SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

Affiliated to

UNIVERSITY OF MUMBAI

Syllabi for the Common Courses

Based on the National Education Policy 2020

Skill Enhancement Course

Course Code: SSEC

S.Y.B.Sc.

2024-25 (NEP)

Programme Outline: Skill Enhancement Course
SYBSc (SEMESTER IV)

Course Code	Name of the Course	Credits
SSEC401	Analytical Techniques for Quality Assessment	2
SSEC402	Interactive Biotechnology and Molecular Biology Techniques	2
SSEC403	Mathematical Models	2
SSEC404	Basic Instrumental Techniques	2
SSEC405	Science Communication	2

ASSESSMENT DETAILS:

Continuous Assessment (50 marks)

1. A minimum of two activities will be given in each semester.
2. Each will be for 20 marks.
3. The nature of the activities will be decided by the Examiner
4. 10 marks will be given for Class participation.

NAME OF THE COURSE	**ANALYTICAL TECHNIQUES FOR QUALITY ASSESSMENT**
CLASS	SYBSc
COURSE CODE	**SSEC401**
NUMBER OF CREDITS	2
NUMBER OF HOURS PER WEEK	4
TOTAL NUMBER OF HOURS PER SEMESTER	60
EVALUATION METHOD TOTAL MARKS PASSING MARKS	CONTINUOUS ASSESSMENT 50 20

COURSE OBJECTIVES:

CO 1.	To know the fundamental concepts of safe laboratory practices.
CO 2.	To learn the techniques of preparing standard solutions and operation of analytical instruments.
CO 3.	To understand the basic principles involved in quantitative and qualitative analysis.
CO 4.	To get exposed to analysis of commercial samples for purity assessment.

COURSE LEARNING OUTCOME:

Learner will be able to

CLO 1.	To decide the most suitable method and perform it by following all safety protocols for a given sample.
CLO 2.	Frame an outline/ flowsheet of experimental set up.
CLO 3.	Operate various instruments for getting qualitative and quantitative information.
CLO 4.	Investigate the experimental findings and express the results in a meaningful manner.

Unit	Description of experiments
I	**Classical Methods:** 1. Estimation of acetic acid content in vinegar sample by acid-base titration using the double burette method. 2. Determination of vitamin C in tablet by redox titration using DCPIP. 3. Determination of aspirin in a tablet by acid-base titration using drop method.
	Colorimetry: (Any three) 1. Determination of λmax of acidified $KMnO_4$ solution. 2. Verification of Beer-Lambert law using acidified $KMnO_4$ solution. 3. Verification of Beer-Lambert law using simulation (dry experiment). 4. Determination of folic acid in a tablet sample by colorimetry.
	Polarimetry: 1. Determination of sucrose in branded sugar/ saline sample by polarimetry. 2. Identification of given carbohydrate samples by polarimetry.
	Project: Students will work on a given project topic and submit a report as one of the CA components.

References:

1. A textbook of quantitative chemical analysis, Athur I. Vogel, Longman, 3rd edition

NAME OF THE COURSE	**INTERACTIVE BIOTECHNOLOGY AND MOLECULAR BIOLOGY TECHNIQUES**
CLASS	SYBSc
COURSE CODE	**SSEC402**
NUMBER OF CREDITS	2
NUMBER OF LECTURES PER WEEK	4
TOTAL NUMBER OF LECTURES PER SEMESTER	60
EVALUATION METHOD	CONTINUOUS ASSESSMENT
TOTAL MARKS	50
PASSING MARKS	20

COURSE OBJECTIVES:

CO1	To determine enzyme activity and specific activity and understand their importance in biochemical processes.
CO2	To investigate the effects of inhibitors on enzyme kinetics, focusing on Km and Vmax.
CO3	To apply agarose and non-denaturing PAGE for the separation and analysis of proteins or biomolecules.
CO4	To design and understand basic gene cloning strategies and recombinant DNA techniques.
CO5	To study sugar fermentation under varying conditions and measure CO2 production as an indicator.
CO6	To complete survey-based projects, enhancing scientific analysis, reporting, and critical thinking skills.

COURSE LEARNING OUTCOMES:

CLO1	determine and calculate enzyme activity and specific activity, interpreting kinetic data.
CLO2	explain the impact of inhibitors on enzyme kinetics and calculate Km and Vmax values.
CLO3	perform agarose and PAGE techniques, analyzing protein separation and electrophoresis results.
CLO4	understand and propose basic gene cloning strategies and recombinant DNA manipulation.
CLO5	measure and compare fermentation rates under different conditions, explaining key factors.
CLO6	conduct and complete a survey-based research project, analyzing and presenting data professionally

Practical of SSEC (SSE204)

1. Determination of-i) enzyme activity ii) specific activity.
2. Effect of inhibitors on Km of amylase/any other convenient enzyme.
3. Agarose gel electrophoresis of the extracted amylase or serum
4. Non- denaturing PolyAcrylamide Gel Electrophoresis of E.coli extract /Serum proteins/Saliva /Egg white or any other suitable sample
5. Gene Cloning strategy (Craft)
6. Sugar Fermentation rate in presence of different substrate /pH /temperature measure accumulated CO2 with under different conditions. (Demonstration / group experiment)
7. Analysis and submission of survey-based projects (in continuity of Sem III project proposals)

REFERENCES:

1. Molecular Techniques in Biochemistry and Biotechnology by S Shrivastava, New central book Agency (P)Ltd, 2006
2. Principles of Biochemistry by Nelson and Cox (Lehninger) — Chapter on Enzymes.
3. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis by Robert A. Copeland.
4. Michaelis-Menten kinetics articles from the Journal of Biological Chemistry.
5. Lab protocols from Current Protocols in Molecular Biology or Nature Protocols.

6. Molecular Cloning: A Laboratory Manual by Sambrook and Russell — Standard reference for electrophoresis protocols.
7. Principles and Techniques of Biochemistry and Molecular Biology by Wilson and Walker.

8. The Proteomics Protocols Handbook edited by John M. Walker — Covers native PAGE techniques.
9. Current Protocols in Protein Science — Detailed practicals for protein electrophoresis.
10. Practical Biochemistry (Principles and Techniques) by Keith Wilson and John Walker.

11. Gene Cloning and DNA Analysis: An Introduction by T.A. Brown — Great overview of cloning strategies.
12. Molecular Biology of the Gene by Watson et al. — Detailed cloning and expression strategies.
13. AddGene and NEB websites for practical cloning protocols.

14. Microbiology: An Introduction by Tortora, Funke, and Case — Classic reference for microbial fermentation.
15. Brock Biology of Microorganisms by Madigan and Martinko — Detailed sections on bacterial metabolism and fermentation assays.
16. Open-source protocols from ASM (American Society for Microbiology) or JoVE.

NAME OF THE COURSE	**MATHEMATICAL MODELS**
CLASS	SYBSc
COURSE CODE	**SSEC403**
NUMBER OF CREDITS	2
NUMBER OF PRACTICAL HOURS PER WEEK	4
TOTAL NUMBER OF PRACTICAL HOURS PER SEMESTER	60
EVALUATION METHOD	CONTINUOUS ASSESSMENT
TOTAL MARKS	50
PASSING MARKS	20

COURSE OBJECTIVES:

CO 1.	To familiarize students with the fundamental concepts and frameworks of decision theory, including decision-making under certainty, risk, and uncertainty.
CO 2.	To equip students with tools and techniques for solving real-world decision-making problems using mathematical models.
CO 3.	To provide students with knowledge of payoff matrices, decision trees, and other decision analysis tools.
CO 4.	To introduce students to basic statistical concepts and techniques used in analyzing and interpreting data.

COURSE LEARNING OUTCOMES:

CLO 1.	The learner will be able to understand decision -making frameworks.
CLO 2.	The learner will be able to apply decision-making tools.
CLO 3.	The learner will be able to analyse real-world decision problems.
CLO 4.	The learner will be able to solve optimization problems.
CLO 5.	The learner will be able to develop problem-solving skills.

UNIT 1	DECISION THEORY
1.1	Decision making under uncertainty: Laplace criterion, Maximax (Minimin) criterion, Maximin (Minimax) criterion, Hurwitz criterion, Minimax Regret criterion.

1.2	Decision making under risk: Expected Monetary Value criterion, Expected Opportunity Loss criterion, EPPI, EVPI.
1.3	Decision tree analysis along with Posterior probabilities.
UNIT 2	STATISTICAL ANALYSIS USING SOFTWARE
2.1	Correlation Analysis
2.2	Simple linear Regression Analysis
2.3	Multiple linear Regression analysis

REFERENCES:

1. Schaum Series book in O.R. Richard Broson. 2nd edition Tata Mcgraw Hill Publishing Company Ltd.

2. Operations Research: Methods and Problems: Maurice Sasieni, Arthur Yaspan and Lawrence Friedman,(1959), John Wiley & Sons.

3. Mathematical Models in Operations Research : J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.

4. Principles of Operations Research with Applications to Management Decisions: Harvey M. Wagner, 2nd Edition, Prentice Hall of India Ltd.

5. Operations Research: S.D.Sharma.11th edition, KedarNath Ram Nath& Company.

6. Operations Research: H. A.Taha.6th edition, Prentice Hall of India.

7. Kantiswarup, P.K. Gupta, Manmohan : Operations Research, Twelth edition, Sultan Chand & sons

8. Bronson R. : Theory and problems of Operations research, First edition, Schaum's Outline series

9. Vora N. D. : Quantitative Techniques in Management, Third edition, McGraw Hill Companies.

10. Bannerjee B. : Operation Research Techniques for Management, First edition, Business Books.

NAME OF THE COURSE	**BASIC INSTRUMENTAL TECHNIQUES**
CLASS	SYBSC
COURSE CODE	**SSEC404**
NUMBER OF CREDITS	2
NUMBER OF LECTURES PER WEEK	4
TOTAL NUMBER OF LECTURES PER SEMESTER	60
EVALUATION METHOD	CONTINUOUS ASSESSMENT
TOTAL MARKS	50
PASSING MARKS	20

COURSE OBJECTIVES:

CO 1.	To understand the laws governing colorimeter and UV spectrophotometer
CO 2.	To prepare silver nanoparticles via chemical methods and characterize them
CO 3.	To learn techniques for separation of biomolecules and cells

COURSE LEARNING OUTCOMES:

CLO 1.	The learner will be able to determine the approximate density of the bacterial suspension using a colorimeter
CLO 2.	The learner will be able to develop skills to use a UV-visible spectrophotometer
CLO 3.	The learner will be able to synthesize and characterize silver nanoparticles
CLO 4.	The learner will be able to identify and analyze biomolecules using chromatography and electrophoretic techniques
CLO 5	The learner will be able to set up an experiment for separation of cells using density gradient centrifugation

UNIT 1	PRACTICAL (60 LECTURES)
1.1	Verification of Beer and Lambert's law using colorimeter.

1.2	Preparation of saline suspension of *E.coli*, adjusting the density using a colorimeter and correlation with the cell number.
1.3	Chemical synthesis of silver nanoparticles and confirmation using UV-visible spectro-photometer.
1.4	Separation of amino acids by paper chromatography
1.5	Separation of sugars by Thin layer chromatography
1.6	Separation of a mixture of cells using Density gradient centrifugation
1.7	Separation of DNA using Agarose gel Electrophoresis

REFERENCES:

1. Plummer, David T. (1998). An introduction to practical biochemistry, 3rd edn, *Tata McGraw Hill edition.*
2. Jayaraman. Laboratory manual in biochemistry. *New Age International Publishers.*
3. Willey, J.M., Sherwood, L.M., and Woolverton, C.J. (2008). Prescott, Harley and Klein's Microbiology, 7th edn. *New York, McGraw Hill International Edition.*
4. Madigan, M., Martinko, J., Bender, K., Buckley, D., and Stahl, D. (2015). Brock Biology of Microorganisms 14th edn. *Pearson.*
5. Wilson, Keith., and Walker, John. (2010). Principles and Techniques of Biochemistry and Molecular Biology, 7th edn. *Cambridge University Press.*
6. Boyer, Rodney. (2000). Modern Experimental Biochemistry, 3rd edn. *Benjamin Cummings*
7. Himedia kit protocol

NAME OF THE COURSE	**SCIENCE COMMUNICATION**
CLASS	SYBSc
COURSE CODE	**SSEC305**
NUMBER OF CREDITS	2
NUMBER OF LECTURES PER WEEK (1 Lecture is 120 minutes)	2
TOTAL NUMBER OF LECTURES PER SEMESTER	60
EVALUATION METHOD	CONTINUOUS ASSESSMENT
TOTAL MARKS	50
PASSING MARKS	20

COURSE OBJECTIVES:

CO 1.	To gain knowledge about the various elements of science communication
CO 2.	To apply the scientific writing skills while preparing various types of science communications
CO 3.	To implement and evaluate the important aspects of ethics in research publication

COURSE LEARNING OUTCOMES:

CLO 1.	The learner will be able to carry out exercises to understand different media of science communication
CLO 2.	The learner will be able to construct different types of manuscripts as per appropriate type of communication
CLO 3.	The learner will be able to apply the publication ethics in science writing

	All the topics will be covered by doing suitable activity-based exercises
1	Introduction to Philosophy of Science and basics of science communication
2	Scientific Writing - Research article: Structure and components of a research paper: preparation of manuscript for publication of research paper- title, authors and their affiliations, abstract, keywords and abbreviations, introduction, material and methods, results, discussion, conclusions, acknowledgement, bibliography; figures, tables and their legends
3	Scientific Writing - Review article: Structure and components of review paper, difference between research and review article
4	Various types of citation styles - in-text citations, bibliography
5	Computer application in scientific writing : Plotting of graphs, Statistical analysis of data. Internet and its application in research-Literature survey, online submission of manuscript for publication
6	Writing Popular science article - Importance of storytelling in science, structure of a popular science article, Books on Popular science - Origin of Species (Charles Darwin), Cosmos (Carl Sagan), Many Secrets of Mangroves (Katie Bagli), Wings Of Fire - An Autobiography (Dr. A.P.J. Abdul Kalam with Arun Tiwari), Science magazines - Vigyaan Pragati (CSIR-Hindi), Science Reporter (CSIR-English), Science ki Duniya (CSIR -Urdu), Down to Earth, Vigyan Patrika, Marathi Vidnyaan Parishad Patrika (Marathi)
7	Incorporating science into fiction: Books by authors such as Robin Cook (Coma), Michael Crichton (Jurassic Park)
8	Various communication media of science communication - Science Documentaries, Films, Writing review based on these media
9	Research Presentation - Oral presentation - strategies of effective oral presentation, making presentation slides by using suitable software
10	Research Presentation - Poster presentation - Structure of a poster, use of suitable software to design the poster
11	Ethics in science communication - Plagiarism, Conflict of interest, how to search and use open sources, plagiarism detection software
12	Research databases
13	Research Metrics

14	Role of responsible science communication - case studies of how science has impacted the society, Vigyan Prasar Activity - Updating the ZooBuzz Board with latest news from science world

REFERENCES:

1. Aliotta M. (2018). *Mastering Academic Writing in the Sciences: A Step-by-Step Guide.* CRC Press.
2. Day R.A. (1998). *How to Write and Publish a Scientific Paper*. (5th ed.). Oryx Press.
3. Day R.A. and Sakaduski N. (2011). Scientific English: A Guide for Scientists and Other Professionals. (3rd ed.). Greenwood.
4. Joubert M., Davis L. and Metcalfe, J. (2019). 'Storytelling: the soul of science communication'. JCOM 18 (05), E. https://doi.org/10.22323/2.18050501
5. Leydesdorff L. (2021). *Qualitative and Quantitative Analysis of Scientific and Scholarly Communication: Communication-Theoretical Perspectives on an Empirical Philosophy of Science.* Springer. eBook- Open Access (CC BY-SA) http://www.springer.com/series/13902
6. Psillos S. and Curd M. (2008). *The Routledge Companion to Philosophy of Science.* Routledge.
7. van Dam F., de Bakker L., Dijkstra A. M., Jensen E. (2020). *Science Communication An Introduction*. World Scientific Press. https://doi.org/10.1142/11541