Semester III

Research Specific Elective Courses (RSE)

Title of the Course: Research Methodology and Advanced Biostatistics

Course Code: MIC-600

Number of Credits: 4

Contact hours: 60

Effective from Academic Year: 2022-2023

Prerequisites	Student should have knowledge about microbiology and bassic biostatistics.	
Objective:	● To understand the basic concepts and methodologies involved in research. ● To develop the understanding of various advanced biostatistical tools involved in data analysis and interpretation.	
Content:		
1	**Introduction to research methodology**	**(20)**
1.1	Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research	
1.2	Defining the problem, setting of working hypothesis, Defining the Aims and Objectives, Literature survey: sources of literature, gathering of literature, understanding the flow for literature review, identification of gap areas, Databases and Research Metrics: Indexing databases, citation databases, Web of Sciences, Scopus, Pubmed, *etc*, Impact factor of journals, Citation of bibliography, Work Plan – Time-bound Frame, GANTT chart, technical writing: Research manuscript writing, thesis writing	
1.3	Establishment of ethics in science and research; examples of unethical work done in past, Ethical use of animal subjects, human subjects, Stem cell ethics, plant use and transgenic crops	
1.4	Plagiarism in research: Scientific misconduct, Falsification, fabrication, misinterpretation of data. Anti-plagiarism tools like Ouriginal / iThenticate / Turnitin and other open source software tools	
1.5	Hazards: Types of Hazards: radioactive, chemical and biohazard, waste management and disposal. Safety in laboratory: first-aid, fire safety, biosafety in laboratory, Good Laboratory Practices	
2	**Advanced biostatistics**	**(40)**
2.1	**Curve fitting**- fitting of a second degree parabola, power curve, exponential curve	
2.2	**Multiple Regression Analysis**- Two-variable linear model, significance test for parameter estimates, goodness of fit, three variable linear model, coefficient and adjusted coefficient of multiple determination, test of overall significance of regression (F test), correlation coefficient- partial, zero order, first order, second order, Multiple correlation, generalized linear model, matrix	

	approach for analysis, Regression analysis for qualitative variable/s and role of dummy variable	
2.3	**Non-parametric tests** – Concept of non-parametric test, advantages, disadvantages, sign test for one sample and two samples, Wilcoxon signed rank test, Median test, Run test, Mann-Whitney 'U' test, Kruskal-Wallis 'H' test	
2.4	**ANOVA-Two way classification** with one observation and multiple observations per cell- concept, procedure and examples	
2.5	**Designs of experiment**- Use and reasons for Design of experiments, definitions, concepts and terminology, Principles of experimental designs – replication, randomization and controls, Completely randomized design (CRD), Randomized complete block design (RCBD), Repeated measures design (RMD) – Single factor repeated measure design (SFRMD), handling of missing observations in RCBD, Latin square design (LSD), 2^2 Factorial experiments, Yates' Method, Confounding in factorial design, partial confounding, advantages and disadvantages	
Pedagogy:	Lectures/tutorials/assignments/self-study	
References/ Readings	Alley, M, The Craft of Scientific Writing, Springer Science and Business Media. (1996)	
(Latest edition)	Biological Safety Cabinets And Other Primary Containment Devices, Laboratory safety manual, WHO, (2020)	
	Biosafety in Microbiological and Biomedical Laboratories, U.S. Department of Health and Human Services, (2020)	
	Cochran, WG and Snedecor, GW Statistical Methods. Iowa State University Press. (1989)	
	Cooray P.G. Guide to Scientific and Technical Writing, Hindagala. (1992)	
	Day R.A. How to write and publish a scientific paper, Part 274, Volume 994, Oryx Press. (1998)	
	Good C V, Scates, DE, Methods of Research, Appleton-Century-Crofts. (1954).	
	Haaland, P.D., *Experimental design in biotechnology*. CRC press. (2020)	
	Indian Statistical Institute (https://www.isical.ac.in/)	
	Kothari CR, Research Methodology Methods and Techniques, New Age International (2015)	
	Kumar, RC, Research Methodology. APH Publ Corporation, New Delhi.(2008)	
	Mourya, DT, Yadav, PD, Majumdar, TD, Chauhan, DS and Katoch, VM, Establishment of Biosafety Level-3 (BSL-3) laboratory: Important criteria to consider while designing, constructing, commissioning & operating the facility in Indian setting. *The Indian Journal of Medical Research*, *140*(2), p.171. (2014)	
	Rao, KS, Biostatistics for Health and Life sciences, Himalaya Publishing House. (2017)	
	Rao, PSSS & Richard, J, An introduction to biostatistics - A manual for	

	students in health sciences, Prentice-Hall of India pvt. Ltd., New Delhi (2004)	
Course Outcomes	- Sketch the procedures and methodologies for performing a research experiment. - Predict the required experimental designs. - Analyze the experimental data using various biostatistical tools. - Create a scientific report/ manuscript/ thesis.	