SEMESTER IV

Research Specific Elective Courses

Name of the Programme: M. Sc Botany

Course Code: BOT-606

Title of the Course: Research Methodology, Techniques, and Instrumentation

No. of Credits: 4

Effective from AY: 2022-23

Prerequisites for the course:	Knowledge of computers, information technology, and biochemistry.	
Objective(s):	To impart training in literature survey, citations, scientific writing, experimental design, basic biostatistics, principles, and working of various instruments.	
Content:	1. **Literature survey**: Need for literature review; research reading and discriminative reading; bibliographic collection; literature citation; different system of citations, Journal abbreviations.	**3 hours**
	2. Computers and information technology in Research: Computer operating systems, search engines, e-journals, online publications, M.S. office, Webliography.	**3 hours**
	3. **Scientific Writing:** Basics and importance of scientific writing; clarity, language; scientific paper and proposal components, Title, Abstract, Introduction, Materials and Methods, Results and Discussion, Conclusion, References, Tables, and Illustrations; Research article, Review Paper, Book Chapter, Presentation, Scientific poster.	**3 hours**
	4. Use of Intellectual Property Rights to search IPR databaseas a tool for research, Patent databases: worldwide (Espacenet), country specific (Industrial property digital library, CIPO, SurflP), Non-Governmental databases, IPR in data management, Data Licensing and Ownership.	**4 hours**
	5. **Experimental Designs and Biostatistics:** Basic principles of experiment, Experimental unit, and sampling unit, Observation, Hypothesis, Experimental error, replicates, controls, randomization, null hypothesis; Population and sample, variables, data collection sampling methods, Significance, statistical test.	**4 hours**
	6. **Laboratory practices and safety in the laboratory**: Research Bioethics and Good Laboratory Practices, General safety measures, Chemical, Physical, and Biological hazards, spillage and waste disposal, disposal of radioactive waste, first aid, and Material Safety Datasheet (MSDS).	**2 hours**
	7. **pH and buffer solutions**: S.I. units; Molarity and Normality; Acids and bases; Hydrogen ion concentration and pH, Dissociation of acids and bases; Buffer solutions, reaction kinetics, and thermodynamics.	**4 hours**
	8. **Centrifugation Techniques**: Basic principles of sedimentation; Relative Centrifugal Force (R.C.F.) and gravitational (g) force,	

	Density gradient centrifugation; design and care of rotors, safety aspects in the use of centrifuges.	**3 hours**
	9. **Spectroscopic Techniques:** General principles; Radiation energy and atomic structure; Basic law of light absorption; Types of spectra and their biological usefulness. Principle, application, and instrumentation of UV-VIS spectrophotometry; I.R. (infra-red) spectrophotometry; Spectrofluorometry, Atomic absorption spectroscopy (A.A.S.) and flame photometry; Mass spectrometry.	**9 hours**
	10. **Chromatography Techniques**: General Principles, techniques, and applications: Materials for column chromatography, adsorption, partition, molecular sieving, ion exchange, and affinity chromatography. Factors influencing resolution. Column development – isocratic system and gradient solvent. Chromatogram reading, qualitative and quantitative determination of peaks.	**8 hours**
	11. **Electrophoresis Techniques**: General principles, Gel electrophoresis of nucleic acids and proteins, Native PAGE, Sodium Dodocyl Sulphate-Polyacrylamide Gel Electrophoresis (S.D.S.–PAGE), Isoelectric focusing and its application, 2D electrophoresis, Pulsed-field electrophoresis, Capillary electrophoresis, Blotting techniques: Detection, recovery, and estimation.	**7 hours**
	12. **Radiobiology**: The nature of radioactivity; Atomic structure, stability, and radiation; Isotopes; Types of radioactive decay; Detection and measurement of radioactivity; Applications of radioisotopes in biological sciences; Safety aspects for the use of radioisotopes. Non-radioactive labelling.	**2 hours**
	13. **Molecular techniques**: Flow Cytometry, Immuno-techniques, Fluorescence Resonance Energy Transfer (FRET), Fluorescence Recovery After Photobleaching (FRAP), Yeast hybrid assay, Immunoprecipitation assay, Surface Plasmon Resonance, Proximity labelling, Electrophoretic Mobility Shift Assay (EMSA), Footprinting, Protein Crystallography, Microarray analysis, Site-Directed Mutagenesis, Biosensors, Clustered Regularly Interspaced Short Palindromic Sequence/CRIPSR Associated Genes (CRISPR/Cas).	**8 hours**
Pedagogy:	Lecture/e-learning/Assignments/Seminars/Moodle.	
References/ Readings:	**Bailey P.L.** (1980). Analysis and ion selective electrodes 2nd Ed. Heyden, London. **Bates R.G.** (1973). Determination of pH: Theory and Practices, 2nd Ed. John Wiley, New York. **Bauman R.P.** (1981). Absorption Spectroscopy. John Wiley, New York **Becker R.S.** (1969). Theory and interpretation of fluorescence and phosphorescence, Wiley Interscience, New York.	

Bell R. J. (1973). Introductory Fourier Transform spectroscopy. Academic Press, New York.
Brech F. (1974). Analysis in instrumentation. Vol. 6. Plenum, New York.
Colthup N.B., Daly L.H. and Wiberley S.E. (1975). Introduction to Infra-red and Raman Spectroscopy 2nd Ed. Academic Press. New York.
Day, R.A. and Gastel, B. (2016). How to write and publish a scientific paper, Cambridge University Press.
Dean J. and Raina T. (1969). Flame emission and atomic absorption. Dekker, New York.
Dixon R.N. (1965). Spectroscopy and Structure. Mathuen, London
Giddings J.C. (2002). Principles and Theory, Dynamics of Chromatography Part I Dekker, New York.
Grob R.L. (2004). Modern Practices of Gas Chromatography. 2nd Ed. John Wiley, New York.
Guilbault G.G. (Ed.) (2020). Practical Fluorescence. CRC Press.
Gurumani N. (2006). Research methodology for biological sciences. M.J.P. Publishers, Chennai.
Gurumani N. (2005). An Introduction to Biostatistics, M.J.P. Publishers, Chennai.
Hames B.D. and Rickwood D. (1998). Gel electrophoresis of Proteins: A practical approach 2nd ed. IRL Press, Oxford.
Hofmann A. and Clokie S. (2018). Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press.
Jacob R., **Alexander D. Lane L.** (2018). A guidebook to Intellectual property:Patent, trademarks, copyrights and design. Sweet and Maxwell ltd, UK.
Karp, G. (2009). Cell and molecular biology: Concepts and experiments, 7th edition. John Wiley and Sons, U.S.A.
Kolthoff I.M. and Elving P. J. (1978). Treatise on analytical Chemistry, Wiley Interscience, New York.
Myneni S.R. (2019). Patent Drafting and Specification Writing. New Era Law Publication, Hariyana.
Pesez M and Bartos J. (1974). Colorimetric and Fluorometric Analysis of Organic Compounds and drugs, Dekker, New York.
Reece, R. J. (2004). Analysis of genes and genomes. John Wiley and Sons Ltd.
Sacks R.D. (1981). Emission Spectroscopy. John Wiley, New York.
Saraswathy, N. and Ramalingam, P. (2011). Concepts and Techniques in Genomics and Proteomics. Biohealthcare Publishing (Oxford) Limited, New York.
Sharma, B.K. (2006). Principal of analytical chemistry, Meerut Publication, Meerut.
Simpson C.F. (1979). Techniques in liquid chromatography, Wiley-Heyden, New York. Horvath C. HPLC Vol. I Academic Orlando.

	F.L. Fritz J.S., Gjerde D.T. and Pohlandt C. Ion chromatography, A. Huthig, Heidelberg **Walker, J. M., and Rapley, R.** (2008). Molecular Biomethods Handbook, Hertfordshire, U.K. **Watson I.N.** (1976). Introduction to Mass spectroscopy, Raven, New York. **Willard H.F., Merritt L.L., Dean, J.A. and Settle F.A.** (1988). Instrumental Method of analysis. C.B.S. Publishers and distribution, New Delhi **Williams D.R. and Mowthorpe D. J.** (1976). Nuclear Magnetic Resonance Spectroscopy. John Wiley, New York. **Yau W. W., Kirkland J.J. and Bly D.D.** (2009). Modern size exclusion chromatography, Wiley Interscience, New York.	
Learning Outcomes:	1. Will enable a better understanding of the primary research methodologies, instrumentation, and designs. 2. Will enable to gain comprehensive knowledge of proper scientific measuring and scaling approaches along with the theory of computational tools. 3. Will enable better analysis and interpret qualitative and quantitative data. 4. Will enable the investigation of specific biological questions. 5. Will enable to conceive knowledge about scientific writing and presentation of credible scientific reports.	

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