 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 undertake postgraduate lectures 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.

### Examination & passing standard

Written examination as well as paper presentation will be conducted by the research centre as given along the description of the paper. All the research scholars admitted to the Ph.D. programme shall be required to complete the coursework prescribed by the Department within first two semesters.

All Ph.D. scholars have 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.	Name of Paper	Theory	Practical	Internal Assessment (Assignments, Attendance & Seminar)	Max Marks	Lectures	Credits
101	Research Methodology and Ethical Practices in Research	75		25	100	60 Hours	4
102	Literary Theories and Critical Approaches	75		25	100	60 Hours	4
103	Research Training and Research Writing Skills			100*	100	60 Hours	4
104	Soft skills, Communication skill		(non-credit)	Compulsory completion		30 Hours	Completion certificate from

	Presentation skills, Computing skills (use of software relevant to research) e.g. use of Microsoft Word, Powerpoint etc.						the research guide
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\*-seminars/workshops/taking post-graduate lectures/ research paper writing

- 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 the 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.



<b>Paper-101: Research Methodology</b>			
<b>UNIT NUMBER</b>		<b>NUMBER OF Hours</b>	<b>NUMBER OF CREDITS</b>
<b>UNIT I</b>	<b>WHAT IS RESEARCH?</b> 1. Definition and Scope of Research 1.1. Definition and Scope of Research 1.2. What can you do with research? 1.3. Research Designs 2. Types of Research: 2.1. Qualitative Research 2.2. Quantitative Research 2.3. Theoretical Research 2.4. Applied Research 2.5. Longitudinal Research 2.6. Cross-Sectional Research 2.7. Philosophical Research 2.8. Historical Research 2.9. Survey Research 2.10. Experimental Research 2.11. Case-Study Research 3. Research Theory: 3.1.1. Metaphysics and Epistemology 3.1.2. Inductive and Deductive Reasoning 3.1.3. Hypothetico-Deductive Reasoning or Scientific Method 3.1.4. Positivism, Relativism, Postmodernism and Critical Realism 3.1.5. Key Figures	<b>15</b>	<b>01</b>
<b>UNIT II</b>	<b>RESEARCH PROCESS:</b> 1. Materials and Tools of Research 1.1. Primary and Secondary Sources; 1.2. Resources: Library (Print and Online), Field, Archives, Documentaries, E-Resources (UGC Infonet, INFLIBNET and ERNET), Online Repository 2. Research Problem 2.1. Identification of Research Problem 2.2. The Sources of the Problem 2.3. Statement of Problem 2.4. Objectives of Assumptions about the Problem 2.5. Aspects of Delimiting the Problem 2.6. Evaluation of the Problem	<b>15</b>	<b>01</b>

	<ol style="list-style-type: none"> <li>3. Formulation of Hypothesis <ol style="list-style-type: none"> <li>3.1. Definition and nature of hypothesis</li> <li>3.2. Functions of hypothesis</li> <li>3.3. Importance of hypothesis</li> <li>3.4. Forms of hypothesis</li> <li>3.5. Formulation of testable hypothesis</li> <li>3.6. Fundamental basis of hypothesis</li> <li>3.7. Difficulties in formulation of useful hypothesis</li> </ol> </li> <li>4. Tools of Data Collection: <ol style="list-style-type: none"> <li>4.1. Questionnaire</li> <li>4.2. Interviews</li> <li>4.3. Schedule</li> <li>4.4. Observation Technique</li> </ol> </li> <li>5. Data Organisation: <ol style="list-style-type: none"> <li>5.1. Collecting Primary and Secondary Data</li> <li>5.2. General Rules</li> <li>5.3. Interpretation of Data</li> </ol> </li> </ol>		
<b>UNIT III</b>	<p><b>RESEARCH METHODS, AREAS AND WRITING RESEARCH PAPER</b></p> <ol style="list-style-type: none"> <li>1. Research Methods: <ol style="list-style-type: none"> <li>1.1. Historical Method</li> <li>1.2. Descriptive or Survey Method</li> <li>1.3. Experimental Method</li> <li>1.4. Textual Analysis</li> <li>1.5. Discourse Analysis</li> </ol> </li> <li>2. Area of Research: <ol style="list-style-type: none"> <li>2.1. Genre, Period, Region, Author, Texts, Approach</li> <li>2.2. Intra-disciplinary/Interdisciplinary</li> <li>2.3. Background Study</li> <li>2.4. Studies of Literatures</li> </ol> </li> <li>3. Writing Research Proposal/Research Paper/ Thesis: <ol style="list-style-type: none"> <li>3.1. Topic Statement</li> <li>3.2. Abstract</li> <li>3.3. Keywords for Research Paper;</li> <li>3.4. Aims and Objectives</li> <li>3.5. Hypothesis</li> <li>3.6. Rationale for the Project</li> <li>3.7. Methodology</li> <li>3.8. Key Issues and Arguments</li> <li>3.9. A Brief Literature Review/ Review of Scholarships in the area</li> <li>3.10. Socio-cultural Background related to the topic</li> <li>3.11. Work Plan</li> <li>3.12. Chapter Division</li> <li>3.13. Notes and Works Cited</li> </ol> </li> </ol>	<b>15</b>	<b>01</b>

<b>UNIT IV</b>	<b>DOCUMENTATION AND ETHICS OF WRITING</b>	<b>15</b>	<b>01</b>
	<ol style="list-style-type: none"> <li>1. Documentation/Referencing               <ol style="list-style-type: none"> <li>1.1. Indentation, Margins, Font, Spacing, Heading and Title, Pagination, Text Formatting, Abbreviations, Indexing, Glossary and Special Elements such as Title-page, Table of Contents, Headings and Sub-headings, Tables and Figures, Appendix, Bibliography and Proof Reading, Citing Print, Web and Archival Sources, Quotations (run-on and run-off etc.) and Notes</li> </ol> </li> <li>2. Mechanics of Writing:               <ol style="list-style-type: none"> <li>2.1. Paper margin, spacing, heading and title, page numbers, footnotes, tables and figures, appendix, correction and insertion, electronic submission</li> </ol> </li> <li>3. Intellectual property rights               <ol style="list-style-type: none"> <li>3.1. Patents- Introduction to patents, patent databases, Preparation of Patent documents, patent examination, Patent infringement, recent development in patent system.</li> <li>3.2. Geographical indications</li> <li>3.3. Trademarks</li> <li>3.4. Copy rights</li> <li>3.5. Management of intellectual property</li> </ol> </li> </ol>		

1. The Foundations of Social Research: Meaning and Perspective in the Research Process: Michael Crotty, 1<sup>st</sup> Edition, Sage Publicaiton: 1998
2. Research Methodology for Social Sciences: M. Thamilarasan, New Century Publication, 2015
3. Communications Skills: Sanjay Kumar & PuspLata, 2<sup>nd</sup> edition, Oxford University Press
4. An Introduction to Professional English and Soft Skills by B.K. Das et al., Cambridge University
5. Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets. Bouchoux D. 3<sup>rd</sup>Edn. Delmar Cengage Learning. 2009.
6. Office of the Controller General of Patents, Designs & Trade (CGPDTM): Manual of Geographical Indications Practice and Procedure
7. Office of the Controller General of Patents, Designs & Trade (CGPDTM): Manual of Patent Office Practice and Procedure
8. Office of the Controller General of Patents, Designs & Trade (CGPDTM): Revised Draft Manual of Trademarks Practice and Procedure
9. WIPO : WIPO Guide To Using Patent Information
10. WIPO : Intellectual Property (IP) Audit
11. WIPO : WIPO Patent Drafting Manual
12. WIPO : The Value of Intellectual Property, Intangible Assets
13. Any other reference sources as recommended by the course instructor.

102	Paper-II: LITERARY THEORIES AND CRITICAL APPROACHES	NUMBER OF HOURS (60)	CREDIT (04)
<b>Unit I.</b>	<b>Mythological and Archetypal Criticism</b> 1. Frye, Northrop. "The Archetypes of Literature." 2. Jung, Carl: "Archetypes of the Collective Unconscious." 3. Joseph Campbell: "Monomyth"	15	1
<b>Unit II</b>	<b>Formalism</b> 1. Shklovsky, Viktor: "Art as Technique" 2. Wellek, Rene and Austin Warren: "The Ordering and Establishing of Evidence" and "The Analysis of Literary Work of Art" 3. Eichenbaum, Boris. "The Theory of 'Formal Method'"	15	1
<b>Unit III</b>	<b>Structuralism</b> 1. Saussure, Ferdinand de.: "General Principles" 2. Jakobson, Roman: "Linguistics and Poetics" 3. Assiter, Alison: "Althusser and Structuralism"	15	1
<b>Unit IV</b>	<b>Poststructuralism</b> 1. Barthes, Roland: "Death of an Author" 2. Derrida Jacques: "Structure, Sign and Play in the Discourse of the Human Sciences" 3. Foucault Michael: "What is an Author?"	15	1
<b>Unit V</b>	<b>Postmodernism</b> 1. Lyotard, Jean-François: "Answering the question: what is the postmodern?" 2. Fredric Jameson: "Postmodernism, or The Cultural Logic of Late Capitalism" (53-77) 3. Jean Baudrillard: "The Precession of Simulcra"	15	1
<b>Unit VI</b>	<b>Marxism:</b> 1. Marx, Karl and Fredrick Engels: Excerpts from <i>Communist Manifesto</i> 2. Eagleton, Terry: From <i>Marxism and Literary Criticism</i> "Literature and History", "Form and Content" and "Author as a Producer" 3. Luckas, Georg: from <i>History and Class Consciousness</i> "What is Orthodox Marxism?"	15	1
<b>Unit VII</b>	<b>Psychoanalysis:</b> 1. Freud, Sigmund: "Creative Writers and Day Dreaming"	15	1

	<ol style="list-style-type: none"> <li>2. Holland, Norman: "The 'Unconscious' of Literature"</li> <li>3. Lacan, Jacques and Jeffrey Mehlman: "Seminar on 'The Purloined Letter'"</li> </ol>		
<b>Unit VIII</b>	<b>Postcolonialism:</b> <ol style="list-style-type: none"> <li>1. Said, Edward: from <i>Orientalism</i>: 'Introduction' and 'Chapter 1'</li> <li>2. Baba, Homi: from <i>The Location of Culture</i>: 'Of mimicry and man: The ambivalence of colonial discourse'</li> <li>3. Acheraiou, Amar: from <i>Rethinking Postcolonialism: Colonialist Discourse in Modern Literature and the Legacy of Classical Writers</i>: "Class, Race, and Postcolonial Hybridity Discourse"</li> </ol>	15	1
<b>Unit IX</b>	<b>Feminism:</b> <ol style="list-style-type: none"> <li>1. Showalter, Elaine. From <i>A Literature of their Own</i>: "The Female Tradition"</li> <li>2. Millet, Kate. From <i>Sexual Politics</i>: "Instances of Sexual Politics" and "Theory of Sexual Politics"</li> <li>3. Smith, Barbara, "Toward a Black Feminist Criticism"</li> </ol>	15	1
<b>Unit X</b>	<b>Gay, Lesbian and Queer Theory:</b> <ol style="list-style-type: none"> <li>1. Sedgwick, Eve Kosofsky, from <i>Epistemology of Closet</i>: "Introduction: Axiomatic"</li> <li>2. Butler, Judith: from <i>Gender Trouble</i>: "Subjects of Sex/Gender/Desire"</li> <li>3. Harplein, David: "One Hundred Years of Homosexuality"</li> </ol>	15	1
<b>Unit XI</b>	<b>Reader Response Criticism:</b> <ol style="list-style-type: none"> <li>1. Iser, Wolfgang: "The Reading Process: A Phenomenological Approach"</li> <li>2. Fish, Stanley: "Literature in the Reader: Affective Stylistics"</li> <li>3. Jauss, Hans Robert: "Literary History as a Challenge to Literary Theory"</li> </ol>	15	1
<b>Unit XIII</b>	<b>Ecocriticism</b> <ol style="list-style-type: none"> <li>1. Glotfelty, Cheryll: "Literary Studies in Age of Environmental Crisis"</li> <li>2. Warren, Karen J. and Jim Cheney: "Ecological Feminist and Ecosystem Ecology"</li> <li>3. Clark, Timothy: "'Post-colonial' Ecojustice"</li> </ol>	15	1
<b>Unit XIV</b>	<b>Culture Studies</b> <ol style="list-style-type: none"> <li>1. Hall, Stuart: "Cultural studies and its theoretical legacies"</li> <li>2. Slack, Jennifer Daryl: "The theory and method of articulation in cultural studies"</li> </ol>	15	1

### Suggested Reading:

1. Acheraiou, Amar. from *Rethinking Postcolonialism: Colonialist Discourse in Modern Literature and the Legacy of Classical Writers* “Class, Race, and Postcolonial Hybridity Discourse”  
[https://www.academia.edu/36287612/Questioning\\_Hybridity\\_Postcolonialism\\_and\\_Globalization\\_Please\\_respect\\_intellectual\\_property\\_rights](https://www.academia.edu/36287612/Questioning_Hybridity_Postcolonialism_and_Globalization_Please_respect_intellectual_property_rights)
2. Assiter, Alison. “Althusser & Structuralism.” *The British Journal of Sociology*. Vol. 35 No. 2. London: Blackwell Publishing, June 1994. 272-296
3. Baba, Homi: from *The Location of Culture*: ‘Of mimicry and man: The ambivalence of colonial discourse’  
[https://archive.org/stream/TheLocationOfCultureBHABHA/the+location+of+culture+BHABHA\\_djvu.txt](https://archive.org/stream/TheLocationOfCultureBHABHA/the+location+of+culture+BHABHA_djvu.txt)
4. Baudrillard, Jean. “The Precession of Simulera”  
[https://www.ereading.club/bookreader.php/144970/Baudrillard\\_\\_Simulacra\\_and\\_Simulation.pdf](https://www.ereading.club/bookreader.php/144970/Baudrillard__Simulacra_and_Simulation.pdf)
5. Barthes, Roland. “Death of an Author”  
[http://www.tbook.constantvzw.org/wp-content/death\\_authorbarthes.pdf](http://www.tbook.constantvzw.org/wp-content/death_authorbarthes.pdf)
6. Butler, Judith. from *Gender Trouble*: “Subjects of Sex/Gender/Desire”  
[http://lauragonzalez.com/TC/BUTLER\\_gender\\_trouble.pdf](http://lauragonzalez.com/TC/BUTLER_gender_trouble.pdf)
7. Campbell, Joseph. “Monomyth.” *A Hero with a Thousand Faces*. New Jersey: Princeton University Press, 2004. 3-23
8. Eagleton, Terry. *Marxism and Literary Criticism*.  
[https://www.academia.edu/10725186/Eagleton\\_Terry\\_-\\_Marxism\\_and\\_Literary\\_Criticism](https://www.academia.edu/10725186/Eagleton_Terry_-_Marxism_and_Literary_Criticism)
9. Eichenbaum, Boris. “The Theory of ‘Formal Method’”. *Russian Formalist Criticism: Four Essays*. Tr. Lee T. Lemon & Marion J. Reis. London: University of Nebraska Press. 99-139
10. Fish, Stanley: “Literature in the Reader: Affective Stylistics”  
<http://www.philol.msu.ru/~discours/images/stories/article2.pdf>
11. Foucault, Michael. “Who is an Author?”  
<http://artsites.ucsc.edu/faculty/Gustafson/FILM%20162.W10/readings/foucault.author.pdf>
12. Glofelty, Cheryll: “Literary Studies in an Age of Environmental Crisis”  
[static1.squarespace.com/static/5441df7ee4b02f59465d2869/t/58f2e4eabf629a9dbf74f538/1492313328327/The+Ecocriticism+Reader+introduction.pdf](http://static1.squarespace.com/static/5441df7ee4b02f59465d2869/t/58f2e4eabf629a9dbf74f538/1492313328327/The+Ecocriticism+Reader+introduction.pdf)
13. Harplein, David. “One Hundred Years of Homosexuality”  
[https://www.academia.edu/289957/One\\_Hundred\\_Years\\_of\\_Homosexuality](https://www.academia.edu/289957/One_Hundred_Years_of_Homosexuality)
14. Iser, Wolfgang: *The Reading Process: A Phenomenological Approach*  
<http://www.newliteraryhistory.org/articles/3-2-iser.pdf>
15. Jameson, Fredric. “Postmodernism, or The Cultural Logic of Late Capitalism”  
<https://pdfs.semanticscholar.org/40d6/b702fa28fdd1802abfb1210e10f1fa36de42.pdf>
16. Jung, Carl. *The Archetypes and the Collective Unconscious*. Tr. R.F.C. Hull. New York: Princeton University Press. 1-35  
<http://xroads.virginia.edu/~DRBR2/lacan.pdf>
17. Lacan, Jacques and Jeffrey Mehlman: “Seminar on ‘The Purloined Letter’”

18. Leitch, Vincent B. *The Norton Anthology: Theory and Criticism*. Ed. New York: Norton, 2001.
19. Luckas, Georg: from *History and Class Consciousness* "What is Orthodox Marxism?" <https://www.marxists.org/archive/lukacs/works/history/orthodox.htm>
20. Lyotard, Jean-François. "Answering the question: what is the postmodern?" in *The Postmodern Explained to Children*, Sydney, Power Publications, 1992
21. Morley, David: *Stuart Hall: Critical Dialogues in Cultural Studies*
22. <https://filsafattimur.files.wordpress.com/2012/10/critical-dialogues-in-cultural-studies.pdf>
23. Said, Edward: from *Orientalism: 'Introduction' and 'Chapter 1'* [https://sites.evergreen.edu/politicalshakespeares/wp-content/uploads/sites/33/2014/12/Said\\_full.pdf](https://sites.evergreen.edu/politicalshakespeares/wp-content/uploads/sites/33/2014/12/Said_full.pdf)
24. Smith, Barbara. "Toward a Black Feminist Criticism" [http://www.blackwellpublishing.com/content/BPL/Images/Content\\_store/Sample\\_Chapter/9780631222392Sample/Bobo9780631222392.pdf](http://www.blackwellpublishing.com/content/BPL/Images/Content_store/Sample_Chapter/9780631222392Sample/Bobo9780631222392.pdf)
25. Saussure, Ferdinand de. "General Principles." *Course in General Linguistics*. New York: Philosophical Library, 1959. 65-83
26. Sedgwick Eve Kosofsky, from *Epistemology of Closet*: "Introduction: Axiomatic" <http://shifter-magazine.com/wp-content/uploads/2014/11/Sedgwick-Eve-Kosofsky-Epistemology-Closet.pdf>
27. Wellek, Rene and Austin Warren: "The Ordering and Establishing of Evidence" and "The Analysis of Literary Work of Art" *Theory of Literature*. New York: Harcourt, Brace and Company. 1948. 49-67; 139-158.

103	Paper-III RESEARCH TRAINING AND RESEARCH WRITING SKILLS	NUMBER OF HOURS 30+ 30	CREDIT (04)
<b>UNIT- 1</b>	<b>1. Orientation for Short Study:</b> 1.1. Reading Primary and Secondary Literature (including setting up of bibliography) 1.2. From annotated bibliography to status questions 1.3. Establishing corpus and aim 1.4. Selecting method and theoretical frame (Report on Research Orientation with bibliography) 1.5. Definitive selection of primary and secondary literature 1.6. Refinement of research question, corpus, method and theoretical framework (Research Proposal for the short study) 1.7. Submission of first draft of the short study 1.8. Review content, structure, etc with the advisor 1.9. Submission of the short study of 3000 words	15	1
<b>UNIT- II</b>	<b>2. Research Training:</b> 2.1. Short Study Presentation to M.A. English students	15	1

	2.2. 15 hours of taking classes for M.A. English in Research Methodology		
<b>UNIT-III</b>	<b>3.</b> Research Presentation: 3.1. Presentations in Seminars and Conferences 3.2. Skill Enhancement Workshops	30	1
<b>Unit-IV</b>	<b>4.</b> Computer Course 4.1. Use of MS Office; Use of Multimedia Tools 4.2. Use of Internet for Research Purpose; Data Analysis Software and Analysis Techniques	30	1

Assignment marks:

10 marks – Report on Research Orientation and Bibliography

10 marks – Research Proposal

35 marks – Short study of 3000 words

Presentation and viva based on the short study: 25 marks

Lectures taken with the M.A. English classes: 25 marks





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: Biotechnology

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
	<b>Soft skills</b> Communication skill Presentation skills, Computing skills (use of software relevant to research) e.g. use of Microsoft EXCEL, Microsoft Access. SPSS, SAS, Corel draw	30	(non-credit)	Compulsory completion	Completion certificate from research guide

\*-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

UNIT	Topic	No.of hrs	No. Of credits
UNIT I	<b>RESEARCH METHODOLOGY</b> Strategies, planning and analysis ,Scientific problem, Objectives of research,Short term and long term goals, Research conditions,Research design- characteristics of a good research design, types of research design,Repeatability, reproducibility and reliability, Experimental protocols, Literature search, Information literacy, Systematic literature search,How to formulate a query: PICO,Search techniques,Methodology filters, Critical appraisal, Impact factor ,Medical and scientific internet Principal bibliographic databases ,Citation style Reference management software e.g. Mendeley, Zoreto Ethics in science ,Introduction to ethics ,Scientific conduct and misconduct, Authorship issues ,Plagiarism, Basic principles of human research ethics- international regulation ,Ethics of animal research- CPCSEA, Institutional ethics committee, OECD guidelines	15	1
UNIT II	<b>BIostatistics- INTRODUCTION</b> Introduction- definition, scope and limitations Sampling-sampling frame, importance of probability sampling, simple random sampling, systemic sampling, stratified random sampling, cluster sampling,Collection of data, classification & tabulation-diagrammatic & graphical representation,Measurement scales, variables & their measurements ,Measures of central tendency -mean, median, mode, geometric mean ,Measures of dispersion- Range, Q.D., M.D., variance, standard deviation 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	15	01
UNIT III	<b>THEORY OF PROBABILITY</b> 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.Discrete distribution- Binomial distribution, Poisson distribution, Continuous distribution- Normal distribution and its properties	15	01
UNIT IV	<b>HYPOTHESIS TESTING</b> Null and alternate hypothesis ,Type-I & Type-II errors, Level of significance, Power of test ,p value <b>PARAMETRIC TESTS</b> ;Large sample Tests ,Testing significance of single population mean; Testing significance of single population proportion ,Testing significance of two population mean ,Testing significance of two population proportion ,Small sample Tests ,Testing significance of single population mean ,Testing difference between two independent normal population mean ,Testing difference between two correlated normal population mean ,Testing significance of correlation coefficient , $\chi^2$ test-Testing single population variance,Testing Goodness of fit.Testing association between two attributes ,F-test-	15	01

	<p>Testing equality of variance, ANOVA- one-way classification, two way classification</p> <p><b>INTRODUCTION TO NON-PARAMETRIC TESTS</b></p> <p>The Wilcoxon signed-Rank test for location, Testing single population mean, Testing difference between correlated (match pair) population means, Testing difference between two independent population means, The Mann-Whitney Test (Mann-Whitney-Wilcoxon test -for equality of medians), The Kolmogorov-Smirnov Goodness- of -Fit Test, The Kruskal-Wallis One-Way Analysis of Variance by Ranks</p> <p>The Friedman Two-Way Analysis of Variance by Ranks</p>		
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## Paper-II

UNIT	Topic <b>developments in Biotechnology</b>	No.of hrs	No. Of credits
UNIT I	<p><u>Introduction to Animal biotechnology</u> Biology of Cultured Cells , Animal Cell Culture Cloning &amp; Selection; Organ &amp; Histotypic Cultures and Tissue Engineering ;Gene therapy , Transgenic Animals; Immuno-biotechnology ; Transplantation Immunology ; Regenerative medicine and technology</p> <p><u>Introduction to plant biotechnology</u> Plant Tissue Culture;In vitro hybridization ;Plant Transformation Technology;Plant Metabolic Engineering;Plant Molecular Markers ;Mutations- natural and induced; effect on growth patterns and secondary metabolites- case studies</p> <p>Recent advances in Biotechnology Advances in bacterial taxonomy Advances in Microscopy and microscopic techniques ,Metagenomic applications in Microbiology</p>	15	1
UNIT II	<p>,Molecular techniques in cloning and gene expression,Biochemical techniques,Biologics and molecular medicine in immunology (cytokines, chemokines, cell-adhesion molecules, co-stimulatory molecules and surface receptor and ligands as therapeutic targets). Role of non-coding RNA in immune regulation. Advanced immunological techniques: Flow cytometry, Magnetic sorting, MHC tetramer technology, multiplex assays) Antibody purification and protein conjugations, spectratyping, surface plasmon resonance (SPR). Animal model of immunological diseases (Transgenic and knockout animals).Generation of bone -marrow chimeras, humanized mice, parabiosis</p>	15	01
UNIT III	<p>Hybridization techniques: Southern,Western, Nortern and Dot Blots etc. Gene expression studies: Real-Time-PCR. Micro arrays &amp; Gene chips</p> <p>Immunological techniques: Radial Immuno diffusion test. ELISA, RIA, Surface Plasmon Recsonance etc. 5. Molecular Marker: RFLP, AFLP, SCARs, SNPs, ESS-SSR</p> <p>Spectroscopic methods: UV/Vis, fluorescence spectrometry</p> <p>Electrophoretic techniques: Vertical, Horizontal, 2-Dimensional, Denaturing gradient gel electrophoresis, Thermal gradient gel electrophoresis</p> <p>Variants of PCR and Amplification of gene: Sami-quantitative RT PCR Nested PCR, Multiplex PCR, DOP-PCR</p> <p>Bioinformatics: Data Mining GENBANK, Blasting sequence, Primer designing Biological Databases ,Sequence Alignment, Systems Biology ,Experimental Techniques ,Drug Designing Techniques ,Algorithms in Bioinformatics Sequencing: DNA and protein sequencing</p>	15	01
UNIT IV	<p>Metal toxicity in plants, humans and other animals ,Metal tolerance in microbes,Adsorption and accumulation of metals by bacteria,Mechanism of metal tolerance Use of hyperaccumulators in remediation of metal polluted environment,</p>	15	01

	<p>Bioelectrochemistry principles, Electron transport in bacteria, Microbial fuel cells. Generation of electricity using waste-principles and technological implications</p> <p>Classification of habitats based on geological and environmental properties, -identification of pristine habitats ; Special features of selected microbes -actinomycetes, fungi and slime--moulds ,Microbes and Mycorrhiza and their significance.</p> <p>Advanced isolation and sampling techniques</p> <p>Advanced techniques of screening for production of target biomolecules; Industrial potential of selected strains, secondary metabolites extraction</p> <p>Applications of Nanochemistry, Introduction, classification of nanoparticles, synthesis, characterization, properties and application of nanomaterials</p>		
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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. Cerge 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, 3<sup>rd</sup> edition
10. Molecular Cell Biology. Lodish, Birk, and Zipursky. 6<sup>th</sup> edition Freeman
11. Cooper, G.M., Hausman R.E. (2009) The Cell: A Molecular Approach- 5<sup>th</sup> edition. ASM Press.
12. Karp G. (2002). Cell and Molecular Biology: Concepts and Experiments. 3<sup>rd</sup> edition. John Wiley & Sons.
13. Culture of animal cells : Ian Freshney, 5<sup>th</sup> edition, John Wiley & Sons.
14. Clive R. Newton, Alex Graham. (1997) PCR; BIOS Scientific Publishers.
15. **Nanotechnology: Principles and Practices: Kulkarni**, Sulabha K, 3<sup>rd</sup> 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, 2<sup>nd</sup> 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. 5<sup>th</sup>Edn. 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. 3<sup>rd</sup>Edn. 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.
37. Bioelectrochemistry of Membranes Series: Bioelectrochemistry: Principles and Practice, Vol. 6, Walz, Dieter, Teissié, Justin, Milazzo, Giulio (Eds.) 2004, Springer Verlag, Germany. pp 240.
38. Bioremediation: A Critical Overview. Head, I.M., Milner, M., Singleton, I. (Eds.) 2002, Springer Verlag, Germany. pp 400.
39. Disregarded Microbial Diversity and Ecological Potentials in Aquatic Systems Series: Developments in Hydrobiology, Vol. 216, Sime-Ngando, Télesphore, Niquil, Nathalie (Eds.) 2011, Springer Verlag, Germany. pp 118.
40. Microbial ecology: fundamentals and applications. Atlas, R. M.; Bartha, R. 1981, pp 560.
41. Microbial Diversity and Bioprospecting, Alan T. Bull, ASM Press, 2004, pp 496.
42. Microbial Diversity: Form and Function in Prokaryotes, Oladele Ogunseitan, 2008, Wiley-Blackwell, pp 312.





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  
Best College, University of Mumbai 2016-17

**Affiliated to the  
University of Mumbai**

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

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

## **PREAMBLE**

The PhD Research Centre of Botany Department under the aegis of SVKM's Mithibai College of Arts, Chauhan Institute of Science and Amrutben Jivanlal College of Commerce and Economics (Autonomous) is a well-established centre since 2011-12 with well experienced faculty and excellent facilities for research. With autonomous status granted to Mithibai College, comes an opportunity to promote cutting-edge research in the field of plant sciences and related disciplines steered to promote a multi-disciplinary approach through quality research.

A Ph.D degree is awarded in recognition of work of high academic standards, resulting from creative and independent work pushing the frontiers of our knowledge, developing new theories or technology or enhancing our understanding of various processes, event or phenomenon in different disciplines.

Plants are one of the most fascinating and important groups of organisms living on Earth. They serve as the conduit of energy into the biosphere, provide food, and shape our environment. If we want to make headway in understanding how these essential organisms function and build the foundation for a more sustainable future, then we need to apply the most advanced technologies available to the study of plant life.

In this regard, the Department of Botany, Mithibai College (Autonomous) is committed to broad based programs at all levels and encourages multi-disciplinary work across disciplines, departments and institutions. The Ph.D. guides from the department of Botany, endeavors to promote recent research in plant sciences and allied areas encompassing various specializations viz. angiosperm taxonomy, plant anatomy, plant physiology, medicinal botany, mycology, ecology, ethnobotany to name a few in conjunction with the recent trends in plant sciences.

The structure of the Ph.D course work is strictly in accordance with the UGC regulations for Minimum Standards and Procedure as adopted by the Governing Body of Mithibai College (Autonomous).

Each Ph.D. student will have to undergo a 12-credit course-work, and complete the credits in first two semesters. The course work consists of three papers of 4 credits each. It comprises course on research methodology, advanced subject related content essential for the research and IPR. Course 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 semesters student will be ready to initiate research project.

The course therefore aims at grooming the students gradually from building their scientific temper, to development of communication skills and from training them in relevant computer applications to steering publications, presentations and writing synopsis and thesis. The course at the end of 2 semesters will further enable scholars to distinguish between the scientific method and common sense knowledge while laying the foundation for research skills at higher levels making him/her ready to initiate the 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.

### Examination & passing standard

Written 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 credits wherever applicable 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	Mode of assessment
101	Research Methodology	60	4	100 marks Examination at the end of course
102	Area specific basic paper	60	4	Continuous evaluation, contribution to syllabus development
103	Skill development	60*	4	Continuous evaluation Practical assessment/viva voce/seminar/ written literature review on any topic related to advancement in area of research, and viva voce on assignment
	<b>Soft skills</b> Communication skill, Presentation skills, Computing skills (use of software relevant to research) e.g. use of Microsoft EXCEL, Microsoft Access. SPSS, SAS, Corel draw	30	(non-credit)	Completion certificate from research guide

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

- 1 credit- **15 hours of classroom learning and 30 hours of practical's (if any)**
- Journal club/seminars/guest talks/research organisation visits **Not more than 2 credits.**
- Paper-101 & 102 course work can either be completed in Research centre or student can register and complete the course from SWAYAM, MOOC, NPTEL, Course is equivalent to course work credit. Credit will be assigned only on the basis of submission of certificate.

<b>Paper-I (Course No. 101)</b>			
<b>Unit number</b>	<b>General</b>	<b>Number of hours</b>	<b>Number of credits</b>
<b>Unit I</b>	<p><b>Research methodology:</b> Strategies, planning and analysis: Objectives of research, short term and long term goals, research conditions, research design- characteristics of a good research design, types of research design Experimental protocols Literature search: Systematic literature search, Search techniques, Impact factor, Citation style Ethics in science: Introduction to ethics, Scientific conduct and misconduct, Plagiarism, Ethics of animal research- CPCSEA, Institutional ethics committee, OECD guidelines</p>	<b>15</b>	<b>01</b>
<b>Unit II</b>	<p><b>Biostatistics - introduction:</b> Introduction- definition, scope and limitations Collection of data, classification &amp; tabulation- diagrammatic &amp; graphical representation Measures of dispersion - Range, Q.D., M.D., variance, standard deviation <b>Correlation and Regression analysis:</b> Correlations and regressions principles of least squares, Two regression lines, curve fitting Karl Pearson's coefficient of correlation, Spearman's coefficient of correlation</p>	<b>15</b>	<b>01</b>
<b>Unit III</b>	<p><b>Data Analysis:</b> Mathematical and statistical analysis using software tools like MAT Lab, SPSS, Psi LAB or free ware tools. <b>Hypothesis testing:</b> Null and alternate hypothesis, Type-I &amp; Type-II errors, Level of significance, Power of test, p value</p>	<b>15</b>	<b>01</b>
<b>Unit IV</b>	<p><b>Parametric tests:</b> Large sample Tests, Testing significance of single population proportion, Testing significance of two population proportion, Small sample Tests, <math>\chi^2</math> test, Testing single population variance, Testing association between two attributes, F-test, Testing equality of variance, ANOVA / ANCOVA - one-way classification, two-way classification. <b>Introduction to non-parametric tests:</b> The Mann-Whitney Test (Mann-Whitney-Wilcoxon test -for equality of medians), The Kolmogorov-Smirnov Goodness-of-Fit Test, The Kruskal-Wallis One-Way Analysis of Variance by Ranks, The Friedman Two-Way Analysis of Variance by Ranks</p>	<b>15</b>	<b>01</b>



**Reading Resources:**

- Research Methodology: A guide for Researchers in Agricultural Science, Social Science and other related fields. Pradipkumar Sahu. Springer 2006
  - Ranjit Kumar, 2005 Research Methodology- A step-by-step Guide for beginners, 3rd edition, Sage publications.
  - Fundamentals of Research methodology and statistics- Yogesh Kumar Singh, New Age International Publishers
  - Biostatistics: A foundation for analysis in health sciences. Daniel WW, Cross CL. 10thEdn, Wiley.2013
  - Biostatistical Analysis. Zar JH. 5th Edition Pearson Education.2010.
  - Principles of Biostatistics. Pagano M., Gauvreau K., 2ndEdn. Cengage Learning, 2010
  - Fundamentals of Biostatistics. Rosner B. 7thEdn. Duxbury Thomson 2011
  - Introductory Applied Biostatistics D'Agostino RB., Sullivan LM., Beiser AS., Thomson Brooks/Cole 2006
  - Communications Skills: Sanjay Kumar & PuspLata, 2<sup>nd</sup> edition, Oxford University Press
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  - Office of the Controller General of Patents, Designs & Trade (CGPDTM): Manual of Patent Office Practice and Procedure
  - Office of the Controller General of Patents, Designs & Trade (CGPDTM): Manual of Designs Practice and Procedure
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  - WIPO: WIPO Patent Drafting Manual
  - WIPO: The Value of Intellectual Property, Intangible Assets
- Any other reference sources as recommended by the course instructor.

<b>Paper-II</b> <b>(Course No. 102)</b>			
<b>Unit number</b>	<b>Subject based</b>	<b>Number of hours</b>	<b>Number of credits</b>
<b>Unit-I</b>	<b>Cell Biology</b>	<b>15</b>	<b>1</b>
	Cell cycle and control: Check points, Cyclins and CDKs and apoptosis, Cancer biology- Cell cycle regulation, apoptosis, autophagy, senescence, Hallmarks of cancer, angiogenesis and metastasis, Oncogenes and tumor suppressors, epigenetics, Cancer biomarkers, Cell culture, primary cell lines, continuous cell lines, maintenance of cell lines, cell toxicity assays, Cell analysis- Flow Cytometry; Cell proliferation assays, Cell death analysis, immunohistochemistry, blotting techniques, comet assay.		
<b>Unit-II</b>	<b>Molecular Biology techniques and bioinformatics</b>	<b>15</b>	<b>1</b>
	<b>PCR:</b> Basics, factors affecting PCR, applications, variations in PCR, nucleic acid sequence based amplification assays (NASBA) and transcription – mediated amplification assay (TFA); Real Time PCR, <b>Nucleotide sequencing:</b> Chemical and enzymatic methods, Pyrosequencing, Automated DNA sequencing, PCR fragment analysis, Next Generation sequencing <b>Microarray Technology:</b> Proteomics, Metagenomics, 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		
<b>Unit-III</b>	<b>Bioprocess and enzyme technology</b>	<b>15</b>	<b>1</b>
	Enzymes: commercial applications; Production of industrially important enzymes, medically important enzymes such as diagnostic, therapeutic enzymes, Enzyme purification techniques- conventional and advance, Recombinant enzymes-kinetics, Upscaling of production of enzymes, Enzyme immobilisation- kinetics of immobilisation, development of new techniques, application, Microbial products, System biology		
<b>Unit-IV</b>	<b>Ecology and Ecosystems</b>	<b>15</b>	<b>1</b>
	Carbon sequestration, Limno-ecological studies: Physiochemical parameters, Edaphic factors, Proximate composition, Pollutants in environments, Study of Air quality index. Methods in study of biodiversity & fishery science.		
<b>Unit-V</b>	<b>Nanotechnology</b>	<b>15</b>	<b>1</b>
	Types of nanoparticles-classification, Methods for synthesis of Nanoparticles-Methods, assembly,		

	stabilisation, Characterisation of nanoparticles, Applications		
<b>Unit-VI</b>	<b>Introduction to Pharmacology</b>	<b>15</b>	<b>1</b>
	Physico-chemical properties of drug, drug-receptor, interaction, Pharmacokinetics, Pharmacodynamics, Pharmacotherapeutics, Drug interactions, Nature and sources of Drugs, Drug nomenclature and dosage forms, Routes of drugs' administration; advantages and disadvantages of different routes, Drug discovery and development, Drug regulatory affairs, Herbal drugs - Methods of extraction of active constituents, standardisation of herbal drugs, regulatory issues with herbal drugs, regulatory requirement in herbal drugs in India, Drugs for various systems, Drug Toxicity- OECD guidelines Acute, sub-acute and chronic toxicity studies , Carcinogenicity, teratogenicity, genotoxicity, mutagenicity, Definition of Toxicological Dose Descriptors (LD <sub>50</sub> , LC <sub>50</sub> , EC <sub>50</sub> , NOAEL, LOAEL/NOEC, DT <sub>50</sub> )		

<b>Paper-III (Course No. 103)</b>			
<b>Unit number</b>	<b>Skill Development &amp; Enhancement In Research</b>	<b>Number of hours</b>	<b>Number of credits</b>
<b>UNIT-1</b>	<b>INSTRUMENTATION:</b> Good laboratory practices, Separation analytical techniques, chromatographic techniques, conventional and advance techniques, TLC, GC, affinity, ion exchange, size exclusion, supercritical fluid, HPTLC, Electrophoretic technique, Spectroscopic techniques- UV, FTIR, ESR, NMR, Circular Dichroism, Raman, ORD, Atomic absorption spectrometry, Microtomy.	<b>15</b>	<b>1</b>
<b>UNIT-II</b>	<b>Intellectual property rights:</b> Patents- Introduction to patents, patent databases, Preparation of Patent documents, patent examination, Patent infringement, recent development in patent system, Geographical indications, Trademarks, Copy rights, Management of intellectual property, Business & Intellectual property	<b>15</b>	<b>1</b>
<b>UNIT-III</b>	<b>Communication skill:</b> Presentation skills, Journal club, seminars, Skill enhancement workshops, visit to research institutes/industries	<b>30</b>	<b>1</b>
<b>Unit-IV</b>	<b>Computing skills (use of software relevant to research):</b> Use of Microsoft EXCEL, Microsoft Access, SPSS, SAS, Corel draw, Photoshop, Photomicrogyphy, Photographing & Photographic materials, Common faults in photography.	<b>30</b>	<b>1</b>

### Reading Resources

- Research Methodology: A guide for Researchers in Agricultural Science, Social Science and other related fields. Pradip kumar Sahu. Springer 2006
- Ranjit Kumar, 2005 Research Methodology- A step-by-step Guide for beginners, 3rd edition, Sage publications.
- Fundamentals of Research methodology and statistics- Yogesh Kumar Singh, New Age International Publishers
- Biostatistics: A foundation for analysis in health sciences. Daniel WW, Cross CL. 10thEdn, Wiley.2013
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- Fundamentals of Biostatistics. Rosner B. 7<sup>th</sup> Edn. Duxbury Thomson 2011
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- Karp G. (2002). Cell and Molecular Biology: Concepts and Experiments. 3<sup>rd</sup> edition. John Wiley & Sons.
- Culture of animal cells: Ian Freshney, 5<sup>th</sup> edition, John Wiley & Sons.
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- Introduction to Bioinformatics T.K. Attwood and D.J Perry-Smith
- 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
- Communications Skills: Sanjay Kumar & PuspLata, 2<sup>nd</sup> edition, Oxford University Press
- An Introduction to Professional English and Soft Skills by B.K. Das et al., Cambridge University
- Skoog, Holler and Nieman, Principles of Instrumental Analysis, 5th Ed. Australia, Thomson Brock/Cole.
- Wilson K., and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology, Seventh Edition; Cambridge University Press
- Pharmacokinetic in Drug Discovery and Development. Schoenwald RD. CRC Press. 2010.
- Principles and Methods of Toxicology. Hayes W, Kruger CL. CRC Press – Taylor & Francis Group. 2013.
- An Introduction to Medicinal Chemistry. Patrick GL. 5thEdn. Oxford University Press. 2013.
- Good Laboratory Practice: Nonclinical Laboratory Studies Concise Reference. Allport-Settle MJ. PharmaLogika. 2010
- Bajpai P.K. Biological Instrumentation & Methadology S.Chand Publication Edd.2010.
- Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets. Bouchoux D. 3rdEdn. Delmar Cengage Learning. 2009.
- Office of the Controller General of Patents, Designs & Trade (CGPDTM): Manual of Geographical Indications Practice and Procedure
- Office of the Controller General of Patents, Designs & Trade (CGPDTM): Manual of Patent Office Practice and Procedure
- Office of the Controller General of Patents, Designs & Trade (CGPDTM): Manual of Designs Practice and Procedure
- Office of the Controller General of Patents, Designs & Trade (CGPDTM): Revised Draft Manual of Trademarks Practice and Procedure
- WIPO: WIPO Guide To Using Patent Information
- WIPO: Intellectual Property (IP) Audit
- WIPO: WIPO Patent Drafting Manual
- WIPO: The Value of Intellectual Property, Intangible Assets
- Any other reference sources as recommended by the course instructor.

The record of the evaluation is to be maintained till the learner clears his/her Ph.D. degree.

Sevenpoint scale will be followed for assigning the final grade. Learner should get minimum 'C' grade to qualify.

After completion of the Course Work guiding teacher will submit the Certificate of Completion of Course Work in the prescribed format:

**Name of the Research Centre:** .....

**CERTIFICATE**

This is to certify that Mr/Ms/Mrs.....

(Surname)

(First Name)

(Second Name)

Has been regular student of Ph.D. with registration number ..... He/She attended the Course Work conducted at the recognized research centre/department from ..... To ..... during the year ..... He/She has successfully completed the Ph.D. Course Work. He/She secured ..... grade in seven point scale.

Date:

Guiding Teacher

Head of the Department/Principal

Seal

Name:

Name:



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  
Best College, University of Mumbai 2016-17

Affiliated to the  
**UNIVERSITY OF MUMBAI**

**Program: M.Phil./PhD  
Course: M.Phil./PhD Mathematics  
with effect from the academic year 2019-20**

# **Admission Criteria and Revised syllabus in Mathematics**

## **As per credit based system**

### **M. Phil./ Ph.D. 2019-20**

#### **Admission Criteria:**

The candidates who have passed the PET (Mathematics) conducted by University of Mumbai or have passed the NET/SET examination or have a M. Phil. (Mathematics) degree as per the UGC guidelines are eligible to appear for an Interview the Pre-Ph.D.(Mathematics) Programme. The candidates who have qualified in the Interview are be eligible for admission to the Pre- Ph. D (Mathematics) Programme. The candidates seeking admission for the M. Phil.(Mathematics) Programme shall have to appear for an Entrance Examination. The candidates who have passed the NET/SET examination are exempt from appearing for the Entrance Examination. The Entrance Examination consists of a written test for a total of 100 marks. A candidate has to score 50 or more marks to pass the Entrance Examination.

#### **Courses and credits:**

The M. Phil./ Ph.D. (Mathematics) Programme is consists of semester I & II (18 Credits). Each semester is of four months duration. There are three courses in each semester. Each course is assigned 3 credits.

### **Semester I: (3+3+3=9 Credits)**

#### **Paper –I (Research Methodology) (3 Credits)**

The said Paper consists of:

1. Latex and Beamer
2. At least one Mathematics software Maxima/ Scilab / any other such software offered by a research guide
3. Working knowledge of MathSciNet, JSTORE.

#### **Paper- II (3 Credits) and Paper-III (3 Credits) are from the following:**

1. Algebra-I
2. Analysis-I
3. Topology-I
4. Discrete Mathematics-I
5. Any one semester course designed and offered by a research guide/ external expert.

### **Semester II: (3+3+3=9 Credits)**

#### **Paper-I (Research Methodology) (3 Credits)**

This Paper consists of any of the following equivalents:

1. ATM School participation
2. Review of a minimum of two research papers under the guidance of a teacher
3. A Reading Course under the guidance of a teacher.



## **Paper- II (3 Credits) and Paper-III (3 Credits) are from the following:**

1. Algebra-II
2. Analysis-II
3. Topology-II
4. Discrete Mathematics-II
5. Any one semester course designed and offered by a research guide/ external expert.

### **Teaching Pattern:**

There are Two lectures per week per Paper (1 lecture/period is of one hour duration)

## **Algebra-I (30 lectures)**

Ideals, Local rings, Localization of rings and modules, Applications. Noetherian modules, Primary decomposition, Artinian modules, Length of a module.

Integral element, Integral extension, integrally closed domain, Finiteness of integral closure.

Valuation rings, Discrete valuation rings, Dedekind domains.

### **References**

1. N. Jacobson, Basic Algebra, Vol I & II, Hindustan Publishing Corporation, New Delhi.
2. D.S. Dummit, R.M. Foote, Abstract Algebra, John Wiley & Sons, Singapore.
3. M. F. Atiyah and I. G. Macdonald, Introduction to commutative Algebra, Addison-Wesley,

### **Reading.**

4. N. S. Gopalkrishnan, Commutative Algebra, Oxonian Press Pvt. Ltd, New Delhi.
5. S. Lang, Algebra, Addison-Wesley Publishing Company, Singapore.

## **Algebra II (30 lectures)**

Modules, Free modules, Exact sequences, Projective modules, Injective modules, Tensor products, Flat modules.

Filtered rings and modules, Completion, I- adic filtration, Associated graded rings.

Complexes, Derived functors, Homological dimension.

### **References**

1. N. Jacobson, Basic Algebra, Vol I & II, Hindustan Publishing Corporation, New Delhi.
2. D.S. Dummit, R.M. Foote, Abstract Algebra, John Wiley & Sons, Singapore.
3. M. F. Atiyah and I. G. Macdonald, Introduction to commutative Algebra, Addison-Wesley,

### **Reading.**

4. N. S. Gopalkrishnan, Commutative Algebra, Oxonian Press Pvt. Ltd, New Delhi.
5. S. Lang, Algebra, Addison-Wesley Publishing Company, Singapore.

## Analysis I (30 lectures)

$C(X)$ -Spaces of continuous functions on a metric space  $X$ ; the topologies of  $C(X)$  with respect to  $X$  compact, locally compact (and Hausdorff) cases; Discussion on norms, seminorms, induced topology. Discussion of  $C_c(X)$ ,  $C_0(X)$  etc. Discussion of Weierstrass theorem and its different proofs; Stone Weierstrass theorem, Tietze's extension theorem.

Normed linear spaces; Discussion of Finite and infinite dimensional cases. Banach spaces, closed graph theorem, open mapping theorem, Uniform boundedness principle, Banach Steinhaus theorem; Equicontinuity. Inner product spaces, Hilbert spaces, orthonormal basis, Direct Sum, Dual space of a Hilbert space. Riesz representation theorem.

Brief treatment of Lebesgue measure and Integral in general setting;  $L_p$  spaces, completeness, Duality, Reflexivity. Detailed study of  $L^1(0, 2\pi]$  and  $L^1(\mathbb{R})$  and its connection to Fourier Analysis. Fourier transform on  $L^1$ ; Poisson Summation formula; Fourier inversion formula, Riemann Lebesgue Lemma, Fourier transform on  $L^2$ ; Parseval's Identity, Plancherel theorem. The Schwartz class  $S$  of rapidly decreasing functions and its topology; Tempered distributions  $T$  and its topology; Fourier transform as a bijection on  $S$  and  $T$ .

### References

1. Richard Beals, Analysis- An Introduction, Cambridge University Press.
2. E. Hewitt and K. Stromberg, Real and Abstract Analysis, Springer-Narosa.
3. J.B. Conway, A course in Functional Analysis, Springer Graduate Texts in Mathematics.
4. Walter Rudin, Functional Analysis, McGraw Hill.
5. R. Strichartz, A guide to Distribution Theory and Fourier Transforms, CRC Press.
6. Kolmogorov and Fomin, Measure, Lebesgue Integral and Hilbert Space, Academic Press.

## Analysis II (30 lectures)

Detailed study of one of the following topics:

1. Operator theory on Hilbert spaces and Spectral analysis.
2. Classical Differentiation, Dini's derivatives, Functions of Bounded Variation, Absolute continuity, Decomposition of measures, Radon Nikodym derivative theorem and Radon Nikodym theorem; Its applications to Financial Mathematics.
3. Hilbert space techniques, orthonormal basis, theory of wavelets, multiresolution analysis, wavelet basis for  $L^2$ .
4. Theory of Distributions, elliptic PDE.
5. Harmonic Analysis on locally compact abelian groups.
6. Brownian motion, Ito integral, Stochastic Differential equations and Application to Financial Mathematics.
7. Several Complex Variables.

## 8. Ergodic theory

### References

1. Richard Beals, Analysis- An Introduction, Cambridge University Press.
2. E. Hewitt and K. Stromberg, Real and Abstract Analysis, Springer-Narosa.
3. J.B. Conway, A course in Functional Analysis, Springer Graduate Texts in Mathematics.
4. Walter Rudin, Functional Analysis, McGraw Hill.
5. R. Strichartz, A guide to Distribution Theory and Fourier Transforms, CRC Press.
6. Kolmogorov and Fomin, Measure, Lebesgue Integral and Hilbert Space, Academic Press.
7. Gilbert G. Walter, Wavelets and other Orthogonal Systems with Applications, CRC Press.
8. H.I. Resnikoff and R.O. Wells, Wavelet Analysis, the scalable structure of Information, Springer.
9. I.Karatzas and S.E. Shreve, Brownian Motion and Stochastic Calculus Applied to Finance, Springer.
10. Lamberton and Lapeyre, Introduction to Stochastic Calculus Applied to Finance, Chapman and Hall.

## Topology I (30 lectures)

Homotopy, Fundamental Group, Homotopy Equivalence.

Covering Spaces, Classification of Covering Spaces, Covering spaces and Fundamental Group, Covering Transformations.

Classification of Surfaces, Seifert-van Kampen Theorem and applications.

### References

1. James R.Munkres, Topology, Pearson Education, New Delhi.
2. John M.Lee, Introduction to topological manifolds, Springer-Verlag, New York.
3. W.S.Massey, Algebraic Topology an introduction, Harcourt Bruce & World Inc, New York.
4. Allen Hatcher, Algebraic Topology, Cambridge University Press.

## Topology II (30 lectures)

Simplicial Complexes, Triangulable spaces, examples, Abstract simplicial complexes, Simplicial approximation theorem, Simplicial Homology, applications.

Singular homology, Homotopy Invariance.

Homology and the Fundamental Group, Meyer-Vietoris theorem, applications.

### References

1. James R.Munkres, Topology,
2. John M.Lee, Introduction to topological manifolds,
3. W.S.Massey, Algebraic Topology an introduction,
4. Allen Hatcher, Algebraic Topology, Cambridge University Press.

## **Discrete Mathematics I (30 lectures)**

Pigeon hole principle, Ramsey Theory, Some bounds, Addition and Multiplication principles, counting Techniques, Elementary graph Theory, Connected, Eulerian, Hamiltonian graphs, Theorems of Dirac and Posa, Ford-Fulkerson Theorem, Matching Algorithm, Hungarian Algorithm, Eigenvalues of graph, Directed graphs. In addition one of the following topics:

1. Advance graph theory
2. Algorithmic graph theory
3. Generalize Quadrangles
4. Tournaments

### **References**

1. Biggs, Norman, Algebraic Graph Theory, Cambridge University Press.
2. Godsil, Chris; Royle, Gordon , Algebraic Graph Theory, GTM 207, Springer-Verlag.
3. Douglas B. West, Introduction to Graph Theory, Prentice Hall India.
4. William Kocay, Donald L. Kreher, Graphs, Algorithms and Optimization, Chapman and Hall.

## **Discrete Mathematics II (30 lectures)**

Finite fields, Finite geometries, Projective planes, Affine planes, Difference sets, Designs, Construction of Design, Symmetric Design, Binary linear Codes, Generator matrix and check matrix, decoding, Spheres packing, Gilbert-Varshamov bound, single error correcting Hamming Codes. In addition one of the following topics:

1. Advance Coding Theory
2. Matroid Theory
3. Game Theory
4. Combinatorial Matrix Theory

### **References**

1. Thomas Beth & D. Jungnickel & H. Lenz, Design Theory, Volume 1 & 2 Encyclopedia of mathematics and its applications.
2. W. D. Wallis, Further Computational and Constructive Design Theory, Kluwer Academic Publishers.
3. Peter Dembowski, Finite Geometries, Classics in Mathematics, Springer.
4. J.H. van Lint, Introduction to Coding Theory, Springer.
5. Florence Jessie MacWilliams & Neil James Alexander Sloane, The theory of Error Correcting Codes, North-Holland.
6. Richard A. Brualdi, Drago M. Cvetkovi, A Combinatorial Approach to Matrix Theory and its Applications, Chapman & Hall/CRC Press.
7. Richard A. Brualdi, Herbert John Ryser, Combinatorial Matrix Theory, Cambridge University Press.
8. Guillermo Owen, Game Theory. Academic Press.
9. Philip D. Straffin, Game theory and Strategy, Mathematical Association of America Textbook.

## **Scheme of Examination**

The scheme consists of seminars/assignments and two tests in each semester. Each candidate will have to submit a Dissertation which will be assessed by an external examiner.

**Attendance:** 75% attendance to the lectures is essential to qualify for appearing for the tests.  
**First Test:** There will be a mid-semester written test for 40 marks on the topics covered of 2 hours duration in all the three courses.

**Seminars:** There will be continuous assessment in the form of Seminars/Lab works and assignments during the semester and 10 marks are be allotted for this in each course.

**Final Test:** The final test is for 50 marks and is of 2 hours duration in each course on the entire syllabus of the semester.

Candidates securing a total of 50 or more marks in a course from the first test, seminar/ Lab works and the final test with at least 25 marks in the final test will be declared to have passed the respective course and earned 3 credits. Candidates failed in a course will be allowed to take a supplementary examination (at most two attempts) for the final test in the respective course. If a candidate participates in a ATM work shop as course 3 in semester II, then the Head of the Department will request the Coordinator of the ATM work shop to give a grade to the candidate based on the participation.

A candidate who secures a total of **18 credits** from the six courses of Semester I & II together will be declared to have passed the Ph.D. programme/ Theory part of M. Phil programme and he/she will be allowed to submit the Ph.D./M. Phil. dissertation. There is no grade point for the Dissertation work. The Dissertation work is accepted or rejected.

The candidates selected for the Ph.D. programme, after acquiring the M. Phil. (mathematics) degree of University of Mumbai need no credits to be earned. Such candidates will be allowed to submit the Ph.D. dissertation. The candidates selected for the Ph.D. programme after acquiring the M. Phil. (Mathematics) degree of any other University will have to earn 18 credits if there is no equivalent course work prescribed for the M. Phil. programme of the respective other University.

If a candidate wants to leave the Ph.D. programme after earning 18 credits in the Ph.D. Programme, he/she may be allowed to register for the M. Phil. Programme. In such a case, the 18 credits will be transferred to his/her M. Phil. Programme and he/she will be allowed to submit the Dissertation.

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Shri Vile Parle Kelavani Mandal's

**MITHIBAI COLLEGE OF ARTS, CHAUHAN INSTITUTE OF SCIENCE  
& AMRUTBEN JIVANLAL COLLEGE OF COMMERCE AND  
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(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
	<b>Soft skills</b> 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.

<b>Paper-I</b> <b>(Course No. _</b>			
<b>UNIT NUMBER</b>		<b>NUMBER OF Hours</b>	<b>NUMBER OF CREDITS</b>
<b>UNIT I</b>	<p><b>1. RESEARCH METHODOLOGY</b></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>	<b>15</b>	<b>01</b>
<b>UNIT II</b>	<p><b>2. BIostatISTICS- INTRODUCTION</b></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 &amp; tabulation-diagrammatic &amp; graphical representation</p>	<b>15</b>	<b>01</b>

	<p>2.4. Measurement scales, variables &amp; 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 &amp; 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>		
<b>UNIT III</b>	<p><b>3. THEORY OF PROBABILITY</b></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>	<b>15</b>	<b>01</b>
<b>UNIT IV</b>	<p><b>4.</b></p> <p>4.1. HYPOTHESIS TESTING</p> <p>4.1.1. Null and alternate hypothesis</p> <p>4.1.2. Type-I &amp; 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>	<b>15</b>	<b>01</b>

	<p>4.2.2.4. Testing significance of correlation coefficient</p> <p>4.2.3. <math>\chi^2</math> 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	
	<b>2.1. PCR:</b> Basics, factors affecting PCR, applications, variations in PCR, nucleic acid sequence based amplification assays (NASBA) and transcription – mediated amplification assay (TFA); Real Time PCR <b>2.2. nucleotide sequencing:</b> Chemical and enzymatic methods, Pyrosequencing, Automated DNA sequencing, PCR fragment analysis, Next Generation sequencing <b>2.3. Microarray Technology</b> 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, 3<sup>rd</sup> edition
10. Molecular Cell Biology. Lodish, Birk, and Zipursky. 6<sup>th</sup> edition Freeman
11. Cooper, G.M., Hausman R.E. (2009) The Cell: A Molecular Approach- 5<sup>th</sup> edition. ASM Press.
12. Karp G. (2002). Cell and Molecular Biology: Concepts and Experiments. 3<sup>rd</sup> edition. John Wiley & Sons.
13. Culture of animal cells : Ian Freshney, 5<sup>th</sup> edition, John Wiley & Sons.
14. Clive R. Newton, Alex Graham. (1997) PCR; BIOS Scientific Publishers.
15. **Nanotechnology: Principles and Practices: Kulkarni, Sulabha K, 3<sup>rd</sup> 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, 2<sup>nd</sup> 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. 5<sup>th</sup>Edn. 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. 3<sup>rd</sup>Edn. 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.



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  
Best College, University of Mumbai 2016-17

**Affiliated to the  
University of Mumbai**

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

**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 multidimensional 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 credits. The students will complete the credits in first two semesters. 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 focus 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 semesters 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
	<b>Soft skills</b> 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.

<b>Paper-I</b> <b>(Course No. _</b>			
<b>UNIT NUMBER</b>		<b>NUMBER OF Hours</b>	<b>NUMBER OF CREDITS</b>
<b>UNIT I</b>	<p><b>1. RESEARCH METHODOLOGY</b></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>	<b>15</b>	<b>01</b>
<b>UNIT II</b>	<p><b>2. BIOSTATISTICS- INTRODUCTION</b></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 &amp; tabulation-diagrammatic &amp; graphical representation</p>	<b>15</b>	<b>01</b>

	<p>2.4. Measurement scales, variables &amp; 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 &amp; 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>		
<b>UNIT III</b>	<p><b>3. THEORY OF PROBABILITY</b></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>	<b>15</b>	<b>01</b>
<b>UNIT IV</b>	<p><b>4.</b></p> <p>4.1. HYPOTHESIS TESTING</p> <p>4.1.1. Null and alternate hypothesis</p> <p>4.1.2. Type-I &amp; 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>	<b>15</b>	<b>01</b>

	<p>4.2.2.4. Testing significance of correlation coefficient</p> <p>4.2.3. <math>\chi^2</math> 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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## 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.
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13. Office of the Controller General of Patents, Designs & Trade (CGPDTM): Manual of Geographical Indications Practice and Procedure
14. Office of the Controller General of Patents, Designs & Trade (CGPDTM): Manual of Patent Office Practice and Procedure
15. Office of the Controller General of Patents, Designs & Trade (CGPDTM): Manual of Designs Practice and Procedure
16. Office of the Controller General of Patents, Designs & Trade (CGPDTM): Revised Draft Manual of Trademarks Practice and Procedure
17. WIPO : WIPO Guide To Using Patent Information
18. WIPO : Intellectual Property (IP) Audit
19. WIPO : WIPO Patent Drafting Manual
20. WIPO : The Value of Intellectual Property, Intangible Assets
21. Any other reference sources as recommended by the course instructor.