

III SEMESTER
SELF STUDY PAPER

RESEARCH METHODOLOGY

Credits : 2

Course Objectives

1. To impart knowledge on scientific methods in basic research and its methodologies.
2. To develop the right approach on research problems and their predictions.
3. To make the student to understand the importance of systematic protocol in research
4. To motivate the student to have good communication and presentation skill in writing research papers.
5. To acquaint the students with basics of intellectual property rights with special reference to Indian laws & practices.

Course Outline:

UNIT-I

Introduction – Objectives of Research - Types of Research, Application Oriented , Objective Oriented, Conceptual , Applied, Fundamental, Quantitative and Qualitative - Significance of Research - Research process – Problems encountered in research. Research Formulation- Identification and formulating of research problems – Techniques involved

UNIT-II

Research Designs- Exploratory, Descriptive and Causal research design - Research hypothesis - Testing and errors in hypothesis - Research plan – Types of Research Plan. Literature review - Collection and importance - Stages of literature search - Web source- Collection and classification of data

UNIT-III

Information Science- Sources of Information –Scientific reports – Research paper - Review articles- Journal Article. Library, books, journals, periodicals, reference sources, Abstracting and indexing sources, Reviews, Treatise, Monographs, Patents, Internet -Search engines and software, Online libraries, e-Books, e-Encyclopedia, TED Talk, Institutional Websites.



UNIT-IV

Research report writing - Thesis writing -structure and layout - Tabulation – Graphical presentation – Diagrammatic Presentation of Data – Bibliography – Footnotes- Plagiarism. Project proposal writing - Presentation techniques - Oral presentation ,Poster presentation,Conference , Seminar, Workshop.

UNIT-V

Intellectual Property Rights - Copy right- Patents - Trademarks - Safety and precaution - ISO standards for safety - Lab protocols - Lab animal use, care and welfare, Extension - Lab to Field - Life Science Projects and Funding Agencies- **Bioethics – Ethical Committees and Constitution.**

Reference Books

S. No	Title of the Book	Authors	Publishers	Year of Publication
1.	Law relating to intellectual property rights	AnithaGoel	Lexis Nexis- Butterworths Wadhwa	2010
2.	Research Methodology for Scientific Research	K. Prathapan	Wiley India Pvt. Ltd.	2021
3.	Research Methodology The Aims, Practices and Ethics of Science	Pruzan, Peter	Springer International Publishing	2016
4.	Introducing Research Methodology: A Beginner's Guide to Doing a Research Project	Uwe Flick	Sage Publications India	2017
5.	An Introduction to Scientific Research	Chap T.Le	Dover Publications	2003

E- Learning Resources:

<https://research-methodology.net>

<https://cirt.gcu.edu>

<https://www.researchgate.net>

<https://www.sciencedirect.com>

<https://socialresearchmethods.net>

<http://serb.gov.in> <https://www.aamc.org>

<http://www.ipindia.nic.in>


PRINCIPAL

SEMESTER II
RESEARCH METHODOLOGY

Total Hours: 75
Credits: 4

Course Code: 7P21/2C/REM
L T P: 3 2 0

COURSE OBJECTIVES

To enable the students:

1. To gain knowledge on types of research and research methodology.
2. To understand the concept of Hypothesis testing & sampling techniques.
3. To develop knowledge on measurement scales & data collection methods.
4. To understand the steps in processing of data and tools used for analysis of data.
5. To gain knowledge on Interpretation and Report writing techniques.

COURSE OUTLINE

UNIT I

Introduction to Research methodology – meaning and objectives – types of Research; steps in Research Process- criteria of good research- problems. Research problem- steps in selection and formulation of a Research Problem - Research Design- need- features- concepts- types- principles- important experimental designs. **Research ethics.**

(20 hrs)

UNIT II

Hypothesis- meaning – concepts- characteristics -types - procedure for testing Hypothesis – Limitations of hypothesis testing. Sampling- Merits- Limitations – Sampling methods – Probability & Non- probability sampling- Sample Size- Sampling Error and Non-sampling error.

(10 hrs)

UNIT III

Measurement- classifications of measurement scales- goodness of measurement scales- Scaling- Scaling techniques. Data – classification- methods of data collection.

(15 hrs)

UNIT IV

Processing of data – Editing, Coding, Classification & Tabulation, analysis of data – outline of statistical analysis – (Application of SPSS)

(20 hrs)



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UNIT V

Interpretation – meaning- techniques& precautions. Significance of Report writing- steps & mechanics in writing report- Layout of the research report- types of research report- precautions for writing research reports. Research proposal – funding agencies- referencing – citations- plagiarism.

(10 hrs)

Note: Theory only

SKILL DEVELOPMENT ACTIVITIES

1. Writing a research proposal for a funding agency
2. Identifying an research article with a standardised questionnaire
3. Presenting research papers at various National and International Conferences

MOOCs

1. Social Research Ethics by Prof Lakshmi Lingam of TATA Institute of Social Sciences
2. Research Ethics Shri. Manoj Kumar K 01-07-2021 30/10/2021 Central University of Himachal Pradesh

RECOMMENDED TEXT BOOKS


1. Kothari C.R., Research Methodology, Vikas Publishing Ltd 2nd Edition
2. Ravilochanan, Research Methodology , Margham Publications 3rd Edition
3. N.Gurumani , Research Methodology

REFERENCE BOOKS

1. William C Emory, Business Research Methods, R.D.Irwin.Inc
2. Robert G Murdick, Business Research- Concepts & Practice, International text book company
4. Dr. Ranganatham , Research Methodology
5. G. Vijayalakshmi&C.Sivapragasam , MJP Publishers, Edition 2008
6. R.Cauvery, U.K.SudhaNayak, M.Girija, R.Meenaksh- Research Methodology – S.Chand& Company Ltd 1st Edition

JOURNALS

1. Journal of Research Practice
2. Journal of Research Methods and Methodological Practices.
3. International Journal of Social Research Methodology
4. Journals of Mixed Methods Research.



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SEMESTER III
RESEARCH METHODOLOGY AND COMPUTER
APPLICATIONS IN ECONOMICS

Total Hours: 75
Credits: 4

Course Code: 8P21/3C/RMC//3P21/3C/RMC
LTP:2/2/1

COURSE OBJECTIVES

1. To understand the scientific research process.
2. To study the various methods and sources of collecting data.
3. To learn computer applications in executing economic research
4. To use software tools in data maintenance and operations
5. To Apply statistical tools in analyzing the project report

COURSE OUTLINE:

- UNIT I** : Research in Social Sciences – Role of Research Methodology – Research Process – Conceptual Foundation of Research – Economic Theory and Methods – Axiomatic, Mathematical and Historical Methods – Empirical Research – Basic Elements in Research – Identification of a Research Problem – Hypothesis Formulation and Testing – **Ethics in Research.** (15 Hours)
- UNIT II** : Data Collection – Primary Data – Case Study Method – Survey Research – Sample Selection – Sampling Design – Preparation of Structure Interview Schedule – Construction of Questionnaire – Pilot Study – Classification and Tabulation – Diagrammatic Representation – Secondary Data – Sourcing of Data for India and Tamil Nadu – Census of India, NSSO - NFHS – National Accounts Statistics - Economic Survey, RBI Report, Agricultural Census, Annual Survey of Industries. (15 Hours)
- UNIT III** : Concept of Data, Record and File – Type of Data and Data Structure – Data – File Handling and Operations – Data Storage and Retrieval – Data Operations–Algorithms like Sorting, Merging, Joining and Bifurcation – Data Base Concept and Operation on Data Base - Citation Data Base Series – Group Tables – Groups and Objects – Time and Frequency Series – Scopus - Research Metrics (15 Hours)
- UNIT IV** : Report Writing – Plan of Research Report – Style and Mechanics of writing Research Report - **Publication Ethics** – Importance - **Violation of Publication Ethics** -Plagiarism - Predatory Publishers and Journals (15 Hours)
- UNIT V** : Application of Software to Economic Research – SPSS – Use of Plagiarism Software Tools. **(Practical Examination only. No question for End Semester Examination)** (15 Hours)

RECOMMENDED TEXTBOOKS:

1. C.R Kothari and Gaurav Garg, Research Methodology: Methods and Techniques, New Age International Publishers, 2019.
2. Dr.Priti R. Majhi and Dr.Prafull K.Khatua, Research Methodology (Concepts, Methods, Techniques and SPSS), Himalaya Publishing House, 2013.

REFERENCE BOOKS:

1. A.K.Das Gupta, Methodology of Economic Research, Asia Publishing House, 2007.
2. Robert Feber and P J Verdoorn, Research Methods in Economics and Business, The Macmillian Company, 2005.
3. Goode, William J and Paul K Hatt, Methods in Social Research, McGraw Hill International Book Co., London. 2017.
4. Young, Pauline V, Scientific Social Surveys and Research, Prentice Hall of India, New Delhi, 2012.

JOURNALS:

1. International Journal of Quantitative and Qualitative Research Methodology
2. International Journal of Research Methodology

E-LEARNING RESOURCES:

1. <https://www.khanacademy.org>
2. <https://www.economicsnetwork.ac.uk>el>.
3. <https://elearneconomics.com>
4. <https://libguides,wits.ac.za>
5. <https://research-methodology.net>


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SEMESTER I
RESEARCH METHODOLOGY

Total Hours: 90
Credits: 5

Course Code: 3M21/REM
LTP: 3/2/1

COURSE OBJECTIVES

1. To understand the research process and research design.
2. To gain knowledge on sampling methods.
3. To apply mathematical and statistical tools to arrive at conclusion.
4. To interpret data using mathematical tools.
5. To enable the students to write the research report.

COURSE OUTLINE:

- UNIT I :** Meaning of Research - Qualities of a Research Worker - Pure and Applied Research - Scientific Method of Research - Definition - Stage - Steps - Logical - Inductive - Deductive Methods - **Ethics in Research.**
(10 Hours)
- UNIT II :** Purpose of Research - Functions of Research - Research Problem - Research Design - Research Process - Statistical Unit - Sampling Methods
Observation - Case Study - Experimental - Interview - Questionnaire – Pilot Study - Planning of Survey.
(20 Hours)
- UNIT III :** Statistical Tools - Descriptive Statistics - Correlation – Partial - Multiple Regression- Forecasting - Fitting a Trend Line - Formulation of Hypothesis - Testing of Hypothesis - Z test – Anova - Chi square - Use of Excel and SPSS - Univariate - Bivariate Analysis.
(20 Hours)
- UNIT IV :** Sources of Data - Determination of Sample Size - Collection- Classification – Tabulation - One Way - Two Way-Presentation - Analysis - Application of Statistical Tools - Interpretation of Results.
(20 Hours)
- UNIT V :** Preparation and Writing of Research Report - Styles of Writing - MLA Style – Front Matter - Title Page - Table of Contents - List of Tables and Figures - Foot Notes - Back Matter-Appendices- Glossary - Bibliography - Application of Software to Economic Research-Use of Plagiarism Software Tools - **Publication Ethics** - Importance - **Violation of Publication Ethics** - Predatory Publishers and Journals.
(20 Hours)



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RECOMMENDED TEXTBOOKS:

1. Dr.Kirti Gupta, Research Methodology Nirali Prakashan, 2013.
2. David Wikinson The Research tool kit: The Complete Guide to Practitioner Research (Routledge Study Guides), 2002.

REFERENCE BOOKS:

1. Kothari, C.R Research Methodology- Methods and Techniques, Wiley & Eastern Ltd. New Delhi, 2015.
2. Ahuja Ram, Research Methods, Rawat Publications, Jaipur, 2002.
3. Goode, W.J & Paul K. Hart, Methods in Social Research, MC Graw Hill, London, 2019.
4. Mukheyi P.N (Ed) Methodology in Social Research Sage Publication, New Delhi, 2000.
5. Ralph Berry The Research Project: How to write it Edition 5 (Routledge Study Guides) Routledge, 2004.

JOURNALS

1. National Center for the Dissemination of Disability Research
2. International Journal of Social Research Methodology

E-LEARNING RESOURCES:

1. <https://www.khanacademy.org>
2. <https://www.economicsnetwork.ac.uk>el>.
3. <https://elearneconomics.com>
4. <https://libguides.usc.edu>
5. <https://www.openpolytechnic.ac.nz>



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PAPER I – RESEARCH METHODOLOGY

COURSE CODE: 12M21/REM CREDITS: 5

1. To gain familiarity with the research process, problem, research design, data collection and scaling
2. To provide knowledge of hypothesis formulation, testing, sampling and its fundamentals
3. To perform statistical tests T, Z and ANOVA
4. To enable statistical testing with non- parametric tests such as Chi Square Test, Sign Test Kruskal Wallis Test- Wilcoxon Test- Mann Whitney test ,& Spearman’s Rank correlation tests

COURSE OUTLINE

UNIT – I

Research – Meaning – Significance – Research process - Research problem – Review of Literature– Identification of Research gap – Research design – Types– Data collection – Primary– Secondary– Web Sources – Scaling – Nominal– Ordinal– Interval– Ratio scales – **Research Ethics (15hours)**

UNIT – II

Hypothesis – Meaning – Types – Testing of hypothesis – Errors in testing – Limitations in the testing of hypothesis

Sampling – Fundamentals – Types – Sampling and data collection errors – Sample size and its distribution – Testing the appropriateness of a sample size (15 hours)

UNIT – III

Statistical Tests

Parametric tests – Tests of small and large sample-t test - z test-Analysis of variance – One way and Two way ANOVA (20 hours)

UNIT – IV

Non Parametric Tests – Introduction and Advantages – Chi Square test –Sign Test-Kruskal Wallis Test- Wilcoxon Test- Mann Whitney test – Spearman’s Rank Correlation (Simple Problems) (20 hours)

UNIT – V

Data Interpretation and report writing - Layout of report and Types of Reports – Contents – Features of good report – Steps in writing a report research paper –Impact Factor – **Plagiarism and its consequences (5 hours)**



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RECOMMENDED TEXTBOOKS

1. Kothari C R, Gaurav Garg, Research Methodology Methods & Techniques, New Age International Publishers, New Delhi
2. Gupta S P, Statistical Methods, Sultan Chand & Sons, New Delhi

REFERENCE BOOKS


1. David Cooper R & Pamela Scindler S, Business Research Methods, Tata Mcgraw Hill Publications, New Delhi
2. William Goode J & Paul Hatt K, Methods in Social Research, Mcgraw Hill Publications, New York
3. John Best W & James Kahn V, Research in Education, Pearson Publications, USA
4. Israel D, Data analysis in Business research: A Step by Step Non Parametric Approach, Sage Publications, India
5. Robert Lussier N, Research Methods and Statistics for Business, Waveland Pr Inc, USA

JOURNALS

1. International Journal of Research Methodology
2. Indian Journal of Research

e-LEARNING RESOURCES

- www.tanfonline.com
- <https://study.sagepub.com/sites/default/files/fricker>
- <http://www.optimizely.com/optimization-glossary/statistical-significance>
- <http://www.healthknowledge.org.uk/research-methods/parametric-non-parametric>
- <http://elearningindustry.com/Articles>


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SEMESTER – II
RESEARCH METHODOLOGY FOR SOCIAL SCIENCES

Teaching hours: 75 hrs

Course Code : 9SP21/2C/RMR

Credit: 4

LTP: 3 2 0

Course Objectives:

- To provide a basic understanding of research methodology.
- To equip the learners with the ability to select research topic and make project proposals
- To endow the students with knowledge of research methods
- To describe the data collection techniques
- To demonstrate and provide sufficient practice in data analysis techniques
- To explain the basic statistical techniques used for data analysis

Course Outline:

UNIT I	Nature and definition of research; Human rights as an object of inquiry; Selecting a research problem; literature review	15 hrs
UNIT II	Variables, Objectives, Research questions and Hypothesis; Research methods - descriptive, analytical, comparative, survey, case study, Multi disciplinary research methods	15 hrs
UNIT III	Sampling: probability - simple random, systematic, stratified, multi stage, Cluster; Non probability - snowball, purposive; pilot study; reliability and validity; Data collection: types of data, methods of data collection - observation, interview; Research tools - questionnaires, schedules and standardized scales; Data analysis and Interpretation of results	20 hrs
UNIT IV	Framing a research proposal; Report writing and documentation, chapterisation, references, citation styles, plagiarism; Problems, Ethics and Confidentiality in human rights research.	20 hrs
UNIT V	Statistics - Measures of Central Tendency - Mean, median and mode – Measures of variability: Range, quartile deviation, standard deviation and coefficient – Correlation, Inferential statistics, 't' test, Chi-square test, F-test, Analysis of variance, SPSS	20hrs



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Reference Books:

1. Adam McBeth, (2010), Research Handbook on International Human Rights Laws, Edward Elgar Publishing, ISBN 9781847203687, Cheltenham, UK
2. Andreassen A. Bard, (2017), Research Methods in Human Rights, Edward Elgar Publishing, ISBN: 978 1 78536 7786, Norway
3. Asher, Jana (Eds.) (2008), Statistical Methods for Human Rights, Springer, ISBN-13 : 978-0387728360, India
4. Babbie, E. (2011). Adventures in social research: Data analysis using IBM SPSS statistics (7th ed.). Los Angeles, California: Pine Forge Press.
5. Gibaldi, Joseph. (1988). A handbook for writers of research papers. New York: Modern Language Association of America.

Journals:

1. International Journal of Social Science Research
2. International Journal of quantitative and qualitative research

E-References:

1. <http://what-when-how.com/social-sciences/methodology-social-science/>
2. <https://courses.lumenlearning.com/sociology/chapter/research-methods/>

Recommended Text Books:

1. Gilbert, N. (Ed.) (2001). Researching social life. London: SAGE.
2. Kothari, C. R. (1996). Research methodology: Methods & techniques (2nd ed.). New Delhi: Wiley Eastern.
3. Silverman, D. (2004). Qualitative research. London: SAGE.
4. Young, Pauline V. (1966). Scientific social surveys & research (4th ed.). Englewood Cliffs, NJ: Prentice Hall



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SEMESTER III

RESEARCH METHODOLOGY

TOTAL HOURS: 75

COURSE CODE: 12SP21/3C/REM

CREDITS:4

L T P: 3 2 0

COURSE OBJECTIVES

1. To gain familiarity with the research process, problem, research design, data collection and scaling
2. To provide knowledge of hypothesis formulation, testing, sampling and its fundamentals
3. To perform statistical tests T, Z and ANOVA
4. To enable statistical testing with non- parametric tests such as Chi Square Test, Sign Test Kruskal Wallis Test, Wilcoxon Test, Mann Whitney test and Spearman's Rank correlation tests and facilitate good report writing

COURSE OUTLINE

UNIT I

RESEARCH METHODOLOGY – THEORETICAL FRAMEWORK

Research – Meaning – Significance – Research process – Research problem – Review of Literature– Identification of Research gap – Research design – Types– Data collection – Primary– Secondary– Web Sources – Scaling – Nominal– Ordinal– Interval– Ratio scales –
Research Ethics (15hours)

UNIT II

HYPOTHESIS AND SAMPLING

Hypothesis – Meaning – Types – Testing of hypothesis – Errors in testing – Limitations in the testing of hypothesis

Sampling – Fundamentals – Types – Sampling and data collection errors – Sample size and its distribution – Testing the appropriateness of a sample size (15 hours)

UNIT III

PARAMETRIC TESTS

Parametric tests – Tests of small and large sample-t test –Z test – Analysis of variance – One way and Two-way ANOVA (20 hours)



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UNIT IV

NON PARAMETRIC TESTS

Non Parametric Tests – Introduction and Advantages – Chi Square test –Sign Test–Kruskal Wallis Test – Wilcoxon Test – Mann Whitney test – Spearman’s Rank Correlation (Simple Problems) (20 hours)

UNIT V

REPORT WRITING

Data Interpretation and report writing – Layout of report and Types of Reports – Contents – Features of good report – Steps in writing a report research paper –Impact Factor – Plagiarism and its consequences (5 hours)

RECOMMENDED TEXTBOOKS

1. Kothari C R, Gaurav Garg, Research Methodology Methods & Techniques, New Age International Publishers, New Delhi
2. Gupta S P, Statistical Methods, Sultan Chand & Sons, New Delhi

REFERENCE BOOKS

1. David Cooper R & Pamela Scindler S, Business Research Methods, Tata McGraw Hill Publications, New Delhi
2. William Goode J & Paul Hatt K, Methods in Social Research, McGraw Hill Publications, New York
3. John Best W & James Kahn V, Research in Education, Pearson Publications, USA
4. Israel D Data analysis in Business research: A Step by Step Non Parametric Approach, Sage Publications, India
5. Robert Lussier N, Research Methods and Statistics for Business, Waveland Pr Inc, USA

JOURNALS

1. International Journal of Research Methodology
2. Indian Journal of Research

e-LEARNING RESOURCES

- www.tanfonline.com
- <https://study.sagepubcom/sites/default/files/fricker>
- <http://www.optimizely.com/optimization-glossary/statistical-significance>
- <http://www.healthknowledge.org.uk/research-methods/parametric-non-parametric>
- <http://elearningindustry.com/articles>



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SEMESTER II
APPLIED STATISTICS AND RESEARCH METHODOLOGY
CORE - 5

TOTAL HOURS: 75 hours

COURSE CODE: 13SP21/2C/ASR

CREDITS: 4

L-T-P: 3-2-0

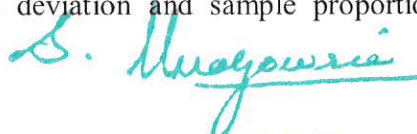
COURSE OBJECTIVES

- ✓ To define the principles of research and recall the methodologies in conducting a research
- ✓ To demonstrate their understanding of facts and principles to formulate research designs
- ✓ To identify the basic theories and techniques of research methodology
- ✓ To analyze and examine numerical data applying statistical procedures appropriate to the area of research
- ✓ To evaluate and discuss the results obtained and draw inferences to provide solutions to problems related to the field of nutrition
- ✓ To compile the data and discover new facts and theories from the research undertaken

COURSE OUTLINE

UNIT I: Meaning of research, Purposes of research, Types of research; Selecting a research problem and preparing a research proposal-The academic research problem, using the library, sending related literature, Note taking;Preparation of a research proposal for getting funds for the research; **Ethical Issues- Ethical importance of consent in research**, Regulations and Guidelines for research on human subjects; Intellectual Property Rights Experimental and quasi experimental research- Principles of experimental research experimental and control groups, variables, controlling extraneous variables, experimental validity, experimental designs, pre, post, true and quasi experimental design, Factorial design, Theory and hypothesis, experimental control. (10 HOURS)

UNIT II: Sampling and Sample Designs-Census and sample methods-Theoretical basis of sampling, law of statistical regularity, law of inertia of large numbers, essentials of sampling. Sampling from infinite population-concept of sampling distribution and standard error, relationship between sample size and standard error; Standard errors of sample mean. Sample variance, sample standard deviation and sample mean, sample standard deviation and sample proportion and the differences in these values



Methods of sampling Non-probability sampling methods, advantages, Limitation of probability sampling; Probability sampling methods –Types, Selection of appropriate method of sampling, size of sample, merits and limitations of sampling, sampling and non-sampling errors. (10 HOURS)

UNIT III: Collection of Data-Primary and secondary data, sources, published and unpublished sources, Editing primary and secondary data, and precautions in the use of secondary data.
Organization of data collection –Limitations and sources of error, Tools of research- Quantitative and Qualitative studies.Observation, Questionnaire, Opinionnaire- various methods and techniques; Reliability and validity of research tools
Classification and tabulation of Data-Meaning and objectives of classification, objects of classification, Types of classification, formation of frequency distribution, typessymmetric and asymmetric distribution considerations in the construction of frequency distribution
Tabulation of data-Difference between classification and tabulation of data, Role of tabulation Parts of the table, general rules of tabulation Review of a table types of tables, machine tabulation. Editing and coding of data records.
Diagrammatic and graphicalrepresentation Significance of diagrams and graphs, comparison of tabular and diagrammatic presentation types of diagrams. Graphs-Techniques of constructing graphs, graphs of time series or line graphs Rules for constructing the line graph or natural scale, types of graphs, graphs of frequency distribution-Histogram, frequency polygon, smoothed frequency curve, cumulative frequency curves or gives, limitations of diagrams and graphs.
(10 HOURS)

UNIT IV: Meaning of statistics, scope and limitations of statistic as a tool for decision making under uncertainty
Measures of central tendency –mean, median, mode and their relative merits finding combined mean, weighted mean, finding median and mode graphically.
Measures of variation-absolute and relative measures-range standard deviation of mean, combined standard deviation given the SD's of two distribution, coefficient of variation, percentiles and their applications
Correlationmethods-meaning, product moment, coefficient of correlation, rank correlation, scatter diagram and regression lines and their uses. Concepts of partial and multiple correlations
Test of significance-hypothesis testing, tests involving normal distribution, tests for large and small samplest tests-A tests to compare means of population and sample means of two independent samples c means of two dependent samples ,F tests-comparison of SD's of two samples ,analysis of variance , non-parametric tests-chi square test.
(35 HOURS)

UNIT V: Report Writing -style manual, format of the research report ,The thesis or dissertation- style of writing, typing a report, reference form (Bibliography)- Pagination, tables, figures-Evaluating a research report-Foot notes plagiarism, Technical and popular reports.
(10 HOURS)



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RECOMMENDED TEXTBOOKS

1. Gupta. S.P, *Statistical Methods*, S Chand & Sons,, New Delhi, 2008
2. Kothari, C. and Garg, G, *Research methodology Methods and Techniques* 3rd edition, New Delhi: New Age International (P) Ltd, 2014

REFERENCE BOOKS

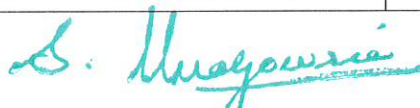
1. Singh, Y.K, *Fundamental of Research Methodology and Statistic*. New Age International (P) Ltd., Publishers. New Delhi, 2015
2. Saravanavel, P, *Research Methodology*, KitabMahal Agencies, New Delhi, 2005
3. Elhance .D.N, Veenaand and Agarwal .B.M, *Fundamental of statistics*,48thEdition, KitabMahal, Allahabad, 2005
4. Best JW and Kahn JV, *Research in Education*, Prentice Hall of India Pvt. Ltd., New Delhi, 1996
5. Koul L, *Methodology of Educational Research*,3rd edition Vikas publishing House Pvt.Ltd,New Delhi
6. William Giles Campbell, *Form and style in Thesis writing*, Houghton Mifflin Company, Boston.
7. Sadhu A.N andSingh A,*Research Methodology in Social Sciences*, Himalaya Publishing House, Mumbai,

JOURNALS

1. International journal of social research methodology
2. Journal of research practice

COURSE OUTCOME

CO No.	CO Statement	Knowledge Level
CO1	To recall the definitions , theories and statistical procedures and gain critical thinking skills to effectively undertake research	K1 & k2
CO2	To demonstrate understanding of the concept of research and acquire the necessary skills to formulate research outline.	K2 & K1
CO3	To implement the skills in employing appropriate tools and techniques in structuring the research designs and solving the research problem.	K3 &K2
CO4	To analyze and classify the data collected using the principles of research methodology and draw conclusions by subjecting it to various statistical treatments	K4
CO5	To interpret and make valid judgements determining the statistical significance obtained	K5
CO6	To compile the information, develop new theories and propose alternative solutions based on the outcomes of the research.	K6



SEMESTER II
ELECTIVE - RESEARCH METHODOLOGY

TEACHING HOURS: 60

COURSE CODE:15SP21/2E/REM

CREDITS: 3

L-T-P: 3-1-0

COURSE OBJECTIVES:

1. To introduce students to research and thesis writing.
2. To introduce the various approaches in invitro research
3. To impart knowledge on experiments with animal & human subjects
4. To expose students to the preparation of plant extracts.
5. To impart knowledge on various types of spectroscopy and basics of nano technology.

COURSE OUTLINE:

UNIT I (12 Hours)

Types of Research - Fundamental & Applied, Descriptive & Analytical, Quantitative & Qualitative. Research funding agencies – Fellowships & Grants

Thesis writing - Introduction, Review of Literature (Use of citation databases), Aim and scope, Materials and Methods, Results and Discussion, Summary and Conclusion, Bibliography- Harvard and Vancouver systems, Scientific writing for journals - Preparation of Abstract, Impact factor of journals, H Index.

Intellectual property rights- Introduction, Patent, Basis of patentability, non patentable inventions, Methods to apply for patents. **Research Ethics – Issue of plagiarism.**

UNIT II (12 Hours)

General approaches to Biochemical Investigations - Introduction to *In vitro*, *In vivo* & *In silico* studies with examples

Preparation of Percentage solutions (w/w, w/v, v/v), Molar, Molal and Normal solutions. Osmolarity, Osmolality & Ionic strength. Dilution of solutions. Hydrogen ion concentration – pH & pOH, Henderson Hassel Balch equation and Preparation of buffers



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Overview of Experiments with microorganisms, Microbial growth curve, Calculations based on doubling time and rate of growth.

Types of cell lines, Different cell lines used in Research, MTT assay, Calculation of IC₅₀, Selectivity index

Cell sorting and Cell counting - Flow cytometry (FACS). Experiments with Cell isolates - Sequence analysis - DNA and Protein sequencer.

UNIT III (12 Hours)

Whole animal studies -Ethical Committee clearance-IAEC, CPCSEA. Maintenance of animals, Control and experimental groups, Experiments with animal models- Metabolism of xenobiotics, Experimental Induction of diseases to evaluate drug candidates, Assessment of Free radical induced damages- Lipid peroxidation, Assessment of Antioxidant status -Enzymic and Non enzymic.

Organ perfusion and tissue slice techniques.Histopathology

Experiments with human volunteers - Ethical clearance- Institutional Ethical committee, Consent form, Clinical trials.

UNIT IV (12 Hours)

Experiments with whole plants

Significance of Plant secondary metabolites- Terpenoids, Phenolics (Tannins, Flavonoids) & Alkaloids - Isolation and Characterization.

Preparation of plant extracts-Solvents used. Methods for extraction- Maceration, Infusion, Percolation, Digestion, Decoction, Hot continuous extraction (Soxhlet), Ultrasound extraction (sonication).

Overview of different types of studies with plant extracts, Phytochemicals as antioxidants, Methods to assess in vitro Antioxidant activity- DPPH scavenging assay, FRAP assay.

UNIT V (12 Hours)

Spectroscopy – Principle, Instrumentation and applications of -ESR, NMR spectroscopy, X ray diffraction, Circular Dichroism and Mass Spectroscopy

Nanotechnology – Classification based on dimension & composition, Preparation using biological material (Green synthesis), Characterisation - SEM, TEM, Zeta potential. Biological applications – Drug & DNA delivery (Dendrimers, Liposomes).

RECOMMENDED TEXTBOOKS:

1. BioPhysical Chemistry Principles and Techniques – Upadhyay & Upadhyay Nath, Himalaya Publishing House. Reprint 2006
2. Scientific Thesis Writing and Paper Presentation - N. Gurumani, MJP Publishers. 2010

REFERENCE BOOKS:

1. Instrumental methods of Chemical Analysis- Chatwal&Anand, Himalaya Publishing House. Reprint 2005.

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- Principles and techniques of practical Biochemistry – Keith Wilson and John Walker , 7th Edition, Cambridge University Press,2004.
- Nanotechnology in Medicine (Nanotechnology in Life sciences)-Vishnu KirthiArivarasan (Editor), KarthikLoganathan (Editor), PushpamalarJanarthanan (Editor)Springer, 2021
- Essentials of Botanical Extractions:principles and Applications -Subash C. Mandal, Vivekananda Mandal, Anup Kumar Das, Academic Press ,2015.
- Title Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications- R. Ian Freshney,, John Wiley & Blackwell, 6th Edition , 2011.

JOURNALS:

- International Journal of Science and Research Methodology
- Open Life Sciences
- Journal of Life Sciences Research
- Indian Journal of Medical Biochemistry
- Journal of Ethnopharmacology

E-LEARNING RESOURCES:

- https://www.ideo.columbia.edu/~martins/sen_sem/thesis_org.html
- <https://www.snc.edu/chemicalhygiene/docs/labsafety/SolutionPrep.pdf>
- <http://biochem.du.ac.in/web/uploads/ Guidelines for Animal Facility.pdf>
- <https://link.springer.com/content/pdf/Nanotechnology in Life Sciences>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7398001/>
- <https://www.intechopen.com/books/plant-extracts/introductory-chapter-plant-extracts>

COURSE OUTCOMES:

CO . NO	CO STATEMENT	KNOWLEDGE LEVEL
CO 1	Sufficient knowledge to apply for research funding, fellowship and grants and write thesis.	K1,K2
CO 2	Trained in calculations for reagent preparation, and planning for invitro experiments	K2, K3
CO3	Gaining knowledge about Maintaining animals for research, Stages of drug development and clinical trials and ethics inv	K3,K4
CO4	Learn the methods of extraction from plants, and invitro antioxidant assays	K3, K4
CO5	Acquire knowledge of principle instrumentation and applications of Advanced spectroscopic techniques	K4,K5



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RESEARCH METHODOLOGY

TOTAL HOURS: 45
CREDITS: 3

COURSE CODE: 16SP21/2E3/RMY
LTP: 3 1 0

COURSE OBJECTIVES:

1. Designing a study and learning bioethics.
2. Applying advance techniques.
3. Exploring research and identifying steps involved.
4. Learn the Art of report and thesis writing.
5. Provide insights on importance of scientific communication, ethical issues in research, plagiarism and IPR.

COURSE OUTLINE:

UNIT I

9 Hours

Research methodology, research approach. Definition, sampling design and types. Fundamentals of bioethics. Committee on Publication ethics. Ethical issues related to publishing, Data fudging, plagiarism and self-plagiarism, software to detect plagiarism. Data collection and analysis pertaining to ICMR standards.

UNIT II

8 Hours

Basic concepts of Journals and Publication of Research or Review papers. Criterion for best journals- ISSN, ISBN, Citation Index - Science Citation Index (SCI), Impact factor (SJIF and RJIF), SJR indicator, h-index, g-index, Citescore.WOS, SCOPUS THOMPSON REUTERS, Google Scholar, UGC CARE journals.

UNIT III

9 Hours

Objectives of research- problem identification and formulation, Approaches, design-exploratory descriptive and experimental, steps and criteria of good research.

UNIT IV

9 Hours

Writing the Research report-Title, Authors, Address, Abstract, Keywords, Introduction, Review of Literature, Materials and Methods, Results, Discussion, Summary, Acknowledgement and Bibliography. Research report- Tables, Figures and Formatting.

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Difference between Dissertation writing and Journal writing. Importance of scientific communication- Types and modes of Scientific communications.

UNIT V

10 Hours

Journals in Microbiology, impact factor of journals, when and where to publish. Intellectual property rights-types, patents, copy rights, trade marks, design rights, geographical indications - importance of IPR - patentable and non patentables - patenting life - legal protection of inventions - world intellectual property organization (WIPO). IPR in India and abroad.

RECOMMENDED TEXT BOOKS:

1. N. Gurumani. (2006). Research Methodology for Biological Sciences, 1st edn., MJP Publisher.
2. Boyer R.F. (2002). Modern Experimental Biochemistry 3rd edn., Pearson Education.
3. Sharma, K.R. (2002). Research methodology, 1st edn., National Publishing House.

REFERENCE BOOKS:

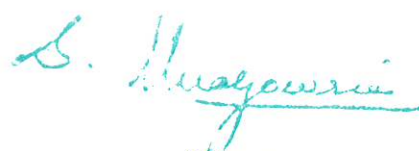
1. Anderson J.B. and Poole M. (2011). Assignment and Thesis Writing, 4th edn., Wiley India Private Limited.
2. Kothari C.R. and Garg G. (2004). Research Methodology: Methods and Techniques, 2nd edn., New Age International Publishers.
3. Ahuja V.K. (2017). Laws Relating to Intellectual Property Rights, 2nd edn., Lexis Nexis.
4. Goel D. and Parashar S. (2013). IPR, Biosafety and Bioethics, 1st edn., Pearson Education in South Asia.
5. Day, R.A. (1988). How to write and publish a scientific paper, 3rd edn., Oryx Press.

JOURNALS:

1. Journal of Biomedical Instrumentation and Applications.
2. Indian Journal of Applied Research.

E-LEARNING RESOURCES:

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5206469/>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2757927/>
3. <https://www.aresearchguide.com/write-a-report.html>
4. <https://www.wipo.int/about-ip/en/>


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