Proposed Syllabus for

M. Phil. and Ph.D. (Biosciences) Course Work

CHOICE BASED CREDIT SYSTEM (CBCS)

w.e.f. June 2019

Department of Biosciences
Veer Narmad South Gujarat University, Surat

Programme Outcome (PO)

- **PO 1: Think Critically:** Get ability to apply the process of science by formulating hypotheses and design experiments based on the scientific method.
- **PO 2: Problem analysis:**Analyze and interpret results generated through studies in Master of Science, taxonomical treatments, field studies, excursion tours and laboratory techniques used in the subject. Identify credible scientific sources to interpret and evaluate the evidences.
- **PO 3: Reasoning ability**: Use quantitative reasoning by using mathematical calculations and graphing skills to solve problems in the field of science.
- **PO 4: Communication Skill:** Effective Communication and collaborate with other disciplines by effectively communicating the fundamental concepts of Biological Science in written and oral format.
- **PO 5: Ethical awareness:** Understand the relationship between science and society by recognizing and discussing logical, scientific and ethical issues in Biological science subject
- **PO 6: Digitally literate:**Capable of using computers for Bioinformatics and computation and appropriate software for analysis of genomics and proteomics data, and employing modern bioinformatics search tools to locate, retrieve, and evaluate location and biological annotation genes of different species.
- **PO 7: Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio- technological changes
- **PO 8: Global thinking:** Knowledgeable disciple students with good values, ethics, and kind heart will help in nation building globally.

Programme Specific Outcome: (PSOs)

PSO 1: to Demonstrate in-depth knowledge and understanding about the fundamental concepts, principles and processes underlying the academic field of Biosciences and its different subfields like Anatomy, physiology, histology of plants, animals and microbes as well as advanced aspect of life like biochemistry, genetics and molecular biology, biotechnology, genomics and proteomics, bioinformatics etc.

PSO 2: to utilize Procedural knowledge that creates different types of professionals in the field of Biosciences and its related fields.

PSO 3: Will acquire skill and cultivate knowledge about the complexity of life processes, their molecular, cellular and physiological processes, their genetics, evolution and behavior and their interrelationships with the environment.

PSO 4: Will get educated about the concepts, principles and theories related with biodiversity and their welfare.

PSO 5: Will be able to Design and conduct experiments to test a hypothesis independently or with team members and will be able to understand and interpret data to reach a conclusion.

PSO 6: Will accept the legal restrictions & ethical considerations placed for animal welfare.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						
PO7						
PO8						

M. Phil. and Ph.D. (Biosciences) Course Work
Outline and evaluation scheme

Subject Code	Subject Title	Credit	External Marks	Internal Marks	Total Marks
CW101	Research Methodology and Communication Skill	4	50	50	100
CW102	Recent Techniques, Biostatistics and Bioinformatics	4	50	50	100
CW103ZO	Advances in Zoology	4	50	50	100
CW103BO	Advances in Botany				
CW103MB	Advances in Microbiology				
CW103BT	Advances in Biotechnology				
Total	4 Subjects/course	12	150	150	300

Course Out Comes (COs)

CW101: Advances in Research Methodology

The course is design to train student for research activity and communication skill. At the end of the course student will be

- **CO 1**Able to understand the research problem and design and research work
- **CO 2**Able to write, prepare poster and present oral presentation
- **CO 3**Able to prepare CV and face the interview

Unit 1 Research methodology I

1.1 Basic Research Designing, Setting up Objectives of the Study and Hypotheses to be tested
1.2 Setting up Experimental Design and Experimental Protocol
1.3 Setting up detailed methodologies, sampling methods, Strategies for execution of the protocols
1.4 Designing protocol for statistical validation.

Unit 2 Research data collection and management

2.1 Scientific literature collection: Types of research literature, Sources
2.2 Documentation of collected literature, Reference Index, Database generation
2.3 Basics of Bibliographic Citations, Different Bibliographic styles; Recording and managing information, Research information system, Research Ethics and Plagiarisms
2.4 Computer and information technology in research, online tools and MOOCs etc.

Unit 3 Research Communication Skill

3.1 Professional English for life sciences
3.2 Writing a literature review and research paper, Writing an abstract, preparing table and figure,
3.3 Writing a Ph.D. thesis,
3.4 Delivering an effective Oral presentation and Poster preparation & scientific networking

Unit 4 Professional practices

4.1 IPR and Innovation,
4.2 Entrepreneurship: Lab to Land
4.3 GLP, NABL and Validation
4.4 Biosafety

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1						
CO 2						
CO 3						

CW102: Advances in Research Techniques

The course is design to impart knowledge regarding sophisticated instrumentation and advanced techniques. At the end of the course student will be

- **CO 1**Able to understand the principle and operating mechanism of various sophisticated instruments.
- **CO 2** will be aware and will be able to perform advanced techniques in the field of molecular biology and biotechnology.
- **CO 3**Able to do Computational Data processing and research problem solving through Biostatistics

Unit 1 Instrumentation

1.1 Microscopy: Basics microscopy, Electron microscopy and advanced specialized microscopy
1.2 Separation techniques
1.3 Atomic and molecular electronic spectroscopy, Vibrational spectroscopy
1.4 Chromatography: Paper chromatography, Thin Layer chromatography, HPLC, HPTLC. Preparative techniques, mobile phase selection, Stationary Phase, GC, LC, Mass Spectroscopy)

Unit 2 Molecular techniques

2.1 Structure determination: Nuclear Magnetic Resonance Spectroscopy (NMR), X-Ray crystallography and Cryo-EM
2.2 Tools for genomics and proteomics: Agarose gel, PAGE, 2D PAGE DNA Sequencing, Protein Sequencing, MALDI and SALDI TOF Mass Spectrometry etc.
2.3 Immunochemical Techniques: ELISA, RIA, flow cytometry etc.
2.4 CRISPR-Cas9 and RNAi biology

Unit 3 Bionanotechnology, Bioinformatics and Biostatistics

3.1 Concept of bionanotechnology, Formulation of various nanomaterials, Tools and techniques in nanotechnology, Application in Health, environment and agriculture
3.2 Bioinformatics resources, Biological databases, Sequence alignments, Bioinformatics techniques for nucleic acid and protein data analysis
3.3 Theoretical Concepts and application of Biostatistics in research
3.4 Computational Data processing and research problem solving through Biostatistics

Unit 4 SWAYM MOOC: Environment Natural resources and Sustainable Development

(URL:https://swayam.gov.in/courses/3911-environment-natural-resources-and-sustainable-development)
Research student has to enrolled and complete the above online course and evaluation can be done by online portal or by the department.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1						
CO 2						
CO 3						

CW103ZO:Advances in Zoology

The paper is aimed to introduce the students to different academic field of Zoology and its different subfields.

- **CO 1**Able to understand Applications of animal tissue culture.
- **CO 2**Able to understand Applications of animal tissue cultureApplications of animal tissue culture
- **CO 3** Knowledge will be impart through active learning methodology like field visit, academic tour and brain storming sessions

Unit 1: Embryology and Toxicology

1.1 Embryo development, embryonic stem cells, Infertility, reasons and treatment

1.2 Reproductive disorders (Menstrual, Fertility & Pregnancy disorders), advanced techniques: IVF, risk in IVF, Designer baby, Ethics; Regulatory laws & guidelines

1.3 Principles of Toxicology: Classes of toxicants, Evaluating dose response relationship, Route of exposure & animal toxicity test: Short term & long term test, Mechanisms of toxicity

1.4 Introduction to OECD guide lines & OECD Section-2:Effects on Biotic System

Unit 2Environment andAnimalGenetics

2.1 Global Environmental problems and impact of environment and ecosystem, Anthropogenic innervations, Conservation of diversity

2.2 Biological Diversity Act, Environment protection acts, wild life protection act, EIA

2.3 Impact of GM crops on biodiversity, Functional of international Union for the protection of new variety of plant (UPOV)

2.4 Animal breeding, out- and in-breeding, open nucleus system, concept of production of specific pathogen free and germ free laboratory (SPF) animal, vaccine production using SPF animals,

Unit 3: Animal Biotechnology

3.1 Applications of animal tissue culture, Types of animal tissue culture: Adherent& Suspension tissue culture, Short term & long term Tissue culture, Cell culture environment, Cell proliferation & differentiation, Cell adherent molecules

3.2 Primary culture, subculture & maintenance of cell line, Culture media,cloning of animal cells: Introduction of DNA in mammalian cell, Stem cell culture, 3D culture

3.3 Applied Zoology: Apiculture, Sericulture, Agricultural entomology and Poultry

3.4 Animal technology: Organic fertiliser, Panchagavya, vermicomposting, poultry manure,

Unit 4: Active Learning module

4.1 Study of review on: Contemporary development in animal science/ zoology

4.2 Study on new methodology research paper

4.3 Field visit / academic tour

4.4 Brain storming on relevant topic

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1						
CO 2						
CO 3						

CW103BO: Advances in Botany

The paper is aimed to introduce the students to different academic field of Botany and its different subfields.

- **CO 1**Able to understand techniques and application of plant tissue culture.
- **CO 2** Able to understand molecular and biochemical aspects of plants and plant toxicity.
- **CO 3** Knowledge will be impart through active learning methodology like field visit, academic tourtour and brain storming sessions

Unit 1: Plant Growth and PGPR

1.1 Long distance transport, Nitrogen and sulphur, Overview of Biosynthesis of hormones and Elicitor Molecules, Signal Perception and Transduction

1.2 Reproductive development, Senescence and Programmed cell Death

1.3 PGPR, Biofertilizer, Biopesticides

1.4 Plant identification and cultivation methods. Processing of crops, spices, medicinal and aromatic plants

Unit 2: Advances Plant Physiology

2.1 Responses to Abiotic and biotic Stresses i.e. Plant Pathogen, and Genetic basis of Plant-pathogen interactions, Control of plant pathogens by genetic engineering

2.2 Plant defence systems, Root exude, its Biochemistry and Hydroponics

2.3 The molecular physiology of micronutrient acquisition and transport

2.4 Plant responses to mineral toxicity

Unit 3: Plant and Agriculture Biotechnology

3.1 Gene flow in plant: Development of Mapping population- Marker assisted selection (MAS), Screening and validation, Trait related markers and characterization of gene involved, QTL mapping, Gene Pyramiding

3.2 Marker assisted breeding for various traits, for ground and background selection, gene introgression, Non-gel based techniques for geneotyping

3.3 Shoot culture, somatic embryos, artificial seeds, Anther culture and di-haploids

3.4 Protoplast culture, Protoplast fusion and somatic hybridization, direct transformation of Protoplast using PEG, electroporation, Particle bombardment, Ti plasmid based transformation

Unit 4: Active Learning module

4.1 Study of review oncontemporary development in plant science

4.2 Study on new methodology (research paper)

4.3 Field visit / academic tour

4.4 Brain storming on relevant topic

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1						
CO 2						
CO 3						

CW103MB: Advances in Microbiology

The paper is aimed to introduce the students to different academic field of Microbiology and its different subfields.

- **CO 1**Able to understand techniques and application of applied microbiology, metabolomics and system biology.
- **CO 2** Able to understand genetical, physiological and taxonomical aspects of microbes.
- **CO 3** Knowledge will be impart through active learning methodology like field visit, academic tourtour and brain storming sessions

Unit 1 Advances in Microbial Taxonomy, Physiology and Genetics

1.1 Advances in taxonomy
1.2 Advances in microbial physiology
1.3 Extremophiles
1.4 Advances in microbial genetics

Unit 2 New Approaches in Microbiology

2.1 Omics integrated microbiology: Concept, tool and application
2.2 Metabolomics, system biology and synthetic biology
2.3 Applied microbiology: Food, Dairy, Agricultural etc.
2.4 Advances in medical microbiology: Antimicrobial resistance, Novel antibiotics, emerging and reemerging of new pathogens ETC.

Unit 3 Microbial Biotechnology

3.1 Pharmaceutical biotechnology
3.2 Enzyme and Microbial technology
3.3 Microbial production of recombinant products
3.4 Environmental microbiology and biotechnology

Unit 4: Active Learning module

4.1 Study of review on: Contemporary development in Microbiology
4.2 Study on new methodology research paper
4.3 Field visit / academic tour
4.4 Brain storming on relevant topic

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1						
CO 2						
CO 3						

CW103BT: Advances in Biotechnology

The paper is aimed to introduce the students to different academic field of biotechnology and its application.

- **CO 1**Able to understand techniques and application of biotechnology in the field of zoology, botany and microbiology.
- **CO 2** Able to understand various advanced biotechnological methods for the betterment of living biota.
- **CO 3** Knowledge will be impart through active learning methodology like field visit, academic tourtour and brain storming sessions

Unit 1: Animal Biotechnology

1.1 Applications of animal tissue culture, Types of animal tissue culture: Adherent& Suspension tissue culture, Short term & long term Tissue culture, Cell culture environment, Cell proliferation & differentiation, Cell adherent molecules

1.2 Primary culture, subculture & maintenance of cell line, Culture media, Cloning of animal cells: Introduction of DNA in mammalian cell, Stem cell culture, 3D culture

1.3 Applied Zoology: Apiculture, Sericulture, Agricultural entomology and Poultry

1.4 Animal technology: Organic fertiliser, Panchagavya, vermicomposting, poultry manure,

Unit 2: Plant and Agriculture Biotechnology

2.1 Gene flow in plant: Development of Mapping population- Marker assisted selection (MAS), Screening and validation, Trait related markers and characterization of gene involved, QTL mapping, Gene Pyramiding,

2.2 Marker assisted breeding for various traits, for ground and background selection, gene introgression and Pyramiding, Non-gel based techniques for geneotyping

2.3 Shoot culture, somatic embryos, artificial seeds, wide hybridization, Anther culture and di-haploids

2.4 Protoplast culture, Protoplast fusion and somatic hybridization, direct transformation of Protoplast using PEG, electroporation, Particle bombardment, Ti plasmid based transformation

Unit 3 Microbial Biotechnology

3.1 Pharmaceutical biotechnology

3.2 Enzyme and Microbial technology

3.3 Microbial production of recombinant products

3.4 Environmental microbiology and biotechnology

Unit 4: Active Learning module

4.1 Study of review on: Contemporary development in Biotechnology

4.2 Study on new methodology research paper

4.3 Field visit / academic tour

4.4 Brain storming on relevant topic

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1						
CO 2						
CO 3						