

## Semester IV

**(Paper 13) SCRM.2.4.1 Elective I (60 h)**

**(Paper 14) SCRM.2.4.2 Elective II (60 h)**

**(Practical 16) SCRM 2.4.P.1 Major Project**

**Elective Papers (Choose any two papers)**

### **1. Research Methodology**

**(60 hrs)**

#### **Unit I. Introduction of Research (15 hrs)**

Introduction , Meaning of Research, Objectives of Research, Significance of Research, Motivation in Research, Research Approaches, Qualitative vs Quantitative Research, Research Method versus Research Methodology, Scientific Method, The Descriptive Method, The Analytic Method , The Historical Method , The Experimental Method , The Quasi-experimental Method .

#### **Unit II. Research problem and Hypothesis (15 hrs)**

Research Process, Research Problem, Selecting the Problem, Criteria for Research Problems, Technique Involved in Defining a Problem, Research Hypotheses, Formulating Hypotheses , The Hypotheses Variables, Dependent and Independent variables, Alternate versus Null Hypothesis, Choosing a mentor, lab and research question; maintaining a lab notebook.

#### **Unit III. Process of communication (15 hrs)**

Concept of effective communication- setting clear goals for communication; determining outcomes and results; initiating communication; avoiding breakdowns while communicating; creating value in conversation; barriers to effective communication; non-verbal communication- interpreting non-verbal cues; importance of body language, power of effective listening; recognizing cultural differences; Presentation skills – formal presentation skills; preparing and presenting using over-head projector, PowerPoint; defending interrogation; scientific poster preparation & presentation; participating in group discussions; Computing skills for scientific research - web browsing for information search; search engines and their mechanism of searching; hidden Web and its importance in scientific research; internet as a medium of interaction between scientists; effective email strategy using the right tone and conciseness.

#### **Unit IV. Scientific communication (15 hrs)**

Technical writing skills - types of reports; layout of a formal report; scientific writing skills - importance of communicating science; problems while writing a scientific document; plagiarism, software for plagiarism; scientific publication writing: elements of a scientific paper including abstract, introduction, materials & methods, results, discussion, references; drafting titles and framing abstracts; publishing scientific papers - peer review process and problems, recent developments such as open access and nonblind review; plagiarism; characteristics of effective technical communication; scientific presentations; ethical issues; scientific misconduct.

### **3. Entrepreneurship and management (60 h)**

#### **Unit I. Introduction (15 h)**

Meaning – nature and characteristics of Management, Scope and Functional areas of management. Management V/s Administration – Roles of Management, Levels of Management. Evolution of management thought: early, contemporary and modern.

#### **Unit II. Nature and purpose of planning and Organization (15 h)**

Types of plans .Decision making. Importance of planning – steps in planning & planning premises.Hierarchy of plans.Components of planning.Principles of organization, Types of organization.DepartmentationCommittees.CentralizationVs Decentralization of authority and responsibility. Nature and importance of staffing–Process of Recruitment and Selection.

#### **Unit III. Meaning and nature of directing (15 h)**

Understanding, Supervision, motivation and leadership. Leadership styles, Motivation Theories (Abraham Maslo, Herzberg and Victor Hvrom's). Communication – Meaning and importance. Meaning and steps in controlling –Essentials of a sound control system –Methods of establishing control (in brief).

#### **Unit IV. Structure of a Biotechnology Company (15 h)**

Start-up of Biotechnology Company, New Product Development. Market Research. Sales &Marketing Principles. Intellectual Property Principles in Biotechnology. Health Care Overview and Role of Government in Biotechnology. Ethical and Other Legal Issues in Biotechnology

### **References**

1. P.C.Tripathi, P. N. Reddy - Principles of Management, 5th edition (2012), Tata McGraw Hill,
2. Vasant Desai – Dynamics of Entrepreneurial Development & Management, 4th edition (2001),Himalaya Publishing House.
3. Poornima M.Charantimath- Entrepreneurship Development Small Business Enterprises, 2nd edition (2006), Pearson Education..
4. Stephen Robbins-Management,17th Edition (2003),Pearson Education.

### **3. Nanobiotechnology (60 hrs)**

#### **Unit1 Introduction to nanobiotechnology (15 hrs)**

Introduction to Nanobiotechnology; Concepts, historical perspective; Different formats of nanomaterials and applications with example for specific cases; Cellular Nanostructures; Nanopores; Biomolecular motors; Bio-inspired Nanostructures, Synthesis and characterization of different nanomaterials.

#### **Unit II Nano Particles and Nano Films (15 hrs)**

Nanoparticles for drug delivery, concepts, optimization of nanoparticle properties for suitability of administration through various routes of delivery, advantages, strategies for cellular internalization and long circulation, strategies for enhanced permeation through various

anatomical barriers. Thin films; Colloidal nanostructures; Self Assembly, Nanovesicles; Nanospheres; Nanocapsules and their characterisation.

### **Unit III Applications of Nano Particles (15 hrs)**

Nanoparticles for diagnostics and imaging (theranostics); concepts of smart stimuli responsive nanoparticles, implications in cancer therapy, nanodevices for biosensor development. Nanomaterials for catalysis, development and characterization of nanobiocatalysts, application of nanoscaffolds in synthesis, applications of nanobiocatalysis in the production of drugs and drug intermediates.

### **Unit IV Nanotoxicity (15 hrs)**

Introduction to Safety of nanomaterials, Basics of nanotoxicity, Models and assays for Nanotoxicity assessment; Fate of nanomaterials in different stratas of environment; Ecotoxicity models and assays; Life cycle assessment, containment.

### **References:**

1. GeroDecher, Joseph B. Schlenoff, (2003); *Multilayer Thin Films: Sequential Assembly of Nanocomposite Materials*, Wiley-VCH Verlag GmbH & Co. KGaA
2. David S. Goodsell, (2004); *Bionanotechnology: Lessons from Nature*, Wiley-Liss
3. Neelina H. Malsch, *Biomedical Nanotechnology*, CRC Press
4. Greg T. Hermanson, (2013); *Bioconjugate Techniques*, (3rd Edition); Elsevier
5. Recent review papers in the area of Nanomedicine.
6. Meeting Educational Needs with “Course” Remodelled Biotech Curricula  
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Edited Dr. Suman Govil, Adviser, DBT Dr. Purnima Sharma, MD, BCIL

## **4. Enzymology and Enzyme Technology (60 h)**

### **Unit I. Introduction To Enzymes & Enzyme Kinetics (15h)**

The Enzyme, Introduction, nomenclature and classification, applications in Industrial, Medical, Analytical, Chemical, Pharmaceutical and Food Sectors, specific activity, turnover number, Enzyme kinetics, Michaelis - Menten equation, Brigg's-Haldane equation & estimation of constants using graphical technique, Kinetics for reversible reactions, basics of enzymatic reaction, collision theory and transition state theory and role of entropy in catalysis, Enzyme inhibition kinetics, substrate product and toxic substance inhibition.

### **Unit II. Pre-Steady-State Enzyme Kinetics: (15 h)**

Determination of rate constants, rapid mixing, stopped flow, determination of the number of active sites of enzyme and relaxation technique. Enzyme kinetics at limiting condition, enzyme kinetics at interface and kinetics of multi substrate reactions.

### **Unit III. Effect of Physical Factors & Enzyme Kinetics In Biphatic Reaction: (15 h)**

Temperature dependence of rate constants of enzymatic reaction, thermal deactivation, pH effect on rate constants and protein structure. pH dependence: ionization of Acids and Bases. Enzyme

kinetics in biphasic liquid systems, stabilization of biphasic aqueousorganic systems, equilibria in biphasic aqueous-organic systems.

#### **Unit IV. Enzyme Immobilization & Kinetics Of Immobilization: (15 h)**

Immobilization of Biocatalysts an Introduction, Electrostatic Effect, effect of charged and uncharged support, Effect of external and internal mass transfer, Damkohler number, effectiveness factor, Interparticles diffusion kinetics, Biot number.

22

#### **References**

1. C. Walsh-Enzymatic reaction mechanisms, (1979) WH Freeman, San Francisco.
2. I. Segel-Enzyme Kinetics, (1993)Wiley Interscience, NewYork.
3. An introduction to enzyme and coenzyme chemistry by T. Bugg 2nd edition (2004), Blackwell Publishers, Oxford.
4. A. Cornish-Bowden - Fundamentals of Enzyme Kinetics, 3rd Edition (2004), Portland Press, London.
5. Meeting Educational Needs with “Course” Remodelled Biotech Curricula  
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Government of IndiaCompiled and Coordinated Ms. Shreya Malik, DM, BCIL  
Edited Dr. Suman Govil, Adviser, DBT Dr. Purnima Sharma, MD, BCIL

### **5. Environmental Sciences and Biodiversity (60 h)**

#### **Unit 1. Environmental Pollution (15h)**

types of pollution methods for management of the pollution, Environmental management, waste water treatment, Solid waste management, degradation of xenobiotics in Environment, Bioremediation of xenobiotics and heavy metals, Ozone depletion, greenhouse effect and acid rains and their impact and biotechnological approaches of management. Use of microbes: Mineral beneficiation and oil recovery

#### **Unit 2. Ecosystem (15h)**

Definition, Principles and scope of ecology, Human ecology and Human settlement, Evolution, Origin of life and speciation. Ecosystem : Structure and functions, Abiotic and Biotic components, energy flows, Food Chains, Food web, Ecological pyramids. Ecological Succession, Population, Community ecology and Parasitism, Preypredator relationships. Common flora and fauna in India Aquatic : Phytoplankton, Zooplankton and Macrophytes

#### **Unit 3. Biodiversity (15h)**

Terrestrial : Forests Endangered and Threatened Species Biodiversity and its conservation : Definition, ‘Hotspots’ of Biodiversity, Strategies for Biodiversity conservation. National Parks and Sanctuaries. Gene pool. Microflora of Atmosphere : Air Sampling techniques, Identification of aeroallergens. Air-borne diseases and allergies. Environmental Biotechnology: Fermentation Technology, Vermiculture technology, Biofertilizer technology.

#### **Unit 4. Biodiversity Conservation (15h)**

Biodiversity conservation Act 2002, Wildlife parks, wildlife reserves, privately owned wildlife reserves & Biosphere reserves , Single species / single habitat based conservation programmes (e.g. Project tiger, Valley of flowers), International conventions on conservation, Important International conventions & treaties on nature & conservation India’s role & contribution

(including VISION 2040) Ex- situ & in-situ conservation, Conservation Breeding (e.g. Vulture, Pygmy hog, Gharial etc.)

**Reference:**

1. The primary readings will be from Fundamentals of Conservation Biology. Hunter M.L. and Gibbs J.P. Third Edition.
2. A Text Book of Environmental Science Vidya Thakur (2016) – 307.
3. **Biodiversity: Law, Policy and Governance** Usha Tandon, Mohan Parasaran, Sidharth Luthra · 2017

**6. Experimental Animal Techniques and Good Laboratory Practices (60 h)**  
**Unit I Laboratory Animals (15 h)**

Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals, Common lab animals: Description and applications of different species and strains of animals. Popular transgenic and mutant animals. Techniques for collection of blood and common routes of drug administration in laboratory animals, Techniques of blood collection and euthanasia.

**Unit II Selection of Animal Model (15 h)**

10 Hours Preclinical screening models a. Introduction: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study. b. Study of screening animal models for Diuretics, nootropics, anti-Parkinson's, antiasthmatics, Preclinical screening models: for CNS activity- analgesic, antipyretic, anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease 177

**Unit III Animal Experiments-1 (15 h)**

Preclinical screening models: for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaesthetics

**Unit IV. Animal Experiments-2 (15 h)**

Preclinical screening models: for CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslipidemic, anti aggregatory, coagulants, and anticoagulants Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics. Research methodology and Bio-statistics Selection of research topic, review of literature, research hypothesis and study design Pre-clinical data analysis and interpretations

**References**

1. Fundamentals of experimental Pharmacology-by M.N.Ghosh

2. Hand book of Experimental Pharmacology-S.K.Kulakarni
3. CPCSEA guidelines for laboratory animal facility.
4. Drug discovery and Evaluation by Vogel H.G.
5. Drug Screening Methods by Suresh Kumar Gupta and S. K. Gupta on using Students 't' test and One-way ANOVA. Graphical representation of data