

**SCHOOL OF BIOSCIENCES**

**M.Phil. Biosciences**

**Curriculum and Syllabus**



**MAHATMA GANDHI UNIVERSITY**

**KOTTAYAM, KERALA**

**M.Phil Biosciences**

**School of Biosciences, Mahatma Gandhi University**

**Priyadarshini Hills PO, Kottayam, Kerala**

**Curriculum and Syllabus**

## **ELIGIBILITY AND ADMISSION TO THE COURSE**

A candidate, who after having passed the Master of Science Examination in Biochemistry, Biotechnology, Microbiology or biophysics with a minimum of 55% from general category and 50% marks from SC/ST category, shall be eligible for admission to the first semester. College and university teacher who have acquired five years of teaching experience are eligible for an exemption of 5% marks in qualifying examination. Selection of candidates for admission will be on the basis of general merit in their post-graduation, entrance examination and interview, 50%, 40% & 10% respectively. Admission will be according to the guidelines from the University.

## **CURRICULUM**

The course shall consist of two Semesters and the study shall extend over a period of one academic year under CSS.

Objectives: The main objective of this course leading to the MPhil degree in Biosciences is to provide a broad and sound base for postgraduates in the life sciences for application of their knowledge towards bio-based business or research that support ecologically

sustainable development of the Nation. The general courses and research assignment in this interdisciplinary. MPhil degree programme of Biosciences stems from the need to train a professional figure who can combine the broad and deep knowledge of basic and advanced principles of biology with specific skills to successfully integrate into biotech companies, pharmaceutical companies and basic research labs within a broad dynamic and international working context.

### **SCHEME OF EXAMINATION**

Semester 1: There shall be four theory papers, the examination of which will be held at the end of the 1<sup>st</sup> semester in addition to the internal assessment which is 50%.

Internal assessment consists of Seminars of 45 minutes duration (12.5 marks), Internal Tests based on two papers (25 marks) and Assignments (12.5 marks). End semester examination consisting of a paper of 100 marks for each course.

For passing Semester 1, a candidate must secure not less than 40% marks in any individual paper/ practical/internal assessment, and not less than 50% marks in aggregate.

Semester 2: In the second semester there will be a project work & Viva-voce of 20 credits marks 100 marks for project work and 100 marks for Viva-voce.

Thesis: In partial fulfillment of the course each candidate shall submit a thesis of the project undertaken by him /her during the period of course.

Declaration of final results and award the degree will be made after the adjudication of the thesis.

### CORUSE STRUCTURE

Semester	Courses	Credits	Distribution of marks				
			Internal exam			End semester exam	Total
			Test 25	Assignment 12.5	Seminar 12.5		
Semester I	Research Methodology (SBSPDIC 1701)	04	50			50	100
	Biochemistry (SBS PDIC1702)	04	50			50	100
	Microbiology Immunology (SBSPDIC1703)	04	50			50	100
	Biotechnology (SBSPDIC 1704)	04	50			50	100
	Semester Total	16	200			200	400
Semester II	Project (SBSPDIIC 1705)	16	Nil			100	100
	Viva (SBSPDIIC 1706)	04	Nil			100	100
Grand Total		36	200			400	600

## **RESEARCH METHODOLOGY (SBSPDIC 1701)**

### **Unit I**

Sciences and Research goals of research, essential qualities of a researcher, methods of research, logical scientific methods, different types of inductive logical methods, method of causal connections, method of differences, method of concomitant variation, method of residues, method of agreement, joint method of agreement and difference. Other logical methods, method of description and classification, evolutionary methods. Various types of research, data and method of data collection.

### **Unit II**

Instrumentation – pH meter, centrifuge, Spectrophotometer, Microscope types- phase contrast, fluorescence, confocal, atomic force microscope.

Electron Microscope- SEM/TEM. Chromatography TLC, Gel filtration ion exchange, HPLC, LC-MS, FT IR GC-MS, NMR X-ray Crystallography. Electrophoretic methods, vertical /horizontal- isoelectric focusing, pulse field electrophoresis, ELISA Thermocycler, Hybridization, blotting techniques, microarray, DNA Sequencing technologies.

### **Unit-III**

Steps in doing research. Review of Literature, Primary and secondary sources, National institutions useful in search of literature- NISCAIR- Library resource- Journals/Periodicals, reviews – abstracts treatise monographs- searching of web resources- electronic data bases- critical review of literature, identification of research gaps- Defining or selection or identification of a research topic or problem, formulation of a hypothesis, significance of hypothesis, types of hypothesis, relevance and assumptions in research, developing of a research plan-execution of research works, exploration, description- diagnosis experimentation, meaning and nature of experimental research, treatments, variation and variables- simple populations, General laboratory etiquette, rules and regulations, safety measures.

### **Unit – IV**

Scientific writing and presentation of scientific data, research proposals, research reports dissertation or thesis- style or scientific writing, structure and language. Title rules, preparation of abstracts, introduction rules, rules of presenting materials and methods, rules for presenting results, concept of discussion, method of conclusion, concept of acknowledgement. Reference style, presentation of tables and figures. Matrix of rows and columns, representing variables, figures- visual

organization of data/observations- picture, pie-charts, bar charts, flow charts, organizational charts, cartogram charts, gantt charts. Scatter plot charts, symbols and legends, photographs and micrographs- peer review- editing the final drafts, manuscript- Submission, presentation tool, features and functions, creating presentation, customizing presentation, showing presentation, oral and poster presentation, Microsoft power point and pdf slides. Open office or similar tool. Bio-ethical issues, bio-safety, environmental impacts, ecological ethics, rights of future generations, issues of commercialization, intellectual property rights, problems related to trade of biological items, ethics in publications plagiarism.

## **Unit V**

Statistical applications in research- Introduction to statistics, probability theories, probability distributions, binomial poison and normal. Testing hypothesis, standard deviations- standard error- point and interval estimation, confidence levels, confidence limits, levels of significance, regression and correlations- parametric and non parametric statistics. Estimates of central tendencies, mean, median, mode and proportions, variations, variance, transforming of data- one sample test- two sample tests/ chi-square tests, associations of attributes, t-test, analysis of variance (ANOVA), one way ANOVA with equal number of

replicate s, two –way ANOVA, coefficient of variation, index number time series analysis, diagrammatic and graphical representations of statistical inferences.

Use of computer in Research- Introduction to computer fundamental, hardware, software, MS-Office, MS-Word, Excel, Power point, computer aided graphical application and data analysis, SPSS, M-stat.

Experimental design- Different types of design- completely randomized design, concept of blocking, randomized complete block design. Latin square design, important concepts related to selection of a design, sample design, sampling theory, sampling techniques, steps in sampling- random and non- random sampling, sampling errors, type I error and type II error, sample size, advantages and limitations of sampling, control observation, merits, demerits.

Evaluation of Research output – Quality assessment, commercial and social value, values as basic science contribution, methods for evaluation.



## **REFERENCES**

1. Panneerselvam R (2004)- Research Methodology, Prentice Hall of India, New Delhi.
2. Jerrord HZ (1999) Biostatistical analysis, Prentice Hall International London.

## **BIOCHEMISTRY (SBSPDIC 1702)**

### **Unit I**

Metabolic pathways and intermediary metabolism. Biosynthesis and degradation of carbohydrates, lipids, amino acids, proteins, nucleic acids. Regulation and interrelation of metabolic pathways. Biological oxidation, respiratory chain and control. Oxidative phosphorylation.

### **Unit II**

Enzymes: Unisubstrate and multisubstrate enzyme kinetics. Methods of examining enzyme-substrate complexes, Enzyme turn over and its significance, Allosteric enzymes- their kinetics and physiological significance. Isoenzymes and their significance. Mechanism of catalysis of serine proteases. Immobilized enzymes & their industrial uses. Enzyme regulation.

### **Unit III**

Reactive Oxygen species, lipid per-oxidation, Anti-oxidant cellular defenses, super oxide dismutase, catalase, glutathione peroxidase, glutathione reductase, reduced glutathione, vitamins A,E,C and selenium. Free radicals and ageing.

### **Unit IV**

Structure & conformation of proteins, Ramachandran Map. Structure –Conformation of nucleic acids, Watson & Hoogsteen base

pairing DNA polymorphism, DNA super coiling, protein- DNA interactions.

## **Unit V**

Ecotoxicology and its environmental significance. Determination of LC50, Acute and chronic exposures, Xenobiotic metabolism- phase I reactions (Oxidation, Reduction, Hydrolysis & Hydration). Phase II reactions/ conjugation: - Methylation, glutathione, glucuronic acid and amino acid conjugations. Pesticide toxicity- Toxicity of organochlorine, organophosphates and carbonates. Metal toxicity – toxicity of mercury, lead and Cadmium.

## **Reference**

1. Fundamentals of biochemistry- Voet & Voet
2. Biochemistry (UV ed) Geoffiry Zubay
3. Biochemistry- Lubert Stryer
4. Harper's Biochemistry- Murray et. al
5. Enzymology- Dixon M & Webb.
6. Fundamentals of Enzymology (lind. Ed.)- Nicholas C- Price & Leuis stervens.
7. Proteins- Structure and molecular principles – T.E. Creighton & W.H. Freeman.
8. Basic environmental toxicology- Lorris G. Corkepem & Barbara S

## **MICROIOLOGY AND IMMUNOLOGY (SBSPDIC 1703)**

### **Unit I**

Morphology and physiology of bacteria; ultra structure. Bacterial nutrition, cultivation of bacteria, culture media and methods. Identification of bacteria: staining reactions, cultural physiological and biochemical characters.

### **Unit II**

Bacterial taxonomy: species concept in bacteria, systems of classification. Recent approaches in classification, intraspecies typing. Fungi: properties and classification pathogenic fungi. Viruses, cultivation of viruses. Pathogenesis of viruses. General character of bacteria, chlamydiae, mycoplasma.

### **Unit III (a)**

Bacteriological examination of water, bacteriology of air, microorganism in soil and factors affecting them.

### **Unit III (b)**

Control of microorganisms basic principles and application of sterilization and disinfection, mechanism of action of antimicrobial agents, drug resistance in bacteria. Infection and immunity: sources of infection, method of transmission, factors predisposing to microbial

pathogenicity, innate and acquired immunity, immunization vaccines & antisera.

#### **Unit IV**

Antigens, antibodies, immunoglobulin classes, structure and functions, complements, antigen-antibody reactions. Organs and cells with immunological functions, cell mediated and antibody mediated immune responses. Tracer techniques in immunology- RIA, ELISA. Immuno fluorescence.

#### **Unit V**

Harmful effects of immunity: hypersensitivity, classification of hypersensitivity reactions, mechanism of tissue damage, autoimmunization mechanisms autoimmune diseases. Immunology of malignancy: tumor antigens, immune responses to tumor antigens, immunological surveillance, immunology of blood transfusion and organ transplantation.

## Reference

1. Microbiology- Concepts and application – Pelzar Jr \* & Chan  
Kreig. Mc. Graw Hill, Inc.
2. Medical Microbiology- Mackie and Mc Cartney- Churchill-  
Livingstone
3. Text book of Microbiology- Ananthanarayan and Jayram  
Panicker, Orient Longman
4. Microbiology- Prescott, Harley and Klein Wim C. Brown  
Publishers

## **BIOTECHNOLOGY (SBSPDIC 1704)**

### **Unit -1**

DNA Replication- Mechanism of DNA replication, DNA polymerases, Theta, Rolling circle, D. Loop replication.

Transcription – Mechanism of transcription, RNA polymerases, promoters, enhancers,

Transcription factors, post transcriptional modification

Translation- Mechanism of translation, post translational modification.

Protein trafficking Lysozyme targeting.

### **Unit II**

RNA based technologies: Ribozymes, Different types of natural ribozymes and their specific function- Application of ribozymes.

Anti-sense RNA: Natural anti sense RNA mechanisms, application of anti-sense RNA technology.

RNAi- SnRNA and micro RNA; History and their mode of regulatory mechanism, possible applications of RNAi

Telomeres; Structure and molecular function. Telomerase- structure function and significance. Nucleic acids as therapeutic agents.

### **Unit III**

Creation and application of transgenic plants and animals. Transgenic animals in clinical research. Methods and ethics of animal cloning and

gene therapy. Imparting new agronomic traits to plants- resistance to abiotic and biotic stress, improving quality and quantity.

Application of animal cell culture in clinical research.

#### **Unit IV**

Molecular markers- Features, methods and applications of proteins and DNA based molecular markers. Marker assisted selection in plant breeding, MAP based cloning and OTL mapping.

#### **Unit V**

Bioreactor- Designing instrumentation of bioreactors, types of bioreactors, control of bioreactors.

Oxygen transfer in bioreactor, volumetric oxygen transfer coefficient (KLa) Estimation of KLa static and dynamic methods.

Microbial growth kinetics- batch culture, specific growth rate, substrate saturation constant, yield coefficient, continuous culture, washing out, fed batch culture.



## Reference

1. Genes VII- Benjamin Lewin, Wiley international edition
2. Molecular biotechnology Glick and Pasternak
3. Principle of gene manipulation Old and primrose (6<sup>th</sup> & 7<sup>th</sup> edition)
4. Handbook of plant biotechnology Christou & Klee
5. From genes to genomes – Dale & Schantz
6. Molecular Biology of gene Watson et al
7. Principles of fermentation technology – Stanburg