Five Year Integrated Master of Science

(Life Sciences)

Programme

Scheme and Syllabus (OBE based)

for Advanced level courses in Semester VII to X

Institute For Integrated Programmes & Research In Basic Sciences (IIRBS)

Mahatma Gandhi University

P. D. Hills P.O., Kottayam-686560

PREAMBLE

I am happy to present the detailed curricula and syllabi of the final four semesters (7-10) of the five year Integrated M.Sc. programmes of Institute for Integrated Programmes and Research in Basic Sciences (IIRBS) in the following five branches of Science.

1. Chemistry (CH)
2. Physics (PH)
3. Life Sciences (LS)
4. Computer Science(CS)
5. Environmental Science(ES)

It may be noted that, an expert committee was constituted *(vide UO 4460/ACA5/2019/MGU, dated 23.09.2019)* for framing the scheme, curriculum and syllabi for the five year Integrated Master of Science (Integrated M.Sc) programmes of Mahatma Gandhi University. Subsequently, the committee drafted the regulations, scheme, curriculum and syllabi of the five year integrated Master of science programmes of IIRBS and were approved *vide UO No. 4467/AC A 5/2020/MGU, dated 05.10.2020* w.e.f 2020 admission batch. However, this approval was involved the detailed scheme and syllabus for foundation level (first six semesters) courses and only scheme for the advanced level courses (in semesters 7-10). Now the expert committee has finalized the **detailed syllabi for advanced level courses in semesters 7-10** in accordance with the OBE format approved by the Mahatma Gandhi University and is presented hereafter. ***This syllabus shall be applicable w.e.f the 2023-24 academic year (for 2020 admisn batch) onwards.***

The expert committee has framed the curriculum as per the Outcome Based Education (OBE) system. OBE is an educational approach that bases each part of the educational system with respect to the goals set for the students. OBE aims to equip the students (learners) with knowledge, competency orientations required for achieving their goals when they depart the institution. Further OBE empowers students to choose what they would like to study and how they would like to study it. The teaching methodologies and the evaluation system are also modified in par with the outcome based approach. The programme Specific Outcomes (PSOs) and the Course Outcomes (COs) are presented in the syllabus. The PSOs and the COs are well correlated in the syllabus of each course.

-Sd-

P.D. Hills
July, 2023

Dr. S. Anas
(Convener, Expert committee)

Members of the Expert committee

1.	Dr. S. Anas, Honorary Director, IIRBS	Convener
2.	Dr. P. R. Biju, Professor, SPAP	Member
3.	Dr. K. B. Subila, Assistant Professor, SCS	Member
4.	Dr. Mahesh Mohan, Assistant Professor, SES	Member
5.	Dr. E.K. Radhakrishnan, Associate Professor, SBS	Member
6.	Dr. V. R. Bindu, Professor and Director, SoCS	Member
7.	Dr. Cyriac Joseph, Director, SPAP	Member
8.	Dr. Anitha C. Kumar, Director, SCS	Member
9.	Dr. K. R. Baiju, Director, SES	Member
10.	Dr. M. S. Jisha, Director, SoBS	Member

Institute for Integrated Programmes and Research in Basic Sciences (IIRBS)

Institute for Integrated Programmes and Research in Basic Sciences (IIRBS**)**, was instituted directly under Mahatma Gandhi University in 2008 and was the first of this kind among the universities in Kerala. Subsequently, the Institute launched Five year Integrated Interdisciplinary Master of Science (Chemistry) programme in the year 2009. Over the years the institute has earned recognition as one of the best interdisciplinary institutions in terms of providing top-notch teaching learning environment and cutting edge instrumentation facilities. In 2020, IIRBS started innovative Five Year integrated interdisciplinary Master of Science programmes in five major disciplines of science (Physics, Chemistry, Life Sciences, Computer Science and Environmental Science). The major objective of the programmes is to integrate the conventional bachelors and masters programmes under a specified research oriented leaning environment by bringing together various science disciplines and thereby empower basic science education. These programmes are designed with an interdisciplinary approach to provide strong foundations for students to prepare for high quality research and expected to contribute to the talent pool of researchers and specialized technicians.

The regulations, scheme, curriculum and syllabi of the five year integrated Master of science programmes of IIRBS were approved *vide UO No. 4467/AC A 5/2020/MGU, dated 05.10.2020.* However, this approval was involved the detailed scheme and syllabus for foundation level (first six semesters) courses and only scheme for the advanced level courses (in semesters 7-10). Now the **detailed syllabi for advanced level courses in semesters 7-10** are prepared in accordance with the OBE format approved by the Mahatma Gandhi University.

Outcome based Education (OBE)

A high priority task in the context of education in India is improvement of quality of higher education for equipping young people with skills relevant for global and national standards and enhancing the opportunities for social mobility. Mahatma Gandhi University has initiated an Outcome Based Education (OBE) for enhancing employability of graduates through curriculum reforms based on a learning outcomes-based curriculum framework, upgrading academic resources and learning environment. Learning outcomes specify what graduates completing a particular programme of study are expected to know, understand and be able to do at the end of their programme of study. The fundamental premise underlying the learning outcomes-based approach to curriculum development is that higher education qualifications are awarded on the basis of demonstrated achievement of outcomes, expressed in terms of knowledge, understanding, skills, attitudes and values. Outcomes provide the basis for an effective interaction among the various stakeholders. It is the results-oriented thinking and is the opposite of input-based education where the emphasis is on the educational process.

The OBE Framework is a paradigm shift from traditional education system into OBE system where there is greater focus on programme and course outcomes. It guarantees that curriculum, teaching and learning strategies and assessment tools are continuously enhanced through a continuous improvement process. All decisions including those related to curriculum, delivery of instruction and assessment are based on the best way to achieve the predetermined outcomes. Traditionally, educators have measured learning in terms of standardized tests. In contrast, outcome-based education defines learning as what students can demonstrate that they know.

OBE is a comprehensive approach to organise and operate a curriculum that is focused onand defined by the successful demonstrations of learning sought from each learner. The term clearly means focusing and organising everything in an education system around “what is essential for all learners to be able to do successfully at the end of their learning experienc-

es". OBE is an approach to education in which decisions about the curriculum and instruction are driven by the exit learning outcomes that the students should display at the end of a programme or a course. By the end of educational experience, each student should have achieved the outcomes

Vision and Mission of Mahatma Gandhi University

Vision

"Mahatma Gandhi University envisions to excel in the field of higher education and cater to the scholastic and developmental needs of the individual, through continuous creation of critical knowledge base for the society's sustained and inclusive growth."

Mission

- To conduct and support undergraduate, postgraduate and research-level programmes of quality in different disciplines
- To foster teaching, research and extension activities for the creation of new knowledge for the development of society
- To help in the creation and development of manpower that would provide intellectual leadership to the community
- To provide skilled manpower to the professional, industrial and service sectors in the country so as to meet global demands
- To help promote the cultural heritage of the nation and preserve the environmental sustainability and quality of life
- To cater to the holistic development of the region through academic leadership

Vision and Mission of IIRBS

Our Vision:

Quality education in basic sciences by providing intellectual, instrumental as well as experimental support for pursuing excellence and thereby contribute to the talent pool of scholars.

Our Mission:

- To promote and disseminate high level knowledge in frontier areas of science
- To develop students as multidimensional personalities to create innovators for the service of human welfare
- To equip students to build up a scientific career and contribute towards the national development
- To inculcate among students human values with global competence

Programme Outcomes (PO) of Mahatma Gandhi University

PO 1: Critical Thinking and Analytical Reasoning

Capability to analyse, evaluate and interpret evidence, arguments, claims, beliefs on the basis of empirical evidence; reflect relevant implications to the reality; formulate logical arguments; critically evaluate practices, policies and theories to develop knowledge and understanding; able to envisage the reflective thought to the implication on the society.

PO 2: Scientific Reasoning and Problem Solving
Ability to analyse, discuss, interpret and draw conclusions from quantitative/qualitative data and experimental evidences; and critically evaluate ideas, evidence and experiences from an unprejudiced and reasoned perspective; capacity to extrapolate from what one has learned and apply their competencies to solve problems and contextualise into research and apply one's learning to real life situations.

PO 3: Multidisciplinary/Interdisciplinary/Transdisciplinary Approach
Acquire interdisciplinary /multidisciplinary/transdisciplinary knowledge base as a consequence of the learning they engage with their programme of study; develop a collaborative-multidisciplinary/interdisciplinary/transdisciplinary- approach for formulate constructive arguments and rational analysis for achieving common goals and objectives.

PO 4: Communication Skills
Ability to reflect and express thoughts and ideas effectively in verbal and nonverbal way; Communicate with others using appropriate channel; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner and articulate in a specific context of communication.

PO 5: Leadership Skills
Ability to work effectively and lead respectfully with diverse teams; setting direction, formulating a goal, building a team who can help achieve the goal, motivating and inspiring team members to engage with that goal, and using management skills to guide people to the right destination, in a smooth and efficient way.

PO 6: Social Consciousness and Responsibility
Ability to contemplate of the impact of research findings on conventional practices, and a clear understanding of responsibility towards societal needs and reaching the targets for attaining inclusive and sustainable development.

PO 7: Equity, Inclusiveness and Sustainability
Appreciate equity, inclusiveness and sustainability and diversity; acquire ethical and moral reasoning and values of unity, secularism and national integration to enable to act as dignified citizens; able to understand and appreciate diversity, managing diversity and use of an inclusive approach to the extent possible.

PO 8: Moral and Ethical Reasoning
Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work and living as a dignified person in the society.

PO 9: Networking and Collaboration
Acquire skills to be able to collaborate and network with scholars in an educational institution, professional organisations, research organisations and individuals in India and abroad.

PO 10: Lifelong Learning
Ability to acquire knowledge and skills, including "learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of workplace through knowledge/skill development/reskilling.

Programme Specific Outcomes (PSO) for

Integrated M.Sc. (Life Science)

Upon completion of the Integrated M.Sc. **Life sciences** *programme, the students should be able to accomplish the following outcomes*

PSO	*Expected Outcome*
1	Acquire the deep knowledge and skills in diverse areas of life sciences necessary for understanding the basic structural and functional aspects of various living systems.
2	Develop good skills in laboratory techniques for advanced understanding of the biological systems for further applications in research and industry.
3	Translate the technical knowhow in various branches of life sciences for the well-being of humans, other living forms and the environment and to motivate the innovation in biological applications for the emerging and existing needs
4	Nurture excellent research aptitude enabling to design, execute, analyse a research problem to bring a meaningful scientific conclusion by following scientific ethics.
5	To meet the global demand for skilled scientific resources in various branches of life sciences by integrating the knowledge through interdisciplinary approach.
6	Provide a vibrant and internationally competitive academic platform for the fostering of scientific innovations, entrepreneurial skills and communication abilities for the benefit of the society
7	Develop academic standard through deep theoretical knowledge and practical skills to translate scientific learning from life sciences in to process, product, technology or application as per societal demand.
8	Transform life sciences students to leaders/socially committed scientist for improving the quality of life.

SEMESTER VII to X (List of Courses Under Life Sciences Major)					
SEMESTER VII					
Code	**Course**	**L**	**T**	**P**	**C**
IMSC701LS	Genetics	3	1	0	3
IMSC702LS	Developmental Biology	3	1	0	3
IMSC703LS	Enzymology	3	1	0	3
IMSC704LS	Molecular and Cellular Biology	3	1	0	3
IMSC705LS	Lab Course-1	0	0	6	4
IMSE706LS-n (n=1,2,3...)	1. Chemical Biology 2. Microbial Biotechnology 3. Glycobiology 4. Metabolic Basis of Health and Disease 5. Plant Developmental Biology	2 2	0 0	0 0	2 2
	Total	**16**	**4**	**6**	**20**
SEMESTER VIII					
IMSC801LS	Immunology and Infectious Diseases	3	1	0	3
IMSC802LS	Entomology	3	1	0	3
IMSC803LS	Organismic and Evolutionary Biology	3	1	0	3
IMSC804LS	Systems Biology	3	1	0	3
IMSC805LS	Lab Course-2	0	0	6	4
IMSE806LS-n (n=1,2,3...)	1. Nutritional Biochemistry 2. Toxicology 3. Biophysics and Structural Biology 4. Bioanalytical Techniques and Instrumentation 5. Bioinformatics and Integrative Genomics	2 2	0 0	0 0	2 2
	Total	**16**	**4**	**6**	**20**
SEMESTER IX					
IMSC901LS	Plant Molecular Biology	3	1	0	3
IMSC902LS	Neuroscience	3	1	0	3
IMSC903LS	Recombinant DNA Technology	3	1	0	3
IMSC904LS	Lab Course-3	0	0	6	4
IMSE905LS-n (n=1,2,3...)	1. Biostatistics 2. Molecular Parasitology 3. Ethnopharmacology	3	0	0	3
IMSO906OC-n (n=1,2,3...)	Open Course	4	0	0	4
	Total	**19**	**3**	**6**	**20**
SEMESTER X					
IMSC100PR	Major Research Project	0	0	0	16
IMSC100VV	Comprehensive Viva-voce	0	0	0	4
	Total	**0**	**0**	**0**	**20**

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Genetics**		
Type of course	**Core**	**Credit Value**	**3**
Course code	**IMSC701LS**		
Name of Faculty			
Course Summary& Justification	This course discusses the principles of genetics with application to the study of biological function at the level of molecules, cells, and multicellular organisms, including humans. The topics include: population genetics, use of genetic methods to analyze protein function, gene regulation and inherited disease		
Semester	**VII**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	54	18	-	8	80
Pre-requisite	Basics of cell Biology and Genetics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Build a perspective on current developments in the field of, genetics and the cellular level organization of organisms	E	1-7
2	Evaluate the behavior of genotypes and alleles in natural populations	R,U	1-6
3	Perform genetic mapping based on data supplied	A,An	1-7
4	Communicate effectively about a given topic in genetics both verbally and in writing	An,C	1,7,8

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Mutation** Types of mutations - Somatic, germinal, spontaneous, induced, autosomal and allosomal, chromosomal mutations, structural and	12	1

	numerical changes. Gene mutations, molecular basis of mutations, induced mutations, physical and chemical mutagens, factors causing mutation		
2	**Bacterial genetics** Bacterial Genome, Recombination in Bacteria- Transformation. Transduction, Conjugation, F mediated sexduction. Resistance Transfer Factor (RTF), Mechanism of drug resistance in Bacteria. Transposable genetic elements in Bacteria, Basic components and transposition in Bacteria	20	2,3
3	**Human Genetics** Karyotyping - Characterisation of chromosomes using various banding techniques such as Q banding, G banding, R banding, C banding and N banding. Normal Human chromosome Complement, Pedigree analysis, Aneuploidy and Non- disjunction. Autosomal abnormalities (Trisomy 21, Trisomy 18, Trisomy 13) Sex chromosomal abnormalities (Klinefelters syndrome, Turner's and Cri du chat syndrome) Single gene disorder (Brief mention) Autosomal single gene disorder (Achondroplasia, Huntington's Disease, Brachydactly)	16	3,4
4	**Inborn errors of metabolism** Phenylketonuria, alkaptonuria, sicke cell anaemia, Albinism. Multifactorial traits –polygenic disorder- cleft lip and cleft palate. Sex-linked Diseases – Colour blindness, Haemophilia, Holandric traits.	12	4,5,6

References

1. *Sinnut Dunn & Dobzhansky 1959, Principles of Genetics (T.M.H. New Delhi)*
2. *Sobti & Sharma 2008. Essentials of Modern Biology Ane's Student Edition*
3. *Stern C. 1973. Principles of Human Genetics (W.H. Freeman and Co.)*
4. *Strickberger W.M. 1990. Genetics (Mac Millan Publishing Co.)*
5. *Verma P.S and Agarwal V.K. 1998 Genetics (S. Chand and Co. New Delhi)*
6. *Vijayakumaran Nair 2006, Genetics &Molecular Biology. ContinentalPubl., Trivandrum.*
7. *Whittinghill M. 1965 Human Genetics (Oxford & IBH Publ. Co.)*
8. *Winchester A.M. 1966. Genetics (Oxford & IBH Publications.*
9. *Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology.*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for integrated programmes and Research in basic sciences (IIRBS)**					
Programme	**Five Year Integrated M. Sc. (Life Sciences)**					
Course Name	**Developmental biology**					
Type of course	**Core**		**Credit Value**		**3**	
Course code	**IMSC702LS**					
Name of Faculty						
Course Summary& Justification	The course is designed to equip students in perceiving, understanding, and analyzing reproductive and embryological developmental processes in plants and animals					
Semester	**VII**					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	54	18	-	8	80
Pre-requisite	Basics of Biology and Physiology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Students will be able to understand and communicate the reproductive and developmental events in plants and animals effectively	R,U,A	1,4,7
2	They will acquire the skills to explain all kinds of reproductive parts and seed developmental processes, including seed storage in plants	U, A	1,4,7
3	**T**hey will be able to explain how developmental processes initiates and proceeds in plants	An,Ap	1,4,7
4	Students will be able to explain the specific developmental process and its ultimate impact on the productivity or successful completion of lifecycle in plants	An,Ap	1-7
5	Students will learn to understand the development of multicellular organisms from a single cell zygote	U,A	1-6
6	Aable to appreciate the mechanisms that support growth and development and they will learn about post embryonic development in animals	Ap,E	1-6

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Introduction** Basic concepts of developmental Biology; An overview of plant and animal development, Potency, Commitment, Specification, Induction, Competence, Determination and Differentiation morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in the analysis of development	12	1,2,3
2	**Cell differentiation** Different features of embroyonic cells; Totipotency, pleuripotency ,unipotency, Determination and differentiation in embryonic development. Gene action, Drosophila as a model organism (a brief account only), Homeotic genes and Hox genes, Presumptive organ forming areas and fate maps, Gastrulation, morphogenetic movements, epiboly and emboly, the concept of germ layers, derivatives of germ layers	20	5,6
3	**Human** Major Events in Female Reproductive phase; Implantation, pregnancy & parturition. Placentation in mammals - different types of placenta, functions, Teratology. Experimental embryology, developmental disorders. In vitro fertilization and embryo transfer experiments in mammals and test-tube babies, prenatal diagnosis and sex determination methods – amniocentesis chorionic villus sampling, ultrasound scanning. Embryonic and adult stem cell research and stem cell therapy	16	5,6
4	**Development in flowering plants** Life cycle of Angiosperm, Anther: Structure and development, microsporogenesis, male gametophyte development. Palynology: Pollen morphology, exine sculpturing, pollen kit, NPC formula. Viability of pollen grains, Pollination, pollen germination, growth and nutrition of pollen tube, Ovule: Structure, ontogeny and types. Megasporogenesis. Embryosac – development, classes, ultrastructure, and nutrition of embryosac. Female gametophyte development. Applications of palynology	12	3,4
5	**Fertilization in Plants** Double fertilization; embryo development - different types. Endosperm development, types of endosperm, haustorial behaviour of endosperm. Xenia and metaxenia. Polyembryony – types and causes. Seed formation, dormancy and germination. Apomixis, Parthenogenesis.		

References

1. *Elements of Developmental Biology, 6th Edn. Rastogi Publications*
2. *Gilbert. S.F. (2000). Developmental Biology. Sinauer Associates, Inc. Publishers.*
3. *Vijayakumaran Nair, K. and P.V. George (2002).A manual of Developmental Biology. Academica, Trivandrum.*
4. *Werner. A. Muller. (2008). Developmental Biology. Springer.*
5. *Wolpert, L. (1998). Principles of Development. Oxford University Press, N. Y.*
6. *Maheswari P. 1950. An introduction to the embryology of Angiosperms. McGraw Hill*
7. *Wolpert L, C Tickle and AM Arias (2015) Principles of development Optional Further Reading*
8. *Krishnamurthy KV (2015) Growth and Development in Plants*
9. *Raghavan V (2000) Developmental Biology of Flowering Plants*
10. *Developmental Biology Paperback – 2008 by Werner A. Muller*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**					
Programme	**Five Year Integrated M.Sc. (Life Sciences)**					
Course Name	**Molecular and Cellular Biology**					
Type of course	**Core**	**Credit Value**	**3**			
Course code	**IMSC704LS**					
Name of Faculty						
Course Summary& Justification	Molecular Biology and Cell Biology are one of the most dynamic and attractive courses in all branches of applied life sciences**.** The syllabus content in this paper is designed with an objective to train the students in both theoretical and practical aspects of the subject**.** This will also enable the students to get an idea about the latest developments taking place in this area					
Semester	**VII**					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independant Learning etc.	54	18	-	8	80
Pre-requisite	Basics of cell and molecular biology, Basics of tools and techniques of genetic engineering					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	On completing this course the students will be able to**.** Explain the processes of replication, transcription and translation and analyse the importance of these processes in health and disease	E	1
2	Explain the concepts of gene regulation in prokaryotes and RNA world	R, E	1,2
3	Analyse the use of different tools and techniques of gene cloning in E coli and explain the applications of DNA technology	U	1
4	Ability to develop a protocol for cloning a gene from a selected organism	A	1-3
5	Ability to explain verbally and orally the concepts of molecular biology and genetic engineering	E	1
6	Ability to write a research proposal based on the concepts discussed in the course	An,C	1-6
7	Compare and analyze the processes of cell cycle, cell division, cell differentiation and cell death and analyze the relationship between cell cycle, ageing	An	1-5

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**DNA Replication** DNA polymerases in eukaryotes and prokaryotes , Okazaki fragments, Klenov fragment, modes of replication, theta, rolling circle, d-loop replication, Primasome, SSB, Helicase, Ligase, methylation and control, repetitive DNA sequences, minisatellite, microsatellite, DNA protein interation DNA Linking number and topoisomerase, Inhibition of replication.	12	1,2,5,6
2	**Transcription** Process of transcription, stages in transcription, RNA polymerases in prokaryotes and eukaryotes, sigma factor in prokaryotes, Rho dependant and Rho independent termination. Enhancers, Transcription factors in Eukaryotes, Differences in transcription between prokaryotes and Eukaryotes, post transcriptional modifications, Group 1, II and III Introns, Ribozyme, Importance of ribozyme, properties, application, RNase P, RNAse III, RNAse H. monocistonic and polysistronic m-RNA, Joint transcript of r-RNA and t-RNA in prokaryotes and their processing, Transplicing, alternate splicing, inhibitors of Transcription.	20	1,2,5,6
3	**Molecular mechanism of gene regulation in prokaryotes** Transcriptional regulation in prokaryotes; Inducible & repressible system,+ & -ve regulation; Operon concept, structure of operon, Lac, Trp, Arc operon, Catabolic repression, Atteunation. Role of Hormones in gene regulation. Antisense RNA, SiRNA, MicroRNA, Ribozwitches & their applications; Telomerase structure and function	16	1,2,5,6
4	**Translation** Process of translation. Stages in translation, genetic code, properties, wobble hypothesis, eukaryotes and prokaryotes ribosomes, m-RNAs, t-RNAs, aminoacyl t-RNA synthatases, protein factors initiation complex, peptidyl transferase, releasing factors, differences between prokaryotic and eukaryotic systems, inhibition of translation. Post translation modifications	12	2,5,6
5	**Cell cycle and cell differentiation** Cell cycle- variations, checkpoints, regulations of cell cycle, Aging Process of aging, theories of aging, Arking's contribution Oxidative stress, Telomere problem, DNA repair defects. Cell Death - Necrosis and Apoptosis, mitochondrial damage DNA ladders, transglutaminase activity, programmed cell death in *Ceanorhabdtis elegans* CED 3, CED 4, CED 9 and their roles in Apoptosis Bax, Bid, Bcl2 protein	12	7

References

1. *Principles of gene manipulation – Old, Primrose, and Twyman, Blackwell Scientific publishers, Edn. 6th and 7th*
2. *Molecular biotechnology, Principles and Applications of Recombinant DNA, Glick Pasternak and Patten, 4th edition ISBN 978-1-55581-498-4 Wiley International Pub-*

lishers

3. *From gene to genomes – Concepts and applications of DNA technology Jeromy W Dale and Malcom von Shantz , John Wiley and sons*
4. *Principles of plant biotechnology: An introduction to genetic engineering in plants – SH Mantell*
5. *Cell and Molecular Biology by Gerald Karp, Academic Press*
6. *Gene VIII-Benjamin Lewin*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests Assignments Seminar Presentation Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**					
Programme	**Five Year Integrated M.Sc. (Life Sciences)**					
Course Name	**Laboratory Course-1 (Biochemistry)**					
Type of course	**Core**	**Credit Value**	**4**			
Course code	**IMSC705LS**					
Name of Faculty						
Course Summary& Justification	The course is designed to develop in students the essential skills to perform enzyme assays and related techniques. This will enhance the practical skills to perform enzyme-related methods and computational drug discovery process.					
Semester	**VII**					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	-	-	108	12	120
Pre-requisite	General idea on Reagents, Solvents and Enzymes					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	To prepare reagents, buffers and other solutions in required concentrations and required pH	Ap	2,4,7,8
2	To design and perform enzyme assays	C,S	2,4,7,8
3	To extract and purify enzymes from different sources and to examine their kinetic behavior	A,An	2,4,7,8
4	Isolate and purify a product made through bioprocess	S	2,4,7,8
5	Manipulate the bioprocess for the maximum production of a product at minimum cost	S	2,4,7,8

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	Preparation of solutions: Percentage solutions, Molar solutions, Normal solutions, Dilution of Stock solutions, Preparation of buffers using the Henderson Hasselbach equation	20	1,4
2	Enzyme Assays: Practical Concepts	8	2

3	Acid phosphatase from Fresh Potato ***(****Solanum tuberosum****)*** • β- amylase from Sweet potato ***(****Ipomoea batates****)*** • Urease from Jack bean ***(****Canavalia ensiformis****)*** • Phytase from Seeds	22	2
4	Enzyme Kinetics: • Effect of Substrate Concentration on velocity of Enzyme catalyzed reaction: Determination of KM and Vmax using Line weaver- Burk plot • Effect of Temperature on velocity of Enzyme catalyzed reaction: Determination of Q10 • Effect of pH on velocity of Enzyme catalyzed reaction: • Effect of activators on velocity of Enzyme catalyzed reaction: • Determination of type of inhibition using Line-weaver Burk plot	22	2,3
5	Purification of the enzyme A) Ammonium sulphate precipitation B) Dialysis, C) Gel Filtration D) Ion Exchange chromatography, E) PAGE F) SDS – PAGE	36	5

References

1. *Practical skills in Biomolecular Sciences, Weyers Jonathan, Reed Rob, Jones Allen, Holmes A*
2. *Practical Biochemistry, David Plummer, MaC Crew Publications*
3. *Biochemical Methods Sadasivam and Manickam*
4. *Introductory Practical biochemistry, S. K. Sawhney & Randhir Singh (eds) Narosa Publishing House, New Delhi, ISBN 81-7319-302-9, p 195 – 303*
5. *Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, p 12 – 182.*

Teaching and Learning Approach	**Laboratory Procedure (mode of transaction)** • Direct Instruction: lecture, Explicit Teaching, Demonstration, Hands on experimental sections, Skill acquisition by laboratory training, journal Club
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Chemical Biology**		
Type of course	**Elective**	**Credit Value**	**2**
Course code	**IMSC706LS 1**		
Name of Faculty			
Course Summary& Justification	The fields of biology and chemistry have a merging boundary where contributions from both fields impact the molecular and quantitative understanding of biology. The emphasis of this course will be to understand molecular interactions in biomolecules and approaches to analyze biological systems		
Semester	**VII**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	36	-	-	9	45

Pre-requisite	Basic understanding of biology, chemistry and physics

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Demonstrate an understanding of the role of chemical biology in industry and research	U	1
2	Understanding of applied, translational concepts in life sciences	U,E	1-3
3	Students will demonstrate expertise with techniques for protein analysis	A	1-5
4	Students will learn to perform ELISA and labeling of biomolecules	S,An	1,7,8

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Molecular structure and Stability** Proteins, Protein-protein interactions, membrane protein and their lipid environment, Folding and stability: energy landscape for protein folding, protein folding disease, Nucleic acids: Structure of DNA and conformations, higher order DNA structures, DNA interactions with	12	1, 2

	proteins, RNA structure and folding, Protein sequence composition and properties, secondary structure prediction		
2	**Bioconjugation** Protein chemistry, reactive groups, different functional groups targeting reactions, blocking of specific functional groups, buffer systems, Bioconjugate reagents: different cross linkers (zero, homo and hetero-biofunctional cross linkers etc.), cleavable cross linkers, fluorescent tags, biotinylation reagents, radiolabeling reagents, light activated reagents	12	2,3
3	**Practical applications and techniques** PEGylation of proteins, microspheres, liposomes, dendrimers, immobilization of proteins, antibody-enzyme conjugate (ELISA), label transfer reagents, DNA probes and hybridization, bioorthogonal reagents (click chemistry), Solid-phase peptide synthesis, labelling of sugars, bioconjuagation by exploiting Cell's translational machinery (Auxotrophs)-Bioconjugation using posttranslational machinery (Formyl glycine generating enzymes), Application of bioconjugates with examples	12	3,4

References

1. *Bioconjuagte Techniques, Greg T. Hermanson, 3rd ed., Academic Press, 2013.*
2. *Bioconjugation: Methods and Protocols, Sam Massa & Nick Devoogdt, Humana Press, 2019.*
3. *Kuriyan, Konforti & Wemmer, The molecules of life: Physical and chemical principles, 2012.*
4. *Walsh, Enzymatic reaction mechanisms, 1978*
5. *Biophysical Chemistry by Dagmar Klostermeier & Markus G. Rudolph, CRC press, 2020.*
6. *Real World Drug Discovery: A Chemist's Guide to Biotech and Pharmaceutical Research. Robert M. Rydzewski, Elsevier, 2008.*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Microbial Biotechnology**		
Type of course	**Elective**	**Credit Value**	**2**
Course code	**IMSC706LS 2**		
Name of Faculty			
Course Summary& Justification	The course describes the application of microbes in various sectors**.** The course content explains the role of microbes and its utilization/application in various sectors especially in industrial & pharmaceutical area. The course content also illustrates the various methods & process for production of bioactive compounds & products using microbes		
Semester	**VII**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	36	-	-	9	45

Pre-requisite	Basics of Microbiology

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	On completing this course, the student will be able to Explain the methods for studying microbial genome and describe how metabolic & protein engineering help to enhance the production of microbial metabolites	U,A	1,3,4,7
2	Describe the methods , process & production of various microbial based food and dairy products also students have able to explain microbes are food for animal and human	U,An	1,2,4,7
3	Students should explain the role of microbes as biofertilizer, biopesticide, fungicide, and herbicide and also able to describe the various plant microbe interactions	U,A	1-7
4	Illustrate the utilization of microbes in the production of industrial and pharmaceutical products	An,A	1-7
5	Communicate effectively about a chosen topic in microbial technology both verbally and orally	C	1,7

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Microbial Genomics** Introduction to Microbial genomics, Structural Genomics, Functional genomics, Comparative Genomics, Meta Genomics - Genome analysis of extremophiles, Metabolic engineering and protein engineering for optimization of microbial products	8	1,5
2	**Microbes in food & dairy industry** Fermented foods Introduction, Role & Advantages of fermented foods. Production of cheese, yoghurt, koji & Idli. Knowledge of other fermented dairy products. Single cell proteins-algae, bacteria, fungi, yeast & actinomycetes. Alcoholic beverages-Distilled and non distilled, Production of beer, wine & ethanol. Microbe as animal feed additives. Probiotics, Prebiotic & Synbiotics	8	2,5
3	**Microbes in Agriculture** Nitrogen fixation; Symbiotic & Non symbiotic Mechanism; Biofertilizers-Rhizobium, Azolla, Azospirillum, Algal Biofertilizers; Phosphate solubilizing microorganisms; Microbial biopesticide, biofungicide and herbicide; Micorrhiza; Plant –Microbe Interactions. Mushroom cultivation Microbes & Environment: Biotechnology and pollution control; Use of immobilized microbial cell & enzyme in waste water treatment. Microbial biotransformation-Steroid, Microbial degradation of Herbicides, Insecticides & Pesticides; Bioremediation & Bioleaching	10	3, 5
4	**Industrial &Pharmaceutical Applications** Methanogens & Biogas Production; Microbial Hydrogen production; Microbes in plastic industry - Bioplastics; Microbial biosensors- Micro oxygen electrode. Biochips; Biofilm; Bioactive compounds from microbes. Bioethanol & biodiesel production. Microorganism for Bioassay & as Bio weapon	10	4, 5

References

1. *Biotechnology Fundamentals and Applications, S.S. Purohit and S.S. Mathur; Agro Botanical Publishers India.*
2. *Microbial Biotechnology, Alexander N Glazer & Hiroshi Nikaido Cambridge University Press.*
3. *Microbial Biotechnology, Farshad Darvishi harzevili Hongzhang Chen.CRC Press.*
4. *Microbial Biotechnology Principle & Applications Lee Yuan Kein.World Scientific Press. Microbial Technology-Fermentation Technology Vol 1 & 11 Peppler Perinas Elsiver.*
5. *Biofertilizers in Agriculture, N.S.Subha Rao;Oxford & IBH Publishing Co.Pvt.Ltd New Delhi.*
6. *Essentials of Biotechnology, R.C.Sobti & Suparna.S.Pachauri. Ane Books Pvt.Ltd.*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Glycobiology**		
Type of course	**Elective**	**Credit Value**	**2**
Course code	**IMSC706LS 3**		
Name of Faculty			
Course Summary& Justification	Glycobiology is a new frontier of Molecular Biology. The course is designed to get a deep knowledge of the studies of structure, biosynthesis and biological functions of complex carbohydrates like glycoconjugates. The main objective of the course is to understand the complex glycan mediated interactions between molecule, cells and organisms. The field has a broad relevance to many areas of basic research, medicine, and biotechnology		
Semester	**VII**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	36	-	-	9	45

Pre-requisite	Basic understanding of Immunology, Biochemistry

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Students will be able to evaluate the importance of structures of different types of glycans, glycosylation process and biological functions of glycoconjugates	E	1-3
2	Students will be able to categorize, differentiate and understand carbohydrate metabolism and regulation	U, A	1,2,4
3	To analyze and apply different methods in glycomics that are used for manipulation of glycans	A, An	1,2,4,7
4	Describe the different steps involved in glycosylation and the importance of glycobiological mechanisms centre to disorders and diseases	A,E	1,2,4,7

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Introduction** Overview and historical background, Chemistry of carbohydrates, Cellular organization of glycosylation, Biological functions of Glycans, Types of glycoconjugates (glycoproteins, glycolipids, proteoglycans)	8	1
2	**Carbohydrate Metabolism, Structure and Biosynthesis of Glycans** Metabolism and Regulation of Carbohydrates, N-glycans, O-GalNAc Glycans. Glycosphingolipids, Struture of glycans, proteoglycans, glycoproteins and glycolipids, Advanced glycation end products (AGE), Role of glycomics in Biology	8	1,2.3
3	**Glycans in Physiology and Disease** Glycans in Systemic Circulation, Glycobiology of diet-related diseases, Glycosylaion changes in cancer, generation of AGEs in diabetes, effects of AGEs in the vascular system and on the filtration properties of the kidneys, role of AGEs in the development of atherosclerosis	10	4
4	**Congenital Disorders** Disorders of glycosylation and dietary therapy, fibrotic diseases such as amylodosis, liver fibrosis, arthritis, glucosamine supplementation	10	4

References

1. *Essentials of Glycobiology, 4th edition, Ajit Varki, Richard D. Cummings, Jeffrey D. Esko, Pamela Stanley, Gerald W. Hart, Markus Aebi, Debra Mohnen, Taroh Kinoshi-ta, Nicolle H. Packer, James H. Prestegard, Ronald L. Schnaar, and Peter H. Seeberger. Cold Spring Harbor (NY): Cold Spring Harbor Laboratory Press 2022.ISBN-13: 978-1-621824-21-3.*
2. *Nelson and Cox (2012): Principles of Biochemistry (Worth Publ. Inc. USA)*
3. *Voet, D. and Voet,J.G. (2012): Biocheimstry (John Wiley & Sons Inc)*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Metabolic basis of health and disease**		
Type of course	**Elective**	**Credit Value**	**2**
Course code	**IMSC706LS 4**		
Name of Faculty			
Course Summary& Justification	The course is designed to get a deep knowledge of metabolic processes taking place in the biological systems and their regulation, which is needed to understand the more specialized areas of Biochemistry		
Semester	**VII**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	36	-	-	9	45

Pre-requisite	Basic understanding of chemical groups and bonding; basics of cell biology and physiology

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	To be able to categorize, differentiate and predict the fates of different biomolecules via the metabolic pathways	U, A	1,2,4,7
2	To draw conclusions on the energetics of the metabolic pathways and to find out the variations in ATP generation during physiological and pathological conditions	A	1,2,4,7
3	To analyse different methods of regulation of the metabolic pathways.	A, An	1,2,4,7
4	Describe the different steps involved and the importance of metabolomics in toxicity analysis and health management	A	1,2,4,7

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Bioenergetics** Functional significance of the mitochondrial respiratory chain and oxidative phosphorylation, Electron transport chain: structural components of the chain, complexes, free elements; Structure and functional properties of cytochromes, ferro-sulphurated proteins and	8	1, 2

	CoQ; Generation of the electrochemical proton gradient: Chemiosmosis ATP synthesis: structural and functional properties of ATP synthesis; Inhibitor agents and decoupling agents of the respiratory chain and ATP synthesis; Transport processes across the internal mitochondrial membrane		
2	**Regulation of metabolism** Hormonal and Allosteric regulation of pathways in carbohydrate, fat, nucleotide and protein metabolism; Coordinated regulation of opposing metabolic pathways; Regulation of mitochondrial electron transport and oxidative phosphorylation; Regulation of enzymes of carbon dioxide fixation by light; Regulation of light capture process in photosystems	8	3
3	**Regulation of metabolism** Hormonal and Allosteric regulation of pathways in carbohydrate, fat, nucleotide and protein metabolism; Coordinated regulation of opposing metabolic pathways; Regulation of mitochondrial electron transport and oxidative phosphorylation; Regulation of enzymes of carbon dioxide fixation by light; Regulation of light capture process in photosystems	10	3
4	**Signal Transduction** Intracellular receptor and cell surface receptors signaling: Cyclic AMP-dependent protein kinase; Cyclic GMP-dependent protein kinase; Protein kinase C; Ca2+ -calmodulin-dependent protein kinases ; AMP-dependent protein kinase ; Receptor tyrosine kinases; Protein kinase B; Cytokine activation of the JAK'/STAT pathway; Cell cycle control; Receptor serine/threonine kinases; Other protein kinases ; Phosphoprotein phosphatases; Cancer Pathways: MAPK, P13K, TP53 network, NFkB pathways; Signalling by TGF β factor , STAT factor as Bio weapon	10	4

References

1. *Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray Scrimgeour K Publisher: Pearsarson ISBN: 0131977369, ISBN13:9780131977365, 978-0131977365*
2. *Biochemistry 6th Edition (2007) by Jeremy M Berg John L.tymoczko Lubert Stryer Publisher: B.i.publicationsPvt.Ltd ISBN:071676766X ISBN-13: 9780716767664, 978-716767664*
3. *Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson Michael M. Cox Publisher: W. H. Freeman; Fourth Edition edition (April 23, 2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392*
4. *E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, AText Book of Biochemistry, Oxford and IBH Publishing Co., New Delhi, 1974*
5. *Biochemistry [with Cdrom] (2004) by Donald Voet, Judith G. Voet Publisher: John Wiley & Sons Inc ISBN: 047119350X ISBN-13: 9780471193500, 978-0471193500*
6. *Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance Publisher: Mcgraw-hill Book Company – Koga ISBN:0697142752 ISBN-13: 9780697142757, 978-0697142757*
7. *Biochemistry (2008) by Rastogi Publisher: Mcgraw Hill ISBN:0070527954 ISBN13: 9780070527959, 978-007052795*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Plant developmental biology**		
Type of course	**Elective**	**Credit Value**	**2**
Course code	**IMSC706LS 5**		
Name of Faculty			
Course Summary& Justification	The course is designed to equip students in perceiving, understanding, and analyzing reproductive and embryological developmental processes in plants to apply the principles towards increasing plant productivity through breeding		
Semester	**VII**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	36	-	-	9	45

Pre-requisite	Basics of cell biology

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Students will be able to understand and communicate the reproductive and developmental events in plants effectively	R,U,A	1,4,7
2	They will acquire the skills to explain all kinds of reproductive parts and seed developmental processes, including seed storage in plants	A,E	1,4,7
3	They will be able to explain how developmental processes initiates and proceeds in plants	An,Ap	1-6
4	Students will be able to explain the specific developmental process and its ultimate impact on the productivity or successful completion of lifecycle in plants	An,Ap	1,4,7

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Introduction** Basic concepts of developmental Biology;An overview of plant and animal development, Potency, Commitment, Specification, Induction, Competence, Determination and Differentiation	8	1,2,3

	morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in the analysis of development		
2	**Development in flowering plants**: **(a)** Angiosperm life cycle **(b)** Anther: Structure and development, microsporogenesis, male gametophyte development. Palynology: Pollen morphology, exine sculpturing, pollen kit, NPC formula. Applications of palynology- palynology concerning taxonomy. Viability of pollen grains Pollination, pollen germination, growth and nutrition of pollen tube**. (c)** Ovule: Structure, ontogeny and types. Megasporogenesis. Embryosac – development, classes, ultrastructure, and nutrition of embryosac. Female gametophyte development	8	1,2,3
3	**Fertilization in Plants:** Double fertilization; embryo development - different types. Endosperm development, types of endosperm, haustorial behaviour of endosperm.Xenia and metaxenia. Polyembryony – types and causes. Seed formation, dormancy and germination. Apomixis, Parthenogenesis.	10	1,2,3
4	**Morphogenesis and organogenesis in plants** Shoot and root development; Leaf development and Phyllotaxy. Transition to flowering, floral meristems and floral development; Homeotic genes in plants; Senescence, programmed cell death and hypersensitive response in plants	10	4

References

1. *Wolpert L, C Tickle and AM Arias (2015) Principles of development*
2. *Krishnamurthy KV (2015) Growth and Development in Plants*
3. *Raghavan V (2000) Developmental Biology of Flowering Plants*
4. *Gilbert SF (2000) Developmental Biology*
5. *Developmental Biology, 8th Ed, Gilbert*
6. *Developmental Biology Paperback – 2008 by Werner A. Muller*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

SEMESTER VIII

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**					
Programme	**Five Year Integrated M.Sc. (Life Sciences)**					
Course Name	**Immunology and infectious diseases**					
Type of course	**Core**	**Credit Value**	**3**			
Course code	**IMSC801LS**					
Name of Faculty						
Course Summary& Justification	This course on Immunology deals with study of Immune system, its main components involved in defense responses of human body. This course is an important branch of medical and biological sciences. The immune system protects us from infection through various lines of defense. If the immune system is not functioning as it should, it can result in disease, such as autoimmunity, allergy and cancer. The content in this course has been designed with an objective to provide detailed understanding on the process and mechanisms involved in the defense responses. Understanding on the functioning of immune system is highly essential for a student to explore its theoretical and application for the benefit of society					
Semester	**VIII**					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	54	18	-	8	80
Pre-requisite	Basic understanding about cells					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Students will be able to understand and explain basic concepts of immunology such as compare and contrast the innate versus adaptive immune systems	R,U	1,2
2	Students will be able to learn the latest advances in immunology	R,U	1,2,4,7
3	Students will able to examine the clinical importance of immunological reactions	An	1,2,4,7
4	Students will be able to provide an overview of the interaction between the immune system and pathogens	An	1,4,7
5	Students shall demonstrate the importance of theoretical and practical aspect for the diagnosis of infectious diseases	C,S	1,2,4,7
6	Students can apply the knowledge and skills for clinical and diagnostic applications	A, S	1,2,4,7,8

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Introduction to Immunity** Understanding about Infection, Source and methods of transmission, Types of immunity. Mechanisms of innate immunity, PAMPs, pattern recognition receptors, types, scavenger receptors and toll – like receptors, Phagocytes and Phagocytosis, Organs and cells with immune functions. Lymphocytes and lymphocyte maturation.	12	1
2	**Antigens, Epitopes and paratopes** B-cell and T-cell epitope, Antigenicity and Immunogenicity, Antibodies, Immunoglobulin – structure, classes and functions. Genetic basis of antibody diversity, Organization and Expression of Immunoglobulin Genes, V(D)J rearrangements; recombination signal sequences and their role, somatic hypermutation and affinity maturation Antigen antibody reactions, Agglutination, Precipitation, Immunoflourescence, Complement fixation, Radioimmuno assay, ELISA, Western blotting	20	2,3
3	**Humoral and cell mediated immune responses** Receptors on T and B cellsfor antigens, MHC, TCR- mediated signalling, Signal transduction pathways associated with T-cell activation, Signal transduction by activated B- cell receptor, Antibody production, Primary and secondary immune response,Factors influencing antibody production, Clonal selection theory, Monoclonal antibodies – production and application, Antibody engineering. Complement system, Complement activation, Biological effects of complements, Antigen processing and presentation, Activation of T-cells, T cell function, Cytokines. Human microbiome and immunity	16	3,4
4	**Immunology of organ and tissue transplantation** Allograft reaction and GVH reaction, Factors influencing allograft survival, Immunology of malignancy,Tumor antigens, Immune response in malignancy, Immunotherapy of cancer, Immunohematology, ABO and Rh blood group system, Immunology of blood transfusion, Hemolytic disease of new born , Immunological Tolerance, Autoimmunity, Mechanisms of autoimmunization, Autoimmune diseases. Inflammation, Hypersensitivity –immediate and delayed reactions, Clinical types of hypersensitivity, Immunodeficiency diseases, Immunoprophylaxis, Vaccines –types of vaccines, DNA vaccine, recent trends in vaccine development.	12	4,5,6
5	**Immunological Tolerance, Autoimmunity, Mechanisms of autoimmunization, autoimmune diseases** Inflammation, Hypersensitivity –immediate and delayed reactions, Clinical types of hypersensitivity, Immunodeficiency diseases, Immunoprophylaxis, Vaccines –types of vaccines, DNA vaccine, recent trends in vaccine development.	12	5,6

References

1. *Immunology - Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby, and Janis Kuby,W H Freeman and Co., 2013*
2. *Immunobiology - Charles A. Janeway Jr.,Paul Travers, Mark Walport and Mark J. Shlomchik, Garland Publishing., 2016*
3. *Essential Immunology - Ivan M. Roitt and Peter J delves, Blackwell Publishing, 2016*
4. *Essential Clinical Immunology – Helen Chappel and Mansel Haeney, ELBS/BlackwellScientific Publications, 2014*
5. *Text book of Microbiology – R. Ananthanarayanan and C K Jayaram Panicker. Orient Longman,2013*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Entomology**		
Type of course	**Core**	**Credit Value**	**3**
Course code	**IMSC802 LS**		
Name of Faculty			
Course Summary& Justification	This course deals with the scientific study of insects and other organisms related to them. Because insects have numerous interactions with humans and other types of life on Earth, it is a unique field within biology. This course will introduce students to insects, its development, feeding habits, diversity of insects with examples and an important aspect of Entomology, pest management and different tool used		
Semester	**VIII**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	54	18	-	8	80
Pre-requisite	Basic understanding of General Biology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	On completing the course students will be able to identify few insects based on their morphology, anatomy and life history	U, A	1-5
2	Students will attain knowledge on principles of insect taxonomy and their general feeding behavior	U,R	1-5
3	Students shall attain awareness of the impact that insects have on agricultural entomology and pest management.	U, An	1-5
4	Students will be able to attain broad knowledge of the ecological and physiological aspects that are important to the field of entomology and pest management.	C,S	1-6
5	Communicate effectively about a chosen topic in Entomology both verbally and orally	A,S	1,7

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Introduction** Introduction to insects, insect morphology, Insect Success: Adaptations and Survival , Insect Development: Growth, Molting & Metamorphosis Introduction; Insect Biodiversity; Collecting and preserving insects, Insect external anatomy , Insect internal anatomy & physiology , Development, life history, Reproduction and reproductive physiology , Sensory systems and behavior.	12	1, 5
2	**Insect Feeding** Mechanisms and Behavior, Insect Reproduction, Principles of insect taxonomy, Insect Communication: Emitting and Receiving Messages	12	2, 5
3	**Insect Diversity** Arthropod Phylogeny & Insect Origins, Diversity I: Dragonflies, Grasshoppers and Stick insects, Insect Diversity II: Praying Mantises, Cockroaches, True Bugs, Insect Diversity III: Lacewings, Beetles, Flies, Insect Diversity IV: Fleas, Butterflies, Bees Insect Plant Interactions, Insect Pollinators, Aquatic Insects	16	3, 5
4	**Entomology in Specific Areas** Insect Societies and Social Insects, Insect Predation and Parasitism, Agricultural and Forestry Entomology, Medical and Veterinary Entomology, Urban Entomology, Forensic Entomology, Integrated Pest Management & Control Strategies.	16	4, 5
5	**Integrated Pest Management** Pests affecting economically important plants, Pest management methods, Microbial Insecticides, Bio pesticides.	16	3,4,5

References

1. *Chapman RF. 1998. The Insects: Structure and Function. Cambridge Univ. Press, Cambridge. David BV & Ananthkrishnan TN. 2004. General and Applied Entomology. Tata-McGraw Hill, New Delhi.*
2. *Gupta RK. 2004. Advances in Insect Biodiversity. Agrobios, Jodhpur.*
3. *Boucias DG & Pendland JC. 1998. Principles of Insect Pathology. Kluwer Academic Publisher, Norwel.*
4. *Burges HD & Hussey NW. (Eds). 1971. Microbial Control of Insects and Mites. Academic Press, London.*
5. *De Bach P. 1964. Biological Control of Insect Pests and Weeds. Chapman & Hall, New York*
6. *Dhaliwal GS & Arora R. 2001. Integrated Pest Management: Concepts and Approaches. Kalyani Publ., New Delhi*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Organisimic and Evolutionary Biology**		
Type of course	**Core**	**Credit Value**	**3**
Course code	**IMSC803LS**		
Name of Faculty			
Course Summary& Justification	This is an interdisciplinary course that involves studying biological processes that range from single cells to bigger ecosystems, also studies focus on factors that are key to understand the evolution of organisms, how biodiversity is generated and maintained, how organisms work, and how organisms interact with their environment		
Semester	**VIII**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	54	18	-	8	80

Pre-requisite	Basics of Cell Biology, Evolution and Ecology

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Explain the processes, laws, and theories related to inheritance and evolution	R	1-5
2	Students will be able to understand and communicate the sustenance of natural biological systems on the earth effectively	R,U,A	1-5
3	Acquire skills in explaining all kinds of interrelationships in natural biological systems	U,A	1-6
4	Students will be able to understand the significance of biodiversity and its conservation in the sustenance of natural ecosystems	An,Ap	1-5
5	Communicate effectively about a given topics both verbally and in writing	An, C	1,7

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Concepts in Evolution and Origin of Life** Pre-Darwinian, Lamarck, Darwin and Wallace and Post Darwanian. Concepts of variation, adaptation, struggle, fitness. Natural selection - spontaneity of mutation and the evolutionary synthesis. Neutral Evolution. Molecular Evolution. Neutralist versus Selectionist. Contributions of Margulis (Endosymbiotic theory), Eldredge and Gould (Punctuated equilibrium), Rose Mary and Peter Grant (Molecular evolution in Darwinian finches). Origin of basic biological molecules, concept of Oparin - Haldane, Miller-Urey Experiment. The First Cell. Evolution of Prokaryotes, origin of eukaryotic cells, evolution of unicellular eukaryotes. Genome evolution. Anaerobic metabolism. Origin of photosynthesis and aerobic metabolism. Major events in evolutionary timescale. Anthropocene. Mass extinction and its consequences. Fossils fossilization and its significance.	12	1
2	**Biochemical and Molecular Evolution** Gene evolution, Evolution of gene families, molecular drive, Amino acid sequence divergence in proteins, Nucleotide sequence divergence in DNA, Molecular clocks, Ancient DNA, RNA World, significance of LUCA. Biochemical and genomic evolution: The evolutionary history of proteins, Evolution of gene, gene families, molecular drive, Amino acid sequence divergence in proteins, Nucleotide sequence divergence in DNA noncoding RNA, micro RNAs, the phylogenetic utility of RNA structures, Hitchhiker‘s guide to evolving networks, protein-protein interaction network, the evolution of metabolic networks, and concept of molecular clock, Outline of origin of prokaryotic and eukaryotic genomes, The ―C-Value paradox.	15	1,5
3	**Evolution** Origin of Higher Categories, Origin of Metazoa, theories of origin, Origin and evolution of Trilobites, vertebrate groups- Pisces, Amphibia, Reptilia, Aves and Mammals. Evolutionary history of neural integration, endocrine systems, Hormones Phylogenetic gradualism and punctuated equilibrium, Micro and Macroevolution. Stages in Primate Evolution- Prosimii, Anthropoidea and Hominids. Factors in human origin-Hominid fossils, Cytogenetic and Molecular basis of the origin of the man-African origin of modern man-Mitochondrial Eve, Y chromosomal Adam, - early migration, hunter-gatherer societies, Evolution of human braincommunication, speech and language. Evolution of culture.	15	2,5
4	**Ecology** Biotic and abiotic factors and their interactions, structure, basic components, their interactions and inter-relations, Fundamental concepts relating to the energy-first and second law of thermodynamics, entropy. Gaseous and sedimentary cycles.	15	3,5

	Characteristics of the population: density, natality, mortality, biotic potential environmental resistance, growth forms, immigration, emigration and migration, Characteristics: species diversity, stratification, dominance, boundaries, ecotone and edge effect, ecological indicators, Ecological Energetics, Energy flow, primary and secondary productivity, standing crop, Food chain, food webs, trophic levels and ecological pyramids, Classification of ecosystems based on energy input		
5	**Biodiversity** Introduction, definition, levels of biodiversity (genetic diversity, species diversity and ecosystem diversity), values of biodiversity, Diversity indices: Alpha diversity, Beta diversity and gamma diversity; the species diversity and ecosystem stability, Biodiversity in India: Major biogeographic zones of India, hot spot biodiversity - characteristics; an outline of the features and biodiversity of hot spots in India (the Western Ghats and Himalaya), Features, structure and biodiversity of some of the Indian ecosystems; Terrestrial ecosystems (forest, grassland, desert), aquatic ecosystems, freshwater, marine estuarine	15	4,5

References

1. *Evolution, 4th Edition, by Douglas J. Futuyma & Mark Kirkpatrick (Sinauer Associates, 2017). ISBN-13: 978-1605356051; ISBN-10: 1605356050.*
2. *Remarkable Creatures - Epic Adventures in the Search for the Origins of Species by Sean B. Carroll (Houghton Mifflin Harcourt, 2009). ISBN-13: 978-0547247786; ISBN-10: 0547247788*
3. *Alcock, J. (2009). Animal Behaviour: An Evolutionary Approach. 8th edn. Sinauer Associates Inc. Sunderland, Massachusetts*
4. *Campbell, B. G. (2009). Human Evolution. Transaction Publishers, NJ, USA*
5. *Darwin, C. D. (1859). On the Origin of Species by Means of Natural Selection. John Murray, London. Dugatkin, L. A. (2009).*
6. *Fox, C. W and Wolf, J. B. (2006). Evolutionary Genetics-Concepts and Case Studies. 2nd edn. Sinauer Associates Inc. USA*
7. *Kimura, M. (1983). The neutral theory of molecular evolution. Cambridge University Press, UK.*
8. *Dobzhansky Th. et al. (1976): Evolution. Surjeet Publ*
9. *Freeman S. and Jon C. Herron (1998): Evolutionary Analysis. Prentice-Hall Futuyma D. J. (1998):*
10. *Evolutionary Biology. Sinauer Hartl D. L. and A. G. Clark (1989 & 1997): Principles of Population Genetics.*
11. *Li Wen-Hsiung and Dan Graur (1991): Fundamentals of Molecular Evolution.*
12. *Strickberger M. W. (2000): Evolution. Jones and Bartlett*
13. *White M. J. D. (1978): Modes of Speciation. Freeman*
14. *Peter D Stiling (1999) Ecology: Theories and Evolution*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for integrated programmes and research in basic sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Systems Biology**		
Type of course	**Core**	**Credit Value**	**3**
Course code	**IMSC804LS**		
Name of Faculty			
Course Summary& Justification	This course is designed to provide an overview of human physiology. Course topics will include the various systems of the body, functions of each system, and interrelationships to maintain the internal environment. The course also provides inputs to physiological stress and adaptive strategies to overcome stress		
Semester	**VIII**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	54	18	-	8	80

Pre-requisite	Basic knowledge in Biology and Physiology

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Students should be capable of effectively communicating how the human body works	U	1-4
2	Students should describe the interdependency and interactions of the systems	A	1-4
3	Students should be able to explain contributions of organs and systems to the maintenance of homeostasis	E	1-4
4	The content of the course will elicit curiosity in functioning of human body	I	1-4
5	Able to gain the approaches used to study various functional systems of the human body and physiologic adaptation	I	1,7

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**The system as a basic unit in physiology** Different systems in physiological process, interaction of different systems in physiological process, interaction of different systems in normal and stress conditions, Body organization, cells, tissues, organ and organ systems, body fluid compartments, reflex, biological rhythms	16	1,4
2	**Neuronal system** Neuron, basic principles of electricity, neuronal potentials, neuronal communications, brain, spinal cord, different nervous systems, somatic sensation, vision, hearing, chemical sense, motivation, emotion, learning, memory	16	2,3,4
3	**Gastrointestinal physiology & nutrition** Gastrointestinal structure, food digestion, and absorption, gastrointestinal hormones, central control of gastrointestinal functions, pathological situations of gastrointestinal functions. role of liver and bile in gastrointestinal functions	20	2,5
4	**Stress physiology** Stress-responses, the role of the hypothalamic hypophyseal-adrenal axis, oxidative stress and mechanism, effect of stress-inducing and anti-stress agents, cardio-respiratory responses during high altitude acclimatization, stress-induced diseases, and remedy, Human tolerances to stresses in space including space flight: Physiological adaptation to space flight, physiology in deep sea diving and other high-pressure operations	20	5

References

1. *Systems Biology: Definitions and Perspectives. Alberghina, L. and Westerhoff, H,*
2. *Essentials of Medical Physiology. K Sembulingam&PremaSembulingam*
3. *Biochemistry and Physiology of the cell. An introductory text second edition- Edwards, N. A Hassall, K.A*
4. *Textbook of Medical Physiology. Arthur.C. Guyton&John.E. Hall*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Laboratory Course-2 (Microbiology & Immunology)**		
Type of course	**Core**	**Credit Value**	**4**
Course code	**IMSC805LS**		
Name of Faculty			
Course Summary& Justification	The course includes training on sterilization and disinfection techniques, morphological, cultural and biochemical study of microbes and antibiotic sensitivity tests. The content of the course also includes serological techniques. The technical knowhow of basic microbiological and serological methods is essential for post graduate programmes in all branches of Biosciences.		
Semester	**VIII**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Independent Learning etc.	-	-	108	12	120

Pre-requisite	Theoretical knowledge in Microbiology and Immunology Basic laboratory skills

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Students will acquire skills on practice of sterile and safety precautions in a Microbiology laboratory	A	2,4,7,8
2	Students will be able to prepare and sterilize media and to culture bacteria and fungi in laboratory	S	2,4,7,8
3	Students will be able to perform and interpret antibiotic sensitivity tests	S,E	2,4,7,8
4	Students will be able to test and analyze the efficacy of disinfectants	S,An	2,4,7,8
5	Students will be able to perform and interpret the various serological tests in a diagnostic laboratory	S,E	2,4,7,8

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	Sterilization methods**,** Cultivation of bacteria and fungi	18	1,4

2	Study of cultural characteristics and biochemical reactions of bacteria	20	2
3	Antibiotic Sensitivity Tests	10	2
4	1. Serological tests for the diagnosis of microbial infections 2. Agglutination and precipitation tests 3. Immunodiffusion in gel 4. ELISA	60	2,3

References

1. *Medical Laboratory Manual for Tropical Countries Vol.2 Monica Cheesbrough ELBS, 2009*
2. *Mackie & McCartney Practical Medical Microbiology Churchil Livingstone,1996*
3. *Experiments in Microbiology, Plant Pathology and Biotechnology, K.R Aneja, New Age International (P) Limited, New Delhi, 2003.*

Teaching and Learning Approach	**Laboratory Procedure (mode of transaction)** • Direct Instruction: lecture, Explicit Teaching, Demonstration, Hands on experimental sections, Skill acquisition by laboratory training, Journal Club
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Nutritional Biochemistry**		
Type of course	**Elective**	**Credit Value**	**2**
Course code	**IMSC806LS 1**		
Name of Faculty			
Course Summary& Justification	The course is designed to provide basic information on nutrition and its importance in providing health.		
Semester	**VIII**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independant Learning etc.	36	-	-	9	45

Pre-requisite	Basics understanding of food and food ingredients

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	To describe the basic principles of nutritional biochemistry and different methods of nutritional analysis.	R, U	1,4,5
2	To identify and compare the different ingredients and nutritional value of food components	A	1,2,4,5
3	To evaluate about different diseases associated with nutritional deficiency and over nutrition	An	1,4,5

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Introduction to nutrition** Food as source of nutrients, functions of food, definition of nutrition, nutrients & energy, adequate, optimum & good nutrition, malnutrition. Basics of energy metabolism, nutrition & dietetics - Unit of measuring energy, calorific value of food, BMR & factors affecting it, SDA of food, calculation of energy requirement, balanced diet, nutrition in health & disease. Nutritional disorders Epidemiology, clinical features, prevention and dietary treatment for Protein Energy malnutrition, nutritional anaemias.	8	1,3

2	**Food sources** Carbohydrates : Functions, classification, food sources, storage in body. Fats & oils : composition, saturated and unsaturated fatty acids, classification, food sources, function of fats. Proteins - composition, sources, essential & non-essential amino acids, functions, Protein deficiency	8	2
3	**Water, Vitamins and minerals** Water - as a nutrient, function, sources, requirement, water balance & effect. Minerals - macro & micronutrients. - functions, sources. Bioavailability and deficiency of Calcium, Iron, Iodine, Sodium & Potassium (very briefly). Vitamins (water & fat soluble) - definition, classification & functions. Effect of cooking & heat processing on the nutritive value of foods. Processed supplementary foods	10	2
4	**Nutritional problems affecting the community** Etiology, prevalence, clinical features and preventive strategies of Undernutrition - Protein energy malnutrition: Nutritional Anaemias, Vitamin A Deficiency, Iodine Deficiency Disorders. Overnutrition – obesity, coronary heart disease, diabetes. Fluorosis	10	3

References

1. *Mudambi, SR and Rajagopal, MV. Fundame ntals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2012; New Age International Publishers*
2. *Mudambi, SR, Rao SM and Rajagopal, MV . Food Science; Second Ed; 2006; New 150 Age Publ*
3. *Srilakshmi B. Nutrition Science; 2012; New Age International (P) Ltd.*
4. *Swaminathan M. Handbook of Foods and Nu trition; Fifth Ed; 1986; BAPPCO*
5. *Bamji MS, Krishnaswamy K and Brahmam GNV (Eds) (2009).*
   Textbook of *Human Nutrition, 3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Toxicology**		
Type of course	**Elective**	**Credit Value**	**2**
Course code	**IMSC806LS 2**		
Name of Faculty			
Course Summary& Justification	Toxicology defines the measurement and analysis of the harmful effects of chemical, biological, and physical agents on living organisms, particularly humans. This course provides students with expertise and training in environmental exposure and regulation. In addition to rigorous coursework in toxicology, students gain the basic concepts and methods in the field.		
Semester	**VIII**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	36	-	-	9	45

Pre-requisite	Basics of cell biology and environmental science

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Students will learn awareness of the importance of toxicology to industry, health, the environment and society	R,U	1-5
2	Provide students with a foundation for interpreting the adverse human health effects associated with exposure to environmental toxicants	U	1-5
3	Students will learn about different Pesticides and there toxicity effect on metabolism and environment	U,E	1-5
4	Students shall acquire practical skills such as the ability to design experiments using a wide range of research techniques, collate and interpret the data accordingly	An,S	1-7
5	Students will learn to evaluate both theoretical and practical application of cytotoxicity studies in cell lines	An,A,Ap	1,6,7

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Introduction, definition and various facets of ecotoxicology** Kinds of toxicity; time & dose response relationships; factors influencing the toxicity; Bioassay- toxicity testing; Role of USFDA. Metabolism of toxic substances: biomagnification, biotransformation and detoxification; Effects of environmental toxicants- sub cellular, cellular, individual, population and ecosystem levels. Toxic risk assessment: Methods, monitoring, importance and surveillance of risk assessment; Environmental Impact Assessment.	8	1,2,4
2	**Atmospheric toxicants: Major sources, types and standards** Primary pollutants- Carbon monoxide, sulphur oxides, nitrogen oxides, particulate matter, hydrocarbons, asbestos and CFCs; Secondary pollutants; Impact of air pollutants on climate-Acid rain, photochemical smog, global warming, ozone depletion and haze. Toxicity of Alcohol, tobacco & its products, food additives, petroleum & petroleum products.	10	2,3
3	**Pesticides** Definition, classification, usage and exposure; Insecticides: Organochlorines - DDT, cyclohexane, aldrin and endosulfan poisoning and treatment; Organophosphates and carbamates- Examples, sources, effects and treatment; herbicides, fungicides, rodenticides, endocrine disrupters. PCBs and Dioxins. Metal toxicity - History, sources, emissions, effect of mercury, cadmium, arsenic and lead on metabolism and environment. Poisoning – antidote.	10	3
4	**Advanced analytical methods of Toxicology** Different analytical methods, Instruments used, Cytotoxicity studies in cell lines, Animal toxicity including renal toxicity, Nanomaterial toxicity of nanopesticides	8	4,5

References

1. *Boudou, A. (1997). Aquatic toxicology. Vol. I and II.*
2. *Diwakar Rao, P.L. (1990).Pollution control Hand book, Utility Publications Ltd., Secunderabad, India.*
3. *Eaton, A.D., Clesceri, L.S. & Greenberg, A.E. (1995).Standard Methods for the Examination of Water and Wastewater. APHA, Washington.*
4. *Gupi P.K. and Salunke, D.K. (1985). Modern Toxicology. Vol.I, II and III. Metropolitan Publications, Delhi.*
5. *Hommadi, A.H. (1990). Environmental and Industrial safety. Indian Bibliographics Bureau, Delhi.*
6. *Jorgensen, S.E., (2000). Modelling in Ecotoxicology. Elsevier, Amsterdam.*
7. *Lewin, S.A. et al., (1989). Ecotoxicology: Problems and approaches. Springer - Verlag, Tokyo, NewYork. 40*
8. *Moriarty, F. (1975). Pollutants and animals: A factual perspective. George Allan &Unwin Ltd., London*
9. *Omkar, (1995). Concepts of Toxicology. Chand & Co., Jallandhar.*
10. *Schmitz, R.J. (1996). Introduction to water pollution biology.Asian Books Pvt. Ltd.,*

New Delhi.

11. *Trivedi, P.R. and Sudarshan, K. (1995). Global environmental issues. Commonwealth Publications, New Delhi.*
12. *Vernberg et al. (1981). Biological monitoring of marine pollutants. Academic Press, New York*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Biophysics and Structural Biology**		
Type of course	**Elective**	**Credit Value**	**2**
Course code	**IMSC806LS 3**		
Name of Faculty			
Course Summary& Justification	This course is to introduce interdisciplinary Biophysics area, its scope and its importance**.** The objective of the course is to give an insight into the basic concepts of thermodynamics, importance of basic biophysical phenomena, conformation and conformational changes, interaction of protein with other molecules and basic knowledge about radiation, its interaction with matter and its applications.		
Semester	**VIII**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	36	-	-	9	45

Pre-requisite	Basics of Biophysics

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Explain the scope and importance of biophysics	E	1
2	Describe the concepts of thermodynamics and applications of basic biophysical phenomena.	U, An	1,2
3	Narrate the conformation and interaction of proteins and nucleic acids	R	1,2
4	Explain the electromagnetic radiation, its interaction with matter and applications	S	1,2
5	Perform the retrieval of biological information by using structural and sequence databases	E	1-3

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Biophysical phenomena and Thermodynamics of biomolecular interactions** Scope and definition of Biophysics, Principle and biological importance of Osmosis, Electroosmosis, osmotic pressure, osmotic equilibrium, Donnan equilibrium, Diffusion, Sedimentation, Filtration, Surface tension, Dialysis, Adsorption and Colloids. Laws of thermodynamics, Enthalpy, Entropy, Free energy, Redox reactions, Redox potential and its calculation by Nernst equation, examples of redox reactions in biological system.	8	2
2	**Structural Biophysics and computational biology** The molecular interactions between proteins and nucleic acids: DNA-protein interaction and RNA- protein interactions, DNA-binding motifs: Helix-turn-Helix motif, Zn fingers, Helix-loop helix motifs and Leucine zippers. Molecular forces: Hydrogen bonding, hydrophobic interactions, Dipole interactions: charge-dipole interactions, induced dipoles, steric repulsion, Vander waals force in biomolecules, Structural and Sequence databases, Alignment algorithms; Retrieval of biological information from widely used resources: NCBI and PDB, Molecular modelling and Structure based drug designing.	8	1,3,5
3	**Radiation Biophysics** Electromagnetic spectrum, Ionizing and non ionizing radiation. Properties and biological effects of ultraviolet radiation, infrared and microwave radiations. Radioactivity, Interaction of radiation with matter. Units of Radiation. Biological effects of radiation. Applications of ionizing and non-ionising radiations in industry, agriculture and research. Radiation hazards.	10	1,3,5

References

1. *Proteins, Structure and molecular properties, Thomas E Creighton*
2. *Biochemistry: Donald Voet and Judith G Voet, Wiley Publications*
3. *Biophysics-Hoope W etal*
4. *Biophysics-Volkenstain M.V*
5. *Molecular Biophysics- Volkenstain M.V*
6. *Introduction to thermodynamics of irreversible process-John Wiley*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Bioanalytical Technology and Instrumentation**		
Type of course	**Elective**	**Credit Value**	**2**
Course code	**IMSC806LS 4**		
Name of Faculty			
Course Summary& Justification	The course is designed to introduce different techniques used in life sciences**.** This content gives knowledge of the principle of operation and design of scientific instruments**.** It attempts to render a broad and modern account of scientific instruments		
Semester	**VIII**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	36	-	-	9	45

Pre-requisite	Basics of biophysics and biostatistics

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	To explain the methods used for gaining information about biological systems on an atomic or molecular level	E	1-4
2	To describe different spectroscopic techniques	U, An	1-4
3	To perform various biophysical fractionation and separation of biomolecules	An,A	1-4
4	To describe how to perform electrophoretic techniques	S	1-4
5	To perform different microscopic techniques	An, C	1-4

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Spectroscopic techniques** Basic principles, nature of electromagnetic radiation, Interaction of light with matter, Absorption and emission of radiation; Atomic & Molecular Energy levels, Electronic, vibrational and Rotational spectroscopy of molecules, transition and selection rules; Atomic & Molecular spectra. Principle, Instrument Design, Methods &	8	1,2

	Applications LC MS, MS-MS, GC MS, ICPMES and MS.		
2	**Physicochemical Fractionation techniques** Principle, Instrument Design, methods and Applications of all types of Adsorption and Partition Chromatography- Paper chromatography, Thin layer chromatography, High Performance Thin layer Chromatography, Gel filtration chromatography, Affinity chromatography, Ionexchange chromatography, High Pressure Liquid Chromatography. Reversed phase chromatography, Hydrophobic interaction chromatography, Chiral chromatography, Counter current chromatography, Fast protein liquid chromatography, Two dimensional chromatography.	8	1,3
3	**Electro analytical techniques** Principle, Electrophoretic mobility (EPM) estimation, factors affecting EPM, Instrument design & set-up, Methodology & Applications of Free and zone Electrophoresis – Paper electrophoresis, Capillary electrophoresis, Isoelectric focusing, , pH meter. Centrfifugation-Forces involved, RCF Centrifugation, techniques- principles, types and applications.Flow cytometry	10	1,4
4	**Microscopic techniques** Principle and working of Phase contrast microscope, Interference microscope, Fluorescence microscope, Polarizing microscope, Scanning and Transmission Electron Microscopy, CCD camera, Introduction to Atomic force microscopy, Confocal microscopy	10	5

References

1. *Proteins, Structure and molecular properties, Thomas E Creighton*
2. *Biochemistry: Donald Voet and Judith G Voet, Wiley Publications*
3. *Biophysics-Hoope W et al*
4. *Biophysics-Volkenstain M.V*
5. *Molecular Biophysics- Volkenstain M.V*
6. *Introduction to thermodynamics of irreversible process-John Wiley*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Bioinformatics and Integrative Genomics**		
Type of course	**Elective**	**Credit Value**	**2**
Course code	**IMSC806LS 5**		
Name of Faculty			
Course Summary& Justification	The course describes a new approach, the concept of "OMICS" in various levels. It is a multi-disciplinary emerging field that encompasses genomics, epigenomics, transcriptomics, proteomics, and metabolomics. **T**he course content explain the high-quality techniques, methods & analysis from genome level will help in the complete understanding of a biological process.These approaches are targeted towards understanding complex systems more thoroughly at the molecular level		
Semester	**VIII**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent, earning etc.	36	-	-	9	45
Pre-requisite	Basics of Molecular Biology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	On completing this course, the student will be able t**o** Explain genome and types of genomics, tool and methods in genomic study, as well as Genome structure of selected organisms.	U,E	1-5
2	Explain the Proteomics, Transcriptomics & Metabolomics & Describe the tool and methods employed to study. Students have able to explain the various application of Proteomics, Transcriptomics & Metabolomics study	An,A	1-5
3	Students have able to illustrate the techniques employed for metagenomic analysis and application of metagenomic study	S,I	1-5
4	Describe the classification and types of databases & applications of data bases	E,A	1-5
5	Communicate effectively about a chosen topic in Biotechnology both practically and theoretically	C,S	1,7

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Genome & Genomics** Definition of Genome & Genomics.Types of genomics,, Functional Genomics.Structural genomics&Comparative genomics, Tools in Genomics,Structural genomics:-Classical ways of genome analysis, large fragment genomic libraries; Physical & Genetic mapping of genomes; Genome sequencing, sequence assembly, annotation& bioinformatics.Functional genomics:-DNA chips and their use in transcriptome analysis; Mutants and RNAi in functional genomicsNext generation sequencing methods; Structure of genomes: bacteria, yeast, nematode, Arabidopsis, rice, zebra fish, mouse and man. Applications of genomics	8	1,5
2	**Proteomics,Transcriptomics & Metabolomics:** Basic concepts , Introduction to transcriptomics,proteomics and metabolomicsTools of proteomics- SDS PAGE, 2D PAGE , Liquid chromatography , Mass Spectrometry (ESI and MALDI) ,Protein identification by peptide mass fingerprinting, Applications of proteomics-. Protein identity based on composition, Motifs and patterns, Analysis and characterization of proteins and metabolites:. Proteomics approaches to the analysis of protein-protein interactions, and metabolic profiling through emerging metabolomic techniques like 2D gel electrophoresis and Mass spectrometric and computational techniques. Applications of proteomics in agriculture, human health and industry	8	2,5
3	**Metagenomics** Definition of metagenomics**,** Techniques in metagenomics-Isolating DNA from an environmental sample Clone DNA, Insert into plasmid, Develop sample library, Screen or sequence, Analysis of metagenomic data. Application of metagenomics	10	3,5
4	**Biological data base** Classification databases. Biological databases-primary sequence databases- Composite sequence databases- Secondary databases-composite protein pattern databases,Pattern and profile databases Genome Information Resources: DNA sequence databases-specialized genomic resources, GRAIL, GENSCANProteome databases Protein sequence databases - SWISS-PROT and TrEMBL — PROSITE and BLOCKS - 2D PAGE databases – Structure databases - PDB- Metabolic databases – post translational modification databases	10	4,5

References

1. *Introduction to proteomics, Daniel. C. Libeler, Humana Press 2002*
2. *Thompson, J.D., Schaeffer-Reiss, C., and Ueffing, M. 2008. Functional Proteomics. Methods andProtocols. Humana Press, New York.*
3. *Metabolomics- Methods and Protocols by Wolfram Weckwerth, Humana Press.*
4. *Aurthur M Lesk Introduction to Bioinformatics .Oxford University press.*

5. *Bostjan Koba.,Mitchell Guss & Thomas Habs Structural Proteomics.Humana Press.*
6. *Twyman, R.M. 2004. Principles of Proteomics. Taylor & Francis*
7. *Mass Spectrometry for Biotechnology by Gary Siuzdak, Academic Press.*
8. *Proteomics for Biological Discovery by Timothy Veenstra and John Yates, Wiley.*
9. *Lipidomics- Technologies and Applications by Kim Ekroos, Wiley-VCH.*
10. *Web/Journal Resources.*
11. *Transcriptomics: Expression Pattern Analysis, Virendra Gomase, Somnath Tagore; VDM Publishing, 2009 – Science*
12. *Brown TA. 2007. Genome III. Garland Science Publ.*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

SEMESTER IX

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**					
Programme	**Five Year Integrated M.Sc. (Life Sciences)**					
Course Name	**Plant molecular biology**					
Type of course	**Core**	**Credit Value**	**3**			
Course code	**IMSC 901 LS**					
Name of Faculty						
Course Summary& Justification	Molecular Biology and its related techniques are inevitable to all branches associated with life sciences**.** The syllabus content in this paper is designed with an objective to help students to understand the theoretical and methodological aspects required to apply molecular information in plant breeding. This will also enable the students to get an idea about the latest developments taking place in this area					
Semester	**IX**					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	54	18	-	8	80
Pre-requisite	Basics of cell and molecular biology, Basics of tools and techniques of genetic engineering					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	On completing this course the students will be able t**o** explain basic concept and application of molecular mapping and marker assisted breeding	U	1
2	List out and differentiate various transformation methods	R,U	1-4
3	Explain the importance method of developing transgenic crops and to Summarize its application	U	1-5
4	To explain the concept of genetic marker and to apply it in plant breeding	U,A	1-8
5	Evaluate the safety issues related to GMO. Students will also understand concept and importance of legal awareness in science in terms of IPR and farmers rights	U,E	7,8
6	To explain different sequencing methods, to differentiate DNA profiling and DNA sequencing and to discuss the functional diversity of alleles in rice and *Arabidopsis thaliana*	E	1-4

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Molecular Mapping and Marker-assisted Breeding** Marker-assisted plant breeding; Relative advantages/ disadvantages in conventional plant breeding and molecular breeding; Molecular polymorphism, Construction of genetic and physical map; Marker Assisted Selection (MAS) for genes of agronomic importance.	12	1,4
2	**Genetic Transformation** Various transformation methods; Vector mediated methods; Agro bacterium-mediated gene delivery, Disarming the Ti plasmid, Virus mediated transformation, and Vectorless methods; Chemical and Physical methods, Principles of vector designing; Screenable and selectable markers, Generation of marker-free transgenic methods, chloroplast transformation.	14	2,3
3	**Transgenic Crops** Transgenic Crops for Resistance to Biotic/abiotic Stresses and Quality Improvement -- Viral resistance, fungal resistance, insects and pathogens resistance, drought, salinity, heat stress, low temperature stress, flooding and submergence stress, post-harvest bioengineering, concept of biofactories, herbicide resistance, engineering other traits, Applications of transgenic crops	12	2,3
4	**Genetic Markers** Plant molecular markers; Classical and DNA Markers, Different DNA Markers; Restriction fragment length polymorphism (RFLP), Random amplified polymorphic DNA (RAPD), Amplified fragment length polymorphism (AFLP). Sequence characterized amplified region (SCAR), Sequence tagged sites (STS) mapping , Cleaved amplified polymorphic sequence (CAPS), Simple sequence repeat (SSR), Inter simple sequence repeat (ISSR), Single nucleotide polymorphism (SNP), Factors influencing efficiency of a marker, Applications, Characteristic features.	12	1,4
5	**Biosafety and IPR-related issues** Production and acceptance of transgenic crops; Public and private sectors in plant biotechnology Intellectual property rights (IPR), Plant breeder's rights (PBRs) and farmer's rights	10	5
6	**Genome Mapping** Sequencing and it's types, DNA Profiling, Genomic study of Rice and *Arabidopsis thaliana*.	12	6

References

1. *Weaver, R. F. (2012) Molecular Biology. McGraw Hill, UK.*
2. *Imaging/Microscopy, general. Cold Spring Harbour Protocols: Web link: http://cshprotocols.cshlp.org/site/ Taxonomy/imaging_microscopy_l1.xhtml.*
3. *Imaging of Protein: Protein Interactions. Cold Spring Harbour Protocols; Web link: http://cshprotocols.cshlp.org/cgi/collection/imaging_of_protein:protein_interactions.*
4. *Imaging Protein Interactions by FRET Microscopy: FRET Measurements by Acceptor Photobleaching. Cold Spring Harbour Protocols: Web Links: http://cshprotocols.cshlp.org /content/2006 /6/pdb.prot4598.abstract.*

5. *Paddock, S. W. (2014) Confocal Microscopy: Methods and Protocols. Humana Press, USA.*
6. *Ruzin, S.E. (1999) Plant Microtechnique and Microscopy. Oxford University Press, USA.*
7. *Altman, A. Hasegawa, P. M. (2011) Plant Biotechnology and Agriculture: Prospects for the 21st Century. Academic Press, USA.*
8. *Gurib-Fakim, A. (2014) Novel Plant Bioresources: Applications in Food, Medicine and Cosmetics. Wiley Blackwell, USA.*
9. *Kirakosyan, A. (2016) Recent Advances in Plant Biotechnology. Springer, USA.*
10. *Stewart, C. N. (Jr.) (2016) Plant Biotechnology and Genetics: Principles, Techniques, and Applications. Wiley, USA.*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** ● Direct Instruction: Lecture, Explicit Teaching, E-learning ● Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests Assignments Seminar Presentation Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**					
Programme	**Five Year Integrated M.Sc. (Life Sciences)**					
Course Name	**Neuroscience**					
Type of course	**Core**	**Credit Value**	**3**			
Course code	**IMSC902LS**					
Name of Faculty						
Course Summary& Justification	This course is designed to provide an overview of Neurobiology. Stress will be placed on methods and concepts rather than facts alone. The course will proceed from the basic biophysical properties of neurons and glia to the physiological basis of learning, memory, and sensory processing					
Semester	**IX**					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	54	18	-	8	80
Pre-requisite	Basic understanding of Physiology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Students should be capable of effectively communicating how neural system works	U	1,4,7
2	Students should be able to explain electricity and the biophysics of cell	E	1,2,4,7
3	Students should describe how do neurons talk to one another	A	1,2,4,7
4	Students should be able to explain how neural circuits organize information	A	1,2,4,7
5	Students should be able to narrate how is information stored	E	1,2,4,7
6	Lastly, students should gain a general understanding how is information collected and processed.	I	1,2,4,7

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Introduction to neurobiology** The structure and distinguishing features of neurons, how is a neuron recognized? The architecture of nervous systems. Neuronal model systems. Chemical/electrical synapses. Recording/ monitoring techniques. Ionic basis of the resting potential. Maintenance of resting membrane potential, passive and active mechanisms, channels and pumps, ionic permeability.	18	1,6
2	**Action potentials and ion channels, Mechanism of nerve action potential** Characteristics of action potential, initiation and propagation of action potential, voltage dependent sodium channels, mechanism of action potential propagation, factors affecting the speed of action potential propagation, molecular properties of voltage sensitive sodium channels, molecular properties of voltage dependent potassium channels, calcium dependent action potentials, voltage- clamp analysis of action potentials	20	2,6
3	**Synaptic transmission** Chemical and electrical synapse, neurotransmitter release, synaptic potential, excitatory synaptic transmission between neurons, excitatory neurotransmitters, inhibitory synaptic transmission, inhibitory neurotransmitters, neurotransmitter gated ion channels, presynaptic inhibition and facilitation, neuronal integration, synaptic transmission at neuromuscular junction	18	3,6
4	**Synaptic plasticity, language and cognition** Short term changes in synaptic strength, long term changes in synaptic strength, modification of synaptic strength in reflex circuits, learning, language function and cortical areas involved in language, cognition, dementia and loss of cognitive abilities	16	5,6

References

1. *Basic Neurochemistry- Molecular, cellular and medical aspects. George J Siegel, Bernard W Agra noff R, Wayne Albers, Stephen K Fisher & Michael D Uhler*
2. *Neurobiology: Molecules, cells and systems. Gary G Mattews*
3. *From Neuron to Brain- John G Nicholls, A Robert Martin, Bruce G Wallace & Paul A Fuchs Neuroscience, edited by Purves, Augustine, Fitzpatrick, Hall, LaMantia, Mooney, Platt and White. Sinauer (2018) Sixth Edition.*
4. *Foundations of Neurobiology, Delcomyn, F. 1st edition W. H. Freeman and Company (1998)*
5. *Behavioral Neurobiology: An Integrative Approach, Zupanc, G. K. H. Oxford University Press. 2nd edition (2010)*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**					
Programme	**Five Year Integrated M.Sc. (Life Sciences)**					
Course Name	**Recombinant DNA Technology**					
Type of course	**Core**		**Credit Value**		**3**	
Course code	**IMSC903LS**					
Name of Faculty						
Course Summary& Justification	Molecular Biology and Genetic Engineering are one of the most dynamic and attractive courses in all branches of applied life sciences**.** The syllabus content in this paper is designed with an objective to train the students in both theoretical and practical aspects of the subject**.** This will also enable the students to get an idea about the latest developments taking place in this subject					
Semester	**IX**					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	54	18	-	8	80
Pre-requisite	Basic understanding of Molecular Biology and Genetic Engineering					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Analyse the use of different tools and techniques of gene cloning in *E. coli* and explain the applications of DNA technology	U	1-7
2	Ability to develop a protocol for cloning a gene from a **s**elected organism	A	1-6
3	Ability to explain verbally and orally the concepts of molecular biology and genetic engineering	E	1-6
4	Ability to write a research proposal based on the concepts discussed in the course	An,C	1-7
5	Critically evaluate and explain the pros and cons of transgenic technology	E	1-7
6	Evaluate the ethical issues of transgenesis, gene therapy and genome editing	An,C	1-7

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Introduction** Introduction to rDNA, Isolation of DNA and RNA from different sources, enzymes used in genetic engineering with special reference to restriction enzymes, ligases, and other DNA modifying enzymes. Vectors-Cloning and Expression vectors with examples. Vectors for *E. coli* with special reference to plasmid vectors (pSC101, pBR322,pUC,their development, features and selection procedures), Bacteriophages - λ and M13 vectors, cosmids, phagemids with special reference to pEMBL, pBluescript, pGEM3Z , pSP64, pcDNA, pLITMUS, Construction of genomic libraries and cDNA libraries, procedures for recombinant selection and library screening,	18	1
2	**Polymerase chain reaction** PCR enzymes, types of PCR, primer design, real time PCR, RTPCR, Nested PCR, Inverse PCR, Assymmetric PCR, applications of PCR Cloning, Chemical synthesis of DNA, DNA sequencing:- plus and minus sequencing, Sangers dideoxy sequencing, Maxam and Gilberts method. Advanced sequencing procedures: – pyrosequencing, Illumina, ABI / SOLiD and their applications	20	2,3,4
3	**Application** Applications of transgenic Technology Improving quality, quantity and storage life of fruits and vegetables. Plants with novel features, Engineering metabolic pathways, Pharming. Animal cloning, Ethics of cloning. Applications of Molecular Biology in forensic sciences, medical science, archeology and paleontology	18	3,4
4	**Applications of recombinant DNA technology** Nuclear transfer technology and animal Pharming- Production of Therapeutic proteins, Metabolic engineering, Animal models for human diseases, gene medicine, DNA vaccines and gene therapy. Genome Editing CRISPR Cas 9, TALENS, ZFN and NHEJ for targeted knock ins and knock outs. Bio-safety and Ethics of gene transfer	16	5,6

References

1. *Principles of gene manipulation – Old, Primrose, and Twyman Blackwell Scientific publishers, Edn 7th*
2. *Molecular biotechnology, Principles and Applications of Recombinant DNA, Glick Pasternak and Patten, 4th edition ISBN 978-1-55581-498-4 Wiley International Publishers*
3. *Advanced Techniques in Diagnostic Microbiology Editors: Wu, Shangwei, Stratton, Charles, 2012*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Laboratory Course-3 (Recombinant DNA Technology)**		
Type of course	**Core**	**Credit Value**	**4**
Course code	**IMSC904LS**		
Name of Faculty			
Course Summary& Justification	The course includes training on sterilization and disinfection techniques, morphological, cultural and biochemical study of microbes and antibiotic sensitivity tests. The content of the course also includes serological techniques. The technical knowhow of basic microbiological and serological methods is essential for post graduate programmes in all branches of Biosciences		
Semester	**IX**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Independent Learning etc.	-	-	108	12	120
Pre-requisite	Theoretical knowledge in Molecular Biology and Genetic Engineering, Basic laboratory skills					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	On completing the course, the students will be able to isolate nucleic acids and proteins from tissues/microorganisms	A	2,4,7,8
2	On completing the course, the students will be able to evaluate quantity and quality of nucleic acids	S	2,4,7,8
3	The students will be able to conduct PAGE and will be able to separate proteins using PAGE	S,E	2,4,7,8
4	The students will be able to amplify a DNA fragment selectively using the PCR technique	S,E	2,4,7,8
5	Conduct plasmid isolation and gene cloning in *E. coli*	S,E	2,4,7,8

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	PAGE- Protein separation Native PAGE-Reagent preparation, Apparatus handling, gel casting, electrophoresis and staining	28	1,3
2	DNA isolation • Estimation of DNA • RNA isolation • Estimation of RNA • Separation of DNA and RNA by Agarose gel electrophoresis	30	1,2
3	Selective PCR amplification of a desired fragment	10	1,2,4
4	• Plasmid isolation • Restriction enzyme digestion • Ligation • Competent cell preparation • Transformation • Screening of recombinants • Expression and purification of recombinant protein	40	5

References

1. *Molecular cloning by Sambrook , Fritsch and Maniatis, Cold Spring harbour laboratories*
2. *Biochemical Methods Sadasivam and Manickam*
3. *Gel electrophoresis of proteins :A practical approach(second edition)B D HAmes and Rickwood D(eds) Oxford University press*
4. *Practical skills in Biomolecular Sciences, Weyers Jonathan, Reed Rob, Jones Allen, Holmes A D, Pearson publications*

Teaching and Learning Approach	**Laboratory Procedure (mode of transaction)** • Direct Instruction: lecture, Explicit Teaching, Demonstration, Hands on experimental sections, Skill acquisition by laboratory training, journal Club
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**					
Programme	**Five Year Integrated M.Sc. (Life Sciences)**					
Course Name	**Biostatistics**					
Type of course	**Elective**	**Credit Value**	**2**			
Course code	**IMSC905 LS 1**					
Name of Faculty						
Course Summary& Justification	The course content is to familiarize the basic concepts of biostatistics and its importance in research area of Life sciences The course content is designed with a view to augment CSIR/UGC syllabus					
Semester	**IX**					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	36	-	-	9	45
Pre-requisite	Basics of Biostatistics					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Explain the scope and importance of biostatistics	E	1-5
2	Perform the retrieval of biological information by using structural and sequence databases	E	1-5
3	Explain the basic concept of biostatistics and analyze, interpret statistical softwares and to do statistical design for their research	An,C	1-8

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Introduction to Biostatistics** Scope of Biostatistics, probability and probability distribution analysis. Variables in biologycollection, classification and tabulation of data-graphical and diagrammatic representation- scatter diagrams, histograms frequency polygon- frequency curve-logarithmic curves.	12	1,3
2	**Descriptive statistics** Measures of central tendency, Arithmetic mean, median, mode, geometric mean, harmonic mean. Measures of dispersion, standard	12	3

	deviation, standard error, variance, coefficient of variation. Correlation and Regression		
3	**Test of significance** Basic idea of significance test- hypothesis testing, levels of significance. Testing of single mean, double mean, single proportion, double proportion in large sample. Testing of single mean, double mean and Paired- t in small sample. ANOVA One way and Two way; Chi-square test of goodness of fit and Chi-square test of independence, comparison of means of two samples, three or more samples. Fundamentals of field experiments randomization, replication and local control. CRD and RBD. Statistical packages	12	2

References

1. *Fundamentals of Biostatistics: Iranian. khan, Attica Khoum, Ukase publications 3. Principles of Biostatistics: Marcello Pagan, Kimberley Gauvreau, Duxbury Press*
2. *Statistical methods in Biology- Briley N.J.T*
3. *Biostatistics: Pardeep K. Jasra, Gurdeep Raj, Krishna prakashan Media.(P) Ltd*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Molecular Parasitology**		
Type of course	**Elective**	**Credit Value**	**2**
Course code	**IMSC905 LS 2**		
Name of Faculty			
Course Summary& Justification	The field of Parasitology enables us to diagnose parasites correctly, understand their life cycle and control them effectively and use few as biocontrol agents. The course shall equip the skill in students to see, appreciate and understand the diversities of parasites in the whole spectrum of ecosysytem		
Semester	**IX**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	36	-	-	9	45

Pre-requisite	Basics understanding of animal diversity

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Explain the fundamentals of parasitology, parasitic invasion in both plants and animals, applicable in medical and agriculture aspects	U	1-6
2	Describe the measures to prevent parasitic attack, Diagnosis, Prophylaxis and Treatment of various parasitic infections	A,An	1-6
3	Communicate effectively about a chosen topic in molecular parasitology both verbally and orally	C	1,7,8

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Introduction to Parasitology** Brief introduction of Parasitism, Parasite, Parasitoid and Vectors, Host parasite relationship, Ecology of parasites, Population dynamics of parasite and establishment of the parasite population in the host body,	12	1,3

	the evolution of parasitism, evolution and co evolution of parasite with respect to host strategy, Important case studies in the field of Parasitology including some historical events such as the role of the mosquito control and the successful completion of the construction of the Panama canal.		
2	**Parasitic Protists** Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani, Plasmodium vivax. Parasitic Platyhelminthes Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Fasciolopsis buski, Schistosoma haematobium, Taenia solium and Hymenolepis nana.	12	2,3
3	**Parasitic Nematodes** Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti and Trichinella spiralis. Study of structure, lifecycle and importance of Meloidogyne (Root-knot nematode), Pratylencus (Lesionnematode), Parasitic Arthropoda Biology, importance and control of ticks, mites, Pediculus humanus, Xenopsylla cheopis and Cimex lectularius. Crustacean parasites. Parasitic Vertebrates A brief account of parasitic vertebrates; Cookiecutter Shark, Candiru, Hood Mockingbird and Vampire bat.	12	2,3

References

1. *Foundations of Parasitology, Roberts L.S. and Janovy J., McGraw-Hill Publishers, New York, USA.*
2. *Modern Parasitology: A Textbook of Parasitology, FEG Cox., Wiley-Blackwell, U. K.*
3. *Parasitology: A Conceptual Approach, Eric S. Loker, Bruce V. Hofkin*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests, Assignments, Seminar Presentation, Review Report B. End Semester Examination (60%)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M. Sc. (Life Sciences)**		
Course Name	**Ethanopharmacology**		
Type of course	**Core**	**Credit Value**	**3**
Course code	**IMSE905 LS 3**		
Name of Faculty			
Course Summary& Justification	Ethanopharmacology is one of the main branch of botany usually deals with the different usages of indigenous plants. This course will introduce students to the different traditional usage of indigenous plants, including the necessity of conservation and knowledge on the active principles generally used by the peoples with different cultural perspective. Here emphasis will be giving on recent researches in the respective fields.		
Semester	**IX**		

Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Others include: Group discussions, Problems solving sessions, Seminars, Independent Learning etc.	54	18	-	8	80

Pre-requisite	Basics knowledge on plant identification

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	On completing this course the students will be able to**.** Identify few indigenous medicinal plants, Explain ethnobotany. Make students familiar with scientific basis such as active principles of indigenous plants and the conservation of indegeouns knowledge	E	1-6
2	Explain the concepts and active principles of traditional medicinal formulations	R, E	1-7
3	Identify by analyzing the active principles and effect of plant extract in various ailments	U	1-6
4	Ability to predict and develop a medicinal formulations by assuming the documented evidence of traditional knowledge	A	1-6
5	Ability to explain verbally and orally the concepts of ethanobotany and pharmacology	E	1,7
6	Recognize the region specificity of few important plant families	U, An	1-5

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Module	Course Description	Hrs.	CO No.
1	**Introduction** Scope and status, Classification, Regional, National & International Contributions, Interests in ethnobotany. Centres of Ethnobotanical studies in India, Methods in the ethnobotanical study: Quantitative approach and Qualitative approaches.	6	1,2,5
2	**Indigenous or Traditional Knowledge** Plants used by ethnic groups as food, medicines (Ethnomedicine), beverages, fodder, fibre, resins, oils, fragrances and other uses. NWFP (Non-Wood Forest Produces), animal products, minerals, artefacts, and rituals, used by Tribal and Folk Communities of Kerala. Traditional/indigenous knowledge and its importance. Ethnobotany and Ethno pharmacology as a tool to protect interests of ethnic groups and rural development.	10	1,2,5
3	**Applications of Ethnobotanical data** Ethno-directed sampling in Biodiversity Prospecting: Plant derived drugs used in traditional medical practice; Traditional Plant management and Environmental conservation; Traditional germplasm management: in situ and ex-situ conservation; Local benefits: Cultural survival and community development: Ethnomedicine and Primary health care; Renewable plant products: Protecting local resources. Commercialization and conservation, Documentation and analysis of ethnobotanical data.	10	1,2,5
4	**Ethnopharmacology** A brief account of Phytochemistry, pharmacodynamics and pharmacokinetics. Difference between herbal/botanicals and pharmaceutical medicine. Classification and sources of crude drugs. Quality, safety and efficacy of herbal medicines or nutraceuticals. Role of ethnopharmacology in drug development. Basic definition and types of toxicology, Regulatory guidelines for conducting toxicity studies as per OECD, Alternative methods to animal toxicity testing. Biopiracy, Intellectual Property Rights (IPR). Ethnopharmacology and IPR issue. The integrated drug development programme, technology transfer and commercialization of Traditional medicine.	13	2,5
5	**Biological screening of herbal drugs** *In vitro* Screening methods used for herbal drugs: Antimicrobial screening of herbal drugs, Screening for anticancer activity, Screening for antioxidant activity, Screening for anti urolythetic activity. *In vivo* Screening methods used for herbal drugs: Screening for anti inflammation and analgesic activity, Screening for antiulcer activity, Screening for anti diuretic activity, Screening for liver-related disorders. Database on pharmaceutical uses of plants	15	6

References

1. *Chaudhuri, Rai, H. N., Guha, A., Roychowdhury, E. & Pal, D. C. 1980. Ethnobotanical uses of Herbaria-II. J. Econ. Tax. Bot. 1:163-168.*
2. *Chaudhuri, Rai, H. N., Banerjee, D. K. & Guha, A. 1977. Ethnobotanical uses of herbaria. Bull. Bot. Surv. India19:256-261.*
3. *Faulks, P.J. 1958. An Introduction to Ethnobotany. Moredale Publications Ltd., London. Ford, R. I.(Ed.). 1978.*
4. *The Nature and Status of Ethnobotany. Anthropological Paper no.67. Museum of Anthrop., Univ. of Michigan.*
5. *Harshberger, J. W. 1896. The Purpose of Ethnobotany. Bot. Gazette 31 : 146-154.*
6. *Jain, S. K. & Rao, R. R. 1983. Ethnobotany in India-An Overview. Botanical Survey of India.*
7. *Jain, S. K. (Ed.). 1981. Glimpses of Indian Ethnobotany. Oxford & IBH Publishing Co.*
8. *Jain, S. K. 1964. The role of a Botanist in folklore Research. Folklore 5:145-150*
9. *Jain, S. K. 1967a. Ethnobotany – Its scope and study. Indian Museum Bull. 2:39-43.*
10. *Jain, S. K. 1995. A Manual of Ethnobotany. Scientific Publishers.*
11. *Jain, S. K., Mudgal, V., Banerjee, D. K., Guha, A., Pal, D. C. & Das, D.1984. Bibliography of Ethnobotany. Botanical Survey of India.*
12. *Ranfrew, Jane. 1973. Paleoethnobotany. Columbia University Press.*

Teaching and Learning Approach	**Class room Procedure (mode of transaction)** • Direct Instruction: Lecture, Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments,Peer teaching and learning, Technology-enabled learning, Library work
Assessment Types	**Mode of Assessment** A. Continuous Internal Assessment (40%) Internal Tests Assignments Seminar Presentation Review Report B. End Semester Examination (60%)

SEMESTER X

School Name	Institute for Integrated programmes and Research in Basic Sciences (IIRBS)		
Programme	Five Year Integrated M.Sc. (Life Sciences)		
Course Name	Major Research Project		
Type of course	**Core**	**Credit Value**	**16**
Course code	**IMSC100PR**		
Name of Faculty			
Course Summary& Justification	As part of this course student is expected to carry out an Internship/ project work under the guidance of a research supervisor, in a reputed research/academic Institutions. This course will provide extensive training on methods and methodology of research in the area of study. Accordingly, the student shall acquire updated knowledge, skill and training on the area of research. At the end of this course student has to submit a detailed project report and present a seminar. It will be evaluated by the Examination Board consisting of both Internal and External Examiners.		
Semester	**X**		
Total Student Learning Time (SLT)	Total Learning Time 5-6 months		
Pre-requisite	Theoretical knowledge in Biology and Basic laboratory skills		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Acquire sufficient Knowledge, training and skills to undertake independent, original and critical research on a relevant topic.	U,A,S,E, C	1-8
2	Gain expertise in Scientific literature survey and academic writing and develop interest for further research	S,I,Ap	4-6
3	Skills to effectively present the objectives, methodology, analysis, and results of the research study.	S	3-7
4	Familiarize with advanced and modern research topics/trends	U, Ap	5-8
5	Capability to plan and use adequate methods to conduct spe-cific tasks in given frameworks	A,An	1-7
6	Gain a consciousness of the ethical aspects of research	U, An	4,6,7
7	Create, analyze and critically evaluate different problems and their solutions	An, E, C	2-8

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Course Description	Months	CO No.
Student shall carry out a 5 to 6 months of Research Project in a relevant area related to Biology and submit the project report/dissertation at the end of the course.	5-6	1-7

Teaching and Learning Approach	**Laboratory Procedure (mode of transaction)** • Direct Instruction: Explicit Teaching, Demonstration, Hands on experimental sections, Skill acquisition by laboratory training, Journal Club
Assessment Types	**Mode of Assessment** • Evaluation of the Project by the Examination Board consisting of the Chairman, both Internal and External Examiners based on the quality and quantity of the project work done, Report, and 30 minutes presentation at the End of the Semester (100 %)

School Name	**Institute for Integrated programmes and Research in Basic Sciences (IIRBS)**		
Programme	**Five Year Integrated M.Sc. (Life Sciences)**		
Course Name	**Comprehensive Viva Voce**		
Type of course	**Core**	**Credit Value**	**4**
Course code	**IMSC100VV**		
Name of Faculty			
Course Summary& Justification	The comprehensive viva-voce shall be conducted by the Examination Board consisting of the Chairman, Internal Examiner and External Examiner. A thorough understanding of all the M.Sc. level course contents and recent trends in the broad area of life sciences are evaluated.		
Semester	**X**		
Total Student Learning Time (SLT)	Total Learning Time		
	-		
Pre-requisite	Thorough knowledge on all the M.Sc. level course contents		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning domain	PSO No
1	Reproduce acquired knowledge/ understanding about the subject of study	R,U,A	1
2	Acquire more in-depth knowledge of the major subject of study and apply this knowledge in diverse contexts.	U,A,I	1-4
3	Develop problem solving ability by promptly analyzing /evaluating a problem	An,E,S	1-6
4	Increase communication skill and confidence of students by question answering and discussion.	S,I,Ap	2,6
5	Able to contribute to research and development work	I	2,4,7,8

** Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

Assessment Types	**Mode of Assessment** • A thorough understanding of all the M.Sc. level course contents and recent trends in the broad area of life sciences are evaluated through questions and discussions by the board of examiners at the End of the Semester (100%)