Semester - III

Course Title	Research Methodology
Total hrs	75
Hrs/Week	5
Sub. Code	**21PCCH33**
Course Type	DSC-IX
Credits	4
Marks	100

General Objective:

To apply the knowledge of the fundamentals of research, the processes of citation, referencing and intellectual property rights

Course Objectives:

CO No.	The learners will be able to
CO - 1	Understand the fundamentals of research, sampling and ethics.
CO - 2	Acquire the skill of writing research papers.
CO - 3	Outline the processes of citation and referencing.
CO - 4	Analyze different methods of factor analysis.
CO - 5	Explain the intellectual property rights.

UNIT: I RESEARCH FUNDAMENTALS

Objective - Criteria for good research - Choosing a research problem - Selecting, Defining - Literature survey - Primary and Secondary – Working - Experimental design Sampling, Types - problems faced - Measurement- Scaling, Tests, Techniques- Research ethics - Plagiarism - Complete Plagiarism, Source-based Plagiarism, Direct Plagiarism, Self or Auto Plagiarism, Paraphrasing plagiarism, Inaccurate Authorship, Mosaic Plagiarism, Accidental Plagiarism, Plagiarism software.

UNIT: II RESEARCH WRITING AND PRESENTATION

Report writing - Types of research reports - Research paper, Short communication, Chapters in book, Review and Conference report, Project report- Research writing tools - Toggl, Phrase bank, Zotero, Trello.

Oral presentation - Power point slide preparation, Poster preparation - Writing research paper - Title, Abstract, Key words, Introduction, Methodology, Results and Discussion, Acknowledgement, Statement of conflict of interest, Cover letter, Referencing- Bibliography - Online submission of manuscripts to journals.

Pictorial tools - Mind map, Plotvar, online chart tool, Rapid tables, Chemdraw, Chemsketch.

UNIT: III DATABASE

Literature database - Scifinder, STN and Raxys - Crystallographic database - Protein databank, Cambridge Structural database - Spectral databases - NIST web book, Spectral Data Base System (SDBS), KnowItAll, Chemspider - Reactions database - chemistry. Stack exchange, Organic Synthesis, Inorganic Synthesis - Thermophysical database - NIST, Dortmund Data Bank (DDB) - Conformational database - Frog, click2drug, OMEGA, MS-DOCK - Substructure database - Molsoft, Molcart, Giga Search.

UNIT: IV STATISTICAL TOOLS

Classification of errors - Accuracy – Precision - Minimization of errors - Reliability of results - Q-test, Student's T-test, F-test, Chi-square test - Correlation coefficient - Regression - Random samples - Sampling Distribution - Confidence Intervals - T-Distribution - ANOVA in excel - Wilcoxon Signed-Rank Test - Single and Paired data - Linear Least square Analysis - ToolPak regression tool - Plotting graph for least square fit - Multiple linear regression – Origin - Data analysis, curve and surface fitting, peak analysis, statistics - Impact factor - h-index - i_{10} index.

UNIT: V IPR

Introduction - Types - Need - Protection - Copyrights, Trademarks, Designs, Utility Models, Trade Secrets, Geographical Indications - Patent and Non-patentable inventions - Patent application process - Writing document - Drafting - Filing - Legal requirements - Patent Agent - Qualification, Registration procedure - Patent offices in India - Patent databases.

REFERENCES:

1. Handbook of Research Methodology, A Compendium for Scholars and Researchers, Dr. Shanti Bhushan Mishra Dr. Shashi Alok, Educreation Publishing, 2011.
2. Research Methodology, Methods and Techniques, C. R. Kothari, 2nd Revised edition, New Age International Publishers, 1990.
3. Research Methodology, a step-by-step guide for beginners, Ranjit Kumar, 3rd edition, Sage Publications, 2011.
4. J. Anderson, B.H. Durstan and M. Poole, Thesis and assignment writing, Wiley Eastern, New Delhi, 1977.
5. R.O. Butlet, Preparing thesis and other manuscript.
6. Rajammal P. Devadas, A Handbook of Methodology of Research, S.R.K. Vidyalaya Press, Chennai, 1976.
7. Physical Methods for Chemists, Russell S. Drago, 2nd edition, Scientific Publishers, 1992.
8. Cyber Crime Law and Practice, CS Mamta Binani, The Institute of Company Secretaries of India, 2016.
9. Intellectual Property Law in India, Nishith Desai, Nishith Desai Associates Legal and Tax Counseling, 2015.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Understand the ethics of research.	3, 4, 5	Understanding
CO-2	Develop presentation and writing skills.	3, 4, 5	Applying
CO-3	Analyze the process of referencing.	3, 4, 5	Analyzing
CO-4	Interpret the statistical analysis of samples.	1, 3, 5	Evaluating
CO-5	Elaborate the process of patenting.	1, 2, 3, 5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
III	21PCCH33	Research Methodology	75	4

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1			✓	✓	✓			✓	✓	✓
CO-2			✓	✓	✓			✓	✓	✓
CO-3			✓	✓	✓			✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓		✓		✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓		✓

	Number of matches (✓) = 35
	Relationship = High