DEPARTMENT OF MOLECULAR BIOLOGY AND BIOTECHNOLOGY,

FACULTY OF SCIENCE, UNIVERSITY OF PERADENIYA,

PERADENIYA, SRI LANKA

CURRICULUM

(B.Sc. General and B.Sc. Honors)

2018

Introduction

Molecular Biology and Biotechnology (MBB) are two related, newly established, and yet rapidly developing disciplines in Science. This is evident not only from the explosion of establishment of dedicated highwire journals reporting research from these two disciplines, but also from the crafting of the job market, especially in the western countries. Hence, to do have an edge on the modern world, knowledge, skills and research in MBB are essential. Every conventional area in Science such as medicine, pharmaceuticals, food production, exploration of the life-code and environmental management has been greatly influenced by MBB. The Department of MBB was established in the Faculty of Science, University of Peradeniya in 1997 to contribute to the mission of developing and enhancing the creation and dissemination of knowledge in these fields of study. Until 2005, the MBB Department has made an unprecedented contribution to the undergraduate education in the university by offering MBB as a Principal Subject in BSc General Degree Program. In 2005, the Special Degree Program in Molecular Biology and Biotechnology was established. The exponential growth of knowledge and techniques in these two fields over the past 10 years necessitates the development of the curriculum for our graduates to be on the forefront of these rapidly emerging fields. Hence, we are using the following newly revised BSc curriculum of the Department of MBB which includes the contemporary developments and trends in Molecular Biology and Biotechnology.

B.Sc. General and Special Degree Programs

100 LEVEL - MOLECULAR BIOLOGY AND BIOTECHNOLOGY					
Course Number	**Course Title**	**No. of Credits**	**Pre-requisites**	**Compulsory for**	
				General Degree	**Special Degree**
BL 101	Basic Biology	2		√	√
CH 101	Principles of Chemistry I	3		√	√
CH 102	Principles of Chemistry II	3	CH 101	√	√
CH 108	Elementary Chemistry Laboratory I	1		√	√
CH 109	Elementary Chemistry Laboratory II	1	CH 108	√	√
BL 120	Introduction to Biotechnology and its Applications	2			
	Total	**12**		**10**	**10**

200 LEVEL - MOLECULAR BIOLOGY AND BIOTECHNOLOGY					
Course Number	**Course Title**	**No. of Credits**	**Pre-requisites**	**Compulsory for**	
				General Degree	**Special Degree**
MB 201	Biological Chemistry	3	BL 101, CH 101, CH 102	√	√
MB 206	Principles of Genetics	3	BL 101		√
MB 211	Cell and Tissue Culture	2	BL 101		
MB 216†	General Microbiology	1	BL 101	√	√
MB 221	Enzymology	2	BL 101, CH 101, CH 102	√	√
MB 226	Molecular Genetics	3	BL 101, CH 101, CH 102	√	√
BT 201	Plant Diversity I	2			
BT 206	Plant Physiology	2			
CH 221	Organic Chemistry I	2	CH 101, CH 102		
CH 231	Physical Chemistry I	2	CH 101, CH 102		√
CH 232	Molecular Properties, Molecular Spectroscopy and Spectroscopic Instrumentation	1	CH 231		
PH 261	Medical Physics	2			
ST 202	Applied Statistics	2			
ZL 201	Animal Embryology	2			
	Total	**29**		**9**	**14**

300 LEVEL - MOLECULAR BIOLOGY AND BIOTECHNOLOGY					
Course Number	**Course Title**	**No. of Credits**	**Pre-requisites**	**Compulsory for**	
				General Degree	**Special Degree**
MB 301	Biochemistry and Molecular Biology Laboratory	2	MB 201, MB 226	√	√
MB 306	Recombinant DNA Technology	3	MB 201, MB 226	√	√
MB 311	Molecular Cell Biology	3	MB 201		√
MB 316	Molecular Immunology	2	BL 101		√
MB 322	Molecular Biotechnology	2	MB 226, MB 306	√	√
MB 326	Bioinformatics	3	MB 226		√
MB 331	Fermentation Technology	2	CH 101, CH 102		
MB 333	Molecular Phylogenetics	2	MB 206, MB 226		√
MB 335	Molecular Virology	3	MB 226		√
MB 337	DNA and Forensic Medicine Laboratory	2	MB 226		√
BT 302	Advanced Microbiology	2			
BT 304	Plant Pathology	2			
BT 309	Biodiversity and Conservation Management	2			
BT 311	Plant Reproductive Biology and Plant Breeding	2			
CH 341	Analytical Chemistry	3	CH 231		√
CH 361	Environmental Chemistry	3	CH 211, CH 221		
ZL 302	Comparative Anatomy and Animal Physiology	2			
ZL 322	Insect Pest Management	2	ZL 206		
ZL 324	Inland fisheries and aquaculture	2	ZL 307		
	Total	**44**		**7**	**25**

400 LEVEL – MOLECULAR BIOLOGY AND BIOTECHNOLOGY					
Course Number	**Course Title**	**No. of Credits**	**Pre-requisites**	**Compulsory for**	
				General Degree	**Special Degree**
MB 401	Molecular Biology of Plant and Animal Diseases	2	MB 201, MB 226		√
MB 412	Biotechnology Industry	2	MB 322		√
MB 416	Environmental Biotechnology	2	MB 226, MB 322		√
MB 441	Special Topics in Cell and Molecular Biology	3	MB 311		√
MB 472	Scientific Writing and Research Methodology	3			√
MB 488	Biosafety Issues in Biotechnology	2	MB 322		
MB 489	Quantitative Genomics and Molecular Breeding	3			
MB 490	Independent Study	1			
MB 491	Molecular Developmental Biology	3			√
MB 492	Applications of Nanobiotechnology	3	MB 322		
MB 495	Seminar	1			√
MB 499	Research Project	8			√
SI 401	Industrial Training	2			
BT 419	Biological Nitrogen Fixation	2			
ZL 425	Entomology	3	ZL 322		
ZL 426	Developmental Biology	2	ZL 201		
	Total	**42**			**24**

†Available to students who have not offered biology in GCE (A/L).

Course Capsules

100 Level

Code	**BL 120**
Title	**Introduction to Biotechnology and its Applications**
Credits	**02**
Prerequisites	**None**
Compulsory / Optional	**Optional**
Time allocation	**Lectures: 30 hrs.**

Aims:

1. Provide an overview and applications of Biotechnology.
2. Impart the skills of searching latest details and applications of Biotechnology from World Wide Web resources.
3. Explain the importance of the safe use of Biotechnology for the benefit of human beings and the environment.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. list the principles of Biotechnology for general applications,
2. outline the important applications of Biotechnology and list examples,
3. identify the reliable World Wide Web resources to retrieve information on Biotechnology,
4. describe the safe use of Biotechnology and
5. list the strategies to circumvent to malpractices of Biotechnology for annihilation of human beings and the environment.

Course Syllabus / Course Description:

Introduction to Molecular Biology and Biotechnology, historical development, land mark discoveries and pioneering scientists, diverse applications of Biotechnology in medicine, food production and environmental protection. World Wide Web Resources on Biotechnology and their reliability, the fraudulent nature of bioterrorism and how to circumvent it through proper and safe use of Biotechnology. In the contexts of humanitarian and environmental catastrophes, the use of Biotechnology as a developmental tool to face the challenges in the present and future.

Recommended References:

1. Thieman, W.J., and Palladino, M.A. (2012) Introduction to Biotechnology, (Third Edition). Benjamin Cummings.
2. Walker, S. (2006) Biotechnology Demystified, (Fifth Edition). The McGraw-Hill Companies.
3. National Center for Biotechnology Information, U.S. National Library of Medicine, 8600 Rockville Pike, Bethesda, MD, 20894, USA. Website: http://www.ncbi.nlm.nih.gov/ .
4. International Service for the Acquisition of Agri-biotech Applications (ISAAA), Operated in USA, Kenya and Philippines. Website: http://www.isaaa.org/.
5. GMO Compass, the task of GMO Compass is to collect objective, science-based information on the use of genetic engineering in the agri-food industry and present it to the public in a way that is easy to understand and readily accessible. Maintained at Genius GmbH, Robert-Bosch-Str. 7, 64293 Darmstadt, Germany. Website: http://www.gmo-compass.org/eng/.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

200 Level

Code	**MB 201**
Title	**Biological Chemistry**
Credits	**03**
Prerequisites	**BL 101 , CH 101, CH 102**
Compulsory / Optional	**Compulsory for General and Special**
Time allocation	**Lectures: 45 hrs.**

Aims:

1. Impart the knowledge on structure, synthesis and functions of biological molecules.
2. Explain the mechanisms of metabolism and energy reactions.
3. Describe the key concepts of Biological Chemistry as a foundation to Molecular Biology and Biotechnology.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. describe the structure, synthesis, functions and complex interactions of biological molecules,
2. explain the mechanisms of metabolism, energy reactions and transport across membranes and
3. outline and describe the key concepts of Biological Chemistry.

Course Syllabus / Course Description:

The cell as a basic unit of life; major intracellular organelles and their functions; structure and function of the biological membrane; membrane transport; energetics of biochemical reactions, structure, function and metabolism of biomolecules (carbohydrates, lipids, nucleic acids and proteins) in plant and animal cells; control of cellular metabolism.

Recommended References:

1. Nelson, D.L., Cox, M.M. (2012) Lehninger Principles of Biochemistry, (Sixth Edition). Worth Publishers Inc.
2. Berg, J.M., Tymoczko, J.L., Stryer, L. (2010) Biochemistry, (Seventh Edition). Freeman, W.H. and Company.
3. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., Scott, M.P. (2012) Molecular Cell Biology, (Seventh Edition). Freeman, W.H. and Company.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 206**
Title	**Principles of Genetics**
Credits	**03**
Prerequisites	**BL 101**
Compulsory / Optional	**Compulsory for Special and Optional for General**
Time allocation	**Lectures: 45 hrs.**

Aims:

1. Explain the concepts of genetics and its applications in medicine and breeding.
2. Impart the skill of solving genetic problems and interpreting genetic complexities in biological species.
3. Describe the importance of genetics in biodiversity conservation and evolutionary studies.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. describe the principles of Mendelian genetics and it's deviations,
2. explain the concepts of cytogenetics, population genetics, quantitative genetics and conservation and evolutionary genetics,
3. solve problems regarding the complex genetic situations of life and
4. list and explain the application of genetics in medicine and breeding.

Course Syllabus / Course Description:

Mendelian genetics; alterations of Mendel laws; linkage; sex determination; cytoplasmic inheritance; cytogenetics; macro and micro mutations; polyploidy and aneuploidy; population genetics; quantitative genetics; heterosis and hybrid vigor; conservation and evolutionary genetics; applied genetics; medical genetics, principles and practical aspects of breeding and modern applications.

Recommended References:

1. Klug, W.S., Cummings, M.R., Spencer, C.A., Palladino, M.A. (2015) Concepts of Genetics, (Eleventh Edition). Pearson Education Inc.
2. Brown, T.A. (2011) Introduction to Genetics: A Molecular Approach. Garland Science.
3. Pierce, B.A. (2013) Genetics: A Conceptual Approach, (Fifth Edition). Freeman, W.H. and Company.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 211**
Title	**Cell and Tissue Culture**
Credits	**02**
Prerequisites	**BL 101**
Compulsory / Optional	**Compulsory for Special and Optional for General**
Time allocation	**Lectures: 15 hrs. Practicals: 30 hrs.**

Aims:

1. Explain the principles of plant and animal cell and tissue culture.
2. Impart the skills of laboratory techniques in cell and tissue culture.
3. List and describe diverse applications of cell and tissue culture.
4. Provide the strategies and steps of establishing and managing a tissue culture laboratory.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. list and explain the principles of plant and animal cells and tissue culture,
2. conduct experiments and laboratory procedures in cell and tissue culture,
3. explain applications of cell and tissue culture,
4. state the importance of cell and tissue culture in Genetic Engineering and Biotechnology and
5. plan strategies to establish and mange a tissue culture laboratory as a commercial venture.

Course Syllabus / Course Description:

Introduction and general techniques in cell and tissue (plants and animals) culture; preparation of culture media; isolation and culture of animal cells and tissues for assays; cell counting techniques; embryo and meristem cultures; somatic embryogenesis; protoplast isolation and culture. Somatic hybridization; applications of cell and tissue culture; cell and tissue culture as a tool in Genetic Engineering and Biotechnology, micro propagation as a business, establishment and management of a tissue culture laboratory.

Recommended References:

1. Jain, S.M., Haggman, H. (eds) (2007) Protocols for Micropropagation of Woody Trees and Fruits. Springer.
2. Bhojwani, S.S., Dantu, P.K. (2013) Plant Tissue Culture: An Introductory Text. Springer.
3. Smith, R.H. (2012) Plant Tissue Culture, Techniques and experiments, (Third Edition). Elsevier Inc.
4. Mather, J.P., Roberts, P.E. (2013) Introduction to Cell and Tissue Culture: Theory and Techniques (Introductory Cell and Molecular Biology Techniques). Plenum Press, New York.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 216**
Title	**General Microbiology**
Credits	**01**
Prerequisites	**BL 101**
Compulsory / Optional	**Available to students who have not offered biology in GCE (A/L). Compulsory for General and Special**
Time allocation	**Lectures: 5 hrs. Practicals: 20 hrs.**

Aims:

1. Provide an overview and methods of Microbiology.
2. Impart the skills of identifying and culturing microbes using basic microbiological methods.
3. Explain the importance of Microbiology to mankind and the environment.

Intended Learning outcomes:

At the end of the successful completion of course students will be able to,

1. list the principles of Microbiology for general applications,
2. identify general microbes using routine microbiological procedures and
3. state the applications of Microbiology.

Course Syllabus / Course description:

Introduction. Basic groups of microbes; prokaryotic microbes, viruses and eukaryotic microbes. Microbial reproduction. Microbial taxonomy. Typical microbial growth curve, and predict the effect of different environmental conditions. Role of microbes in global C, N, S, and P cycles, and list examples of microbes that contribute these cycles. Symbiotic interactions between microbes and other organisms. Microbial diseases, prevention and treatments. Other applications of Microbiology. Importance of microbes to the environment. Basic laboratory procedures in Microbiology.

Recommended References:

1. Willey, J., Sherwood, L., Woolverton, C.J. (2013) Prescott's Microbiology, (Ninth Edition). McGraw-Hill Education.
2. Talaro, K., Chess, B. (2014) Foundations in Microbiology: Basic Principles, (Ninth Edition). McGraw-Hill Education.
3. Glazer, A.N., Nikaido, H. (2007) Microbial Biotechnology: Fundamentals of Applied Microbiology, (Second Edition). Cambridge University Press.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 221**
Title	**Enzymology**
Credits	**02**
Prerequisites	**BL 101, CH 101, CH 102**
Compulsory / Optional	**Compulsory for General and Special**
Time allocation	**Lectures: 15 hrs. Practicals: 30 hrs.**

Aims:

1. Explain the concepts and experimental procedures used in enzyme studies.
2. Impart the skills required for laboratory experiments in Enzymology.
3. List and explain the applications of enzymes in industry.
4. Describe the methods of protein engineering as a tool in designing novel enzymes or improving the capabilities of existing enzymes.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. describe the enzymes in relation to structure, function and factors affecting on the activity,
2. conduct experiments in Enzymology,
3. list and explain the applications of enzymes in industry and
4. explain the procedure of protein engineering as a tool in Biotechnology.

Course Syllabus / Course Description:

Enzymes as catalysts in biological systems; protein structure and folding; classification and nomenclature of enzymes; mechanism of enzyme action; kinetics of enzymatic reactions; quantitative and qualitative aspects of enzyme activity; effect of temperature, pH, substrate, enzyme concentration and inhibitors on enzyme activity; mode of enzyme regulation; qualitative tests for different types of enzymes; isozymes and isozyme analysis; enzyme assay methods; purification and characterization; application of enzyme technology in industry; protein engineering.

Recommended References:

1. Scope, R.K. (1993) Protein Purification: Principles and Practice, (Third Edition). Springer.
2. Fersht, A. (1999) Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding, (Third Edition). Freeman, W.H. and Company.
3. Nelson, D.L., Cox, M.M. (2012) Lehninger Principles of Biochemistry, (Sixth Edition). Worth Publishers Inc.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 226**
Title	**Molecular Genetics**
Credits	**03**
Prerequisites	**BL 101, CH 101, CH 102**
Compulsory / Optional	**Compulsory for General and Special**
Time allocation	**Lectures: 45 hrs.**

Aims:

1. Provide knowledge in structure, function, regulation of genes and genetic disorders.
2. Explain genes and genomes regarding the genome structure and arrangements.
3. Describe the procedures in central dogma and DNA repair.
4. Explain the basis and application of DNA cloning and microarrays.
5. Describe the fundamental procedures of genome mapping.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. explain the structure, function and regulation of genes and their expression,
2. describe the genes, genomes and genome mapping techniques,
3. list the steps and explain the procedures of central dogma and DNA repair,
4. state the fundamentals and applications of DNA cloning and microarrays and
5. list the applications of molecular genetic manipulations in Biotechnology.

Course Syllabus / Course Description:

Organization of prokaryotic and eukaryotic genomes; genes and chromosomes; mitochondrial and chloroplast DNA; mobile genetic elements; genome replication; genetic recombination; DNA repair; RNA synthesis, processing and metabolism; the genetic code; protein synthesis; regulation of gene expression; DNA cloning and microarrays; genetic disorders and gene therapy; genomics and genome projects; overview of genome mapping.

Recommended References:

1. Strachan, T., Read, A. (2010) Human Molecular Genetics, (Fourth Edition). Garland Science.
2. Watson, J.D., Baker, T.A., Bell A.P., Gann, A., Levine, M., Losiick, R. (2013) Molecular Biology of the gene, (Seventh Edition). Cold Spring Harbor Laboratory Press. Pearson.
3. Nelson, D.L., Cox, M.M. (2012) Lehninger Principles of Biochemistry, (Sixth Edition). Worth Publishers Inc.
4. Weaver, R.F. (2011) Molecular Biology, (Fifth Edition), McGraw-Hill.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

300 Level

Code	**MB 301**
Title	**Biochemistry and Molecular Biology Laboratory**
Credits	**02**
Prerequisites	**MB 201, MB 226**
Compulsory / Optional	**Compulsory for General and Special**
Time allocation	**Practicals: 60 hrs.**

Aims:

1. Explain and demonstrate the experimental procedures in Biochemistry and Molecular Biology.
2. Impart skills to plan, conduct and report the experiments.
3. Demonstrate, explain and impart skills to operate general equipment such as thermal cycles etc.
4. Explain the safety procedures of the lab personnel and protocols to protect the lab equipment for prolonged use.
5. Introduce the procedure of the acquisition of chemicals, consumables and equipment to the laboratories.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. plan, conduct and report experimental procedures in Biochemistry and Molecular Biology,
2. operate general equipment used under the supervision of experts,
3. follow safety procedures for lab personnel and the equipment,
4. identify the norms and general practices in laboratories of Biochemistry and Molecular Biology and
5. list the procedure of the acquisition of chemicals, consumables and equipment to the laboratories.

Course Syllabus / Course Description:

UV-visible spectroscopy; chromatographic methods; electrophoresis; DNA and RNA purification and analysis; polymerase chain reaction (PCR); restriction fragment length polymorphism (RFLP); DNA sequencing; southern and northern transfer techniques; immunochemical methods; radioactive and non-radioactive detection methods.

Recommended References:

1. Green, M.R., Sambrook, J. (2012) Molecular Cloning – A Laboratory Manual, (Fourth Edition). Cold Spring Harbor Laboratory.
2. Ninfa, A.J., Ballou, D.P., Benore, M. (2009) Fundamental Laboratory Approaches for Biochemistry and Biotechnology, (Second Edition). John Wiley and Sons, Inc.
3. Greenfield, E.A. (2014) Antibodies: A Laboratory Manual, (Second Edition), Cold Spring Harbor Laboratory.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 306**
Title	**Recombinant DNA Technology**
Credits	**03**
Prerequisites	**MB 201, MB 226**
Compulsory / Optional	**Compulsory for General and Special**
Time allocation	**Lectures: 30 hrs. Practicals: 30 hrs.**

Aims:

1. Explain the concepts and experimental procedures in Recombinant DNA Technology.
2. Impart the skills required for laboratory experiments in Recombinant DNA Technology.
3. Describe the strategies and steps of creating transgenic and cisgenic organisms.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. describe the concepts and procedures in Recombinant DNA Technology,
2. conduct basic experiments in Recombinant DNA Technology and
3. explain the steps of creating transgenic and cisgenic organisms.

Course Syllabus / Course Description:

Introduction to Recombinant DNA technology; purification and manipulation of DNA; cloning vectors; transformation; production of genomic and cDNA libraries; isolation, identification & characterization of cloned genes; gene expression; restriction mapping; generation of transgenic and cisgenic plants and animals.

Recommended References:

1. Green, M.R., Sambrook, J. (2012) Molecular Cloning – A Laboratory Manual, (Fourth Edition). Cold Spring Harbor Laboratory.
2. Brown, T.A. (2010) Gene cloning and DNA analysis: An Introduction, (Sixth Edition). Willey Blackwell.
3. Watson, J.D., Meyes, R.M., Caudy, A.A., Witkowski, J.A. (2007) Recombinant DNA: Genes and Genomes – A Short Course: Watson, Recombinant DNA, (Third Edition). Macmillan Higher Education.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 311**
Title	**Molecular Cell Biology**
Credits	**03**
Prerequisites	**MB 201**
Compulsory / Optional	**Compulsory for Special and Optional for General**
Time allocation	**Lectures: 45 hrs.**

Aims:

1. Explain the advanced details of cellular structure and function.
2. Describe the mechanisms of transport across membranes, cell-cell signaling and sensory system.
3. Provide the steps of cell cycle and apoptosis and state the deviations in irregular cells.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. identify the cellular structure, functions, subcellular organelles and explain them in detail,
2. explain the complex mechanisms of membrane transport and inter cellular signaling systems and
3. list and explain the detailed steps of cell cycle and apoptosis, and identify the deviations in irregular cells such as cancer cells.

Course Syllabus / Course Description:

Structure of eukaryotic and prokaryotic cells; cell organelles and functions; cell membrane, function and transport cross membranes; protein trafficking; organelle biogenesis; cytoskeleton and cell motility; extracellular matrix and cell adhesion; cell-to cell signaling; signaling in the sensory system; cell cycle, regulation and apoptosis.

Recommended References:

1. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretsher, A., Ploegh, H., Amon, A., Scott, M.P. (2012) Molecular Cell Biology, (Seventh Edition). Freeman, W.H. and Company.
2. Alberts, B., Johnson, A., Lewis, J., Morgan D., Raff, M., Roberts, K., Walter, P. (2004) Molecular Biology of the Cell, (Sixth Edition). Garland Science.
3. Craig, N., Green, R., Greider, C., Storz, G., Wolberger, C., Cohen-Fix, O. (2014) Molecular Biology: Principles of Genome Function, (Second Edition). Oxford University Press.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 316**
Title	**Molecular Immunology**
Credits	**02**
Prerequisites	**BL 101**
Compulsory / Optional	**Compulsory for Special and Optional for General**
Time allocation	**Lectures: 15 hrs. Practicals: 30 hrs.**

Aims:

1. Explain the cellular and molecular basis of Immunology.
2. Demonstrate and impart skills required to undertake laboratory procedures in Immunology.
3. Explain the synthesis and applications of antibodies for disease diagnosis and treatments.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. describe the cellular and molecular basis of Immunology,
2. conduct laboratory experiments in Immunology and
3. explain the synthesis and applications of antibodies for disease diagnosis and treatments.

Course Syllabus / Course Description:

The immune system; structure and function of immunoglobulins; cells of lymphoid systems; response to antigenic stimulation; antigenic determinants; antigen processing and presentation; intercellular interactions; compliment system and its function; biology of the major histocompatibility complex; mechanisms of immunity and hypersensitivity; Immunmodulatory products of parasites; diagnostic assays using antibodies; polyclonal and monoclonal antibodies; phage antibody production; immunochemical methods.

Recommended References:

1. Murphy, K. (2011). Janeway's Immunobiology, (Eighth Edition). Garland Science.
2. Delves, P.J., Martin, S.J., Burton, D.R., Roitt, I.M. (2011) Roitt's Essential Immunology, (Twelfth Edition). Wiley-Blackwell.
3. Abbas, A.K., Lichtman, A.H.H., Pillai, S. (2014) Cellular and Molecular Immunology, (Eighth Edition). Elsevier Saunders.
4. Greenfield, E.A. (Ed) (2014) Antibodies; A Laboratory Manual, (Second Edition). Cold Spring Harbor Laboratory Press.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 322**
Title	**Molecular Biotechnology**
Credits	**02**
Prerequisites	**MB 226, MB 306**
Compulsory / Optional	**Compulsory for General and Special**
Time allocation	**Lectures: 30 hrs.**

Aims:

1. Explain the principles, procedures and applications of Biotechnology.
2. Describe the potentials of Biotechnology for national and global development.
3. List and explain the Biotechnology as a business and the need for its regulation.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. describe the concepts and applications of Biotechnology for the benefit of mankind,
2. list the potentials of Biotechnology for the development,
3. explain Biotechnology as a Business venture and required regulatory steps for its safe use and
4. identify the career opportunities in the field of Biotechnology.

Course Syllabus / Course Description:

Genetically modified organisms, and their applications; Emergence of Molecular Biotechnology, microbial biotechnology, agricultural biotechnology, medical biotechnology, germplasm assessment and conservation, aquatic biotechnology, bioremediation, effective microorganisms, bioprospecting, regulation of Biotechnology, Biotechnology as a business, career prospects in Biotechnology.

Recommended References:

1. Brown, T.A. (2010) Gene Cloning and DNA Analysis: An Introduction, (Sixth Edition). Wiley-Blackwell.
2. Glick, B.R., Pasternak, J.J., Pattern, C.L. (2009) Molecular Biotechnology: Principles and Applications of Recombinant DNA, (Fourth Edition). American Society for Microbiology Press, Washington DC.
3. Dehlinger, C.A. (2014) Molecular Biotechnology, Jones and Bartlett Learning.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 326**
Title	**Bioinformatics**
Credits	**03**
Prerequisites	**MB 226**
Compulsory / Optional	**Compulsory for Special and Optional for General**
Time allocation	**Lectures: 45 hrs.**

Aims:

1. Explain the molecular biological databases and tools and demonstrate how to use them in research and development.
2. Impart skills to use molecular biological data bases and tools to design and execute molecular applications.
3. Impart skills to use bioinformatics algorithms to interpret sequence and structure data.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. browse, search and retrieve molecular biological data from publicly available data bases and analyze them using bioinformatics tools,
2. explain the fundamental concepts and basic algorithms used in bioinformatics,
3. analyze sequence and structure data for a molecular biological application and
4. design primers and probes for a given nucleic acid sequence.

Course Syllabus / Course Description:

Molecular databases; bioinformatics and computational biology software; sequence alignment;; phylogenetic analysis; functional genomics; genome analysis; complete genome; DNA micro arrays; protein structure analysis, motif identification, evolutionary alignments and structure prediction; drug design; archives and information retrieval, introduction to Systems Biology.

Recommended References:

1. Baxevanis, A. D., Ouellette, B.F. (2004) A Practical Guide to the Analysis of Genes and Proteins, (Third Edition). Wiley-Interscience.
2. Pevsner, J., (2009) Bioinformatics and Fundamental Genomics, (Second Edition). Willey Blackwell.
3. Mount, D.W. (1910) Bioinformatics: Sequence And Genome Analysis, (Second Edition). IDEA Group Publishing.
4. Lesk, A.M. (2014) Introduction to Bioinformatics, (Fourth Edition). Oxford University Press.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 331**
Title	**Fermentation Technology**
Credits	**02**
Prerequisites	**CH 101, CH 102**
Compulsory / Optional	**Optional for General and Special**
Time allocation	**Lectures: 30 hrs.**

Aims:

1. Explain the process of Fermentation Technology, products and state how Biotechnology can be used to improve the traditional process.
2. Describe how the bioreactors are used in large scale operations.
3. State how to use functional genomic approaches for the improvement of organisms used in Fermentation Technology.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. outline and describe the Fermentation Technology,
2. list the essential products of fermentation in medicine and food industry,
3. explain the microbial growth kinetics in diverse bioreactor operations and
4. list the functional genomic approaches of improving organisms for fermentation kinetics.

Course Syllabus / Course Description:

Microorganisms used in industrial fermentation; isolation and preservation of pure cultures; mutants, factors influencing rate of mutation; bioreactor design and operation; fermentation kinetics; culture media; sterilization; control of different parameters; process monitoring; isolation of products; current applications, synthesis of secondary metabolites, strain improvement applications of functional genomics in fermentation technology.

Recommended References:

1. El-Mansi, E.M.T., Bryce, C.F.A., Dahhou, B., Sanchez, S., Demain, A.L., Allman, A.R. (Ed) Fermentation Microbiology and Biotechnology. CRC Press, Taylor and Francis Group.
2. Dehlinger, C.A. (2014) Molecular Biotechnology, Jones and Bartlett Learning.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 333**
Title	**Molecular Phylogenetics**
Credits	**02**
Prerequisites	**MB 206, MB 226**
Compulsory / Optional	**Compulsory for Special**
Time allocation	**Lectures: 30 hrs.**

Aims:

1. Explain the molecular basis of Evolution and Taxonomy.
2. Impart skills to construct molecular phylogenies to assess biodiversity.
3. Impart skills to use related software for molecular phylogenetic data analysis.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. describe how evolution is taking place at molecular level and explain molecular taxonomy as an alternative or extension to classical taxonomy,
2. draw and tabulate molecular phylogenies and interpret them and
3. use software for molecular phylogenetic data analysis.

Course Syllabus / Course Description:

Introduction to evolution and systematics; molecular basis of heredity and evolution; genetic maps; general principle of systematics; phylogenetic variations in plant and animal taxa (cladistics and phonetics etc.); molecular phylogenies; speciation and hybridization; applications of molecular methods in biodiversity assessment; *in vitro* germplasm conservation.

Recommended References:

1. Ridley, M. (2003) Evolution, Blackwell.
2. Hall, B.K., Hallgrimsson, B. (2013) Strickberger's Evolution, (Fifth Edition). Jones and Bartlet Publishers.
3. Yang, Z. (2014) Molecular Evolution: A Statistical Approach, (First Edition). Oxford University Press.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 335**
Title	**Molecular Virology**
Credits	**03**
Prerequisites	**MB 226**
Compulsory / Optional	**Compulsory for Special and Optional for General**
Time allocation	**Lectures: 45 hrs.**

Aims:

1. Explain the biology and molecular mechanisms of viruses.
2. Describe the pathogenicity of virus and how to develop the host's immunity.
3. List the anti-viral treatments, uses of viruses and explain the basis of vaccination.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. describe the diversity and molecular biology of virus,
2. explain the pathogenic nature of virus and host immune responses and
3. list anti-viral treatments, uses of virus in molecular biology and biotechnology and explain the process of vaccination.

Course Syllabus / Course Description:

History of virology and general characteristics of viruses; virus classification; structure and genomes; virological methods; virus infection cycle; virus receptors and mechanism of virus entry; replication and transcription of RNA viruses; reverse transcription and integration of DNA viruses; replication and transcription of DNA viruses; viral protein synthesis; virus assembly and exit; virus pathogenesis; oncogenic transformation; host resistance to viral infection; antiviral treatment; HIV and AIDS; exploitation of viruses in gene therapy.

Recommended References:

1. Flint, S.J., Racaniello, V.R. (2015) Principles of Virology, Vol. 1 and 2 (Fourth Edition). ASM Press.
2. Shors, T. (2011) Understanding Viruses (Second Edition). Jones & Bartlett Learning.
3. Cann, A.J. (2015) Principles of Molecular Virology, (Sixth Edition). Elsevier.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 337**
Title	**DNA and Forensic Medicine Laboratory**
Credits	**02**
Prerequisites	**MB 226**
Compulsory / Optional	**Compulsory for Special and Optional for General**
Time allocation	**Lectures: 20 hrs. Practicals: 20 hrs.**

Aims:

1. Explain the essential nature of DNA based evidences in modern day justice.
2. Describe the detailed procedure of DNA profiling to establish the personal identities in criminal and non-criminal cases.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. describe how DNA band evidence improves the accuracy of modern day justice,
2. explain the detailed procedure of DNA profiling and
3. state why standard and accredit laboratory practices are required in DNA forensics.

Course Syllabus / Course Description:

Principles and methods of DNA profiling; recent examples; biological evidences and serology, distribution and spattering of blood and other useful biological samples, isolation of DNA from forensic samples, techniques in DNA analysis; forensic DNA databases; STR population data analysis, forensic genetics, challenges and case studies, accreditation and quality control, applications such as criminal investigations and paternity analysis, implications in law enforcements, future trends.

Recommended References:

1. Dehlinger, C.A. (2014) Molecular Biotechnology, Jones and Bartlett Learning.
2. Rudin, N., Inman, K. (2001) An Introduction to Forensic DNA Analysis (Second edition). CRC Press.
3. Buttler, J.M. (2014) Advance Topics in Forensic DNA Typing: Interpretation. Elsevier.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

400 Level

Code	**MB 401**
Title	**Molecular Biology of Plant and Animal Diseases**
Credits	**02**
Prerequisites	**MB 201, MB 226**
Compulsory / Optional	**Compulsory for Special**
Time allocation	**Lectures: 30 hrs.**

Aims:

1. Explain the molecular basis of genetic, abiotic disorders and infectious diseases in plant and animals.
2. Describe the process of designing drugs and diagnostic procedures.
3. Explain the mechanisms of resistance development and outline and describe strategies to mitigate it.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. outline and describe the molecular basis of plant and animal diseases,
2. list and explain the steps designing drugs and molecular diagnostics and
3. explain the building up of resistance against drug and state strategies to overcome it.

Course Syllabus / Course Description:

Genetic disorders; abiotic stresses; infectious diseases; host-parasite interactions; infectiousness of disease causing agents; host response to disease causing agents; diagnosis of disease; treatment; molecular aspects to drug resistance; rational drug design.

Recommended References:

1. Agrios, G.N. (2002) Plant Pathology, (Fifth Edition). Elsevier Academic Press.
2. Fox, R.T.V. (1993) Principals of Diagnostic Techniques in Plant Pathology C & B Intl.
3. Delves, P.J., Martin S.J., Burton, D.R., Roitt, I.M. (2011) Roitt's Essential Immunology, (Twelfth Edition). Wiley-Blackwell.
4. Cheng, L., Zhang, D.Y., Eble, J.N. (Eds) (2013) Molecular Genetic Pathology, (Second Edition). Springer Reference.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 412**
Title	**Biotechnology Industry**
Credits	**02**
Prerequisites	**MB 322**
Compulsory / Optional	**Compulsory for Special**
Time allocation	**Lectures: 30 hrs.**

Aims:

1. Explains the process and diverse applications of Biotechnology Industry.
2. Show and describe the concept of White Biotechnology for safe and sustainable use.
3. Explain and discuss the future / current advancements of Biotechnology which has industrial potentials.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. describe the large scale operations of Biotechnology Industry,
2. list and explain the diverse applications of Biotechnology Industry,
3. list and explain the strategies required to use Biotechnology Industry for development and
4. state future advancements.

Course Syllabus / Course Description:

Pharmacogenomics for personalized medicine, concept of White Biotechnology, industrial production process according to Kyoto objective applications, economic potential and implications for the society, biopharmaceuticals, food and feed, paper and pulp, bio-energy and high-tech food production with GM , Bio-refineries.

Recommended References:

1. Soetaert, W., Vandamme, E.J. (2010) Industrial Biotechnology: Sustainable Growth and Economic Success, (First Edition). Willey-UCH.
2. Kamm, B., Grubew, P.R., Kamm, M. (2010) Biorefineries Industrial Processes and Products: Status Quo and Future Directions. Wiley-UCH.
3. Da Silva, S.S., Chandel, A.K. (2014) Bio Fuels in Brazil: Fundamental Aspects, Recent Development and Future Perspectives. Springer.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 416**
Title	**Environmental Biotechnology**
Credits	**02**
Prerequisites	**MB 226, MB 321**
Compulsory / Optional	**Compulsory for Special**
Time allocation	**Lectures: 30 hrs.**

Aims:

1. Explain the utmost requirement of minimizing environmental pollution and introduce Environmental Biotechnology as one of the major mitigation measure.
2. Describe the gene manipulation that can be used to improve living organisms for Environmental Biotechnology.
3. State and list the component of integrated Environmental Biotechnology.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. explain the principles and applications of Environmental Biotechnology,
2. describe how genetic manipulation can enhance the potential of organisms that can be used in environmental management and pollution detection and
3. outline the procedures of integrated Environmental Biotechnology.

Course Syllabus / Course Description:

Living organisms as pollution indicators; biodegradation; waste management; pollution treatment; bio-mining; biogas production; microbes in environmental management, phytotechnology and photosynthesis, biotechnology waste, genetic manipulation, integrated Environmental Biotechnology.

Recommended References:

1. King, R.B., Long, G.M., Sheldon, J.K., (1997) Practical Environmental Bioremediation: The Field Guide, (Second Edition). CRC Press.
2. Ergas, S.J., Daniel, P., Chang, Y., Schroeder, E.D., Eweis, J.B. (Eds) (1998) Bioremediation Principles. McGraw-Hill.
3. Evans, G.M., Furlong, J.C. (2010) Environmental Biotechnology: Theory and Application. Willey-Blackwell.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 441**
Title	**Special Topics in Cell and Molecular Biology**
Credits	**03**
Prerequisites	**MB 311**
Compulsory / Optional	**Compulsory for Special**
Time allocation	**Lectures: 45 hrs.**

Aims:

1. Explain the advanced concepts and details of the Molecular Biology of cancer.
2. Describe the fate of stem cells and potential manipulations.
3. Explain the molecular aspects of germ line cells - sex differentiation in mammals.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. outline and provide the details of Molecular Biology of cancer,
2. explain the formation and differentiation of stem cells and the procedure of stem cell engineering and
3. describe the molecular mechanism of mammalian sex differentiation and fertilization.

Course Syllabus / Course Description:

Cancer as a micro-evolutionary process; the preventable causes of cancer, finding the cancer critical genes; the molecular basis of cancer cell behavior; cancer treatment: present and future. epidermis and its renewal by stem cells, renewal by multi-potent stem cells: blood cell formation; fibroblasts and their transformations, stem cell engineering. primordial germ cells and sex determination in mammals; eggs; sperm; fertilization.

Recommended References:

1. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P. (2004) Molecular Biology of the cell, (Sixth Edition). Garland Science.
2. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon A., Scott, M.P. (2012) Molecular Cell Biology, (Seventh Edition). Freeman, W. H. and company.
3. Karp, G. (2013) Cell and Molecular Biology Concepts and Experiments, (Seventh Edition). Wiley PLU.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 472**
Title	**Scientific Writing and Research Methodology**
Credits	**03**
Prerequisites	**None**
Compulsory / Optional	**Compulsory for Special**
Time allocation	**Lectures: 45 hrs.**

Aims:

1. Explain the components and procedures of writing research proposals and papers (manuscripts).
2. Describe the research philosophy and the responsible conductance of research.
3. Explain the publication process and indices of measuring scientific productivity.
4. Impart skills in scientific writing and presentations.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. explain the components and needs of a research proposal,
2. write a complete research proposal,
3. list and explain the components of research philosophy and the responsible conduct of research,
4. write the draft research reports (thesis), manuscripts and
5. list and explain the modern indices explaining productivity of researchers and institutes.

Course Syllabus / Course Description:

Review of research area; introduction to project; types and purposes of project proposals; structure and components of proposal; covering letter and the recipients of the proposal; identifying, justifying and presenting a problem; literature review and development of proposal; time frame, resource identification and budgeting; research philosophy, responsible conduct of research, monitoring project progress, thesis writing, avoidance of plagiarism, indices to measure productivity of scientists and research organizations.

Recommended References:

1. Graustein, J.S. (2013) How to Write an Exceptional Thesis or Dissertation: A Step–By–Step Guide from Proposal to Successful Defense. Atlantic Publishing Group.
2. Schimel, J. (2011) Writing Sciences: How to Write Papers that get Cites and Proposal that get Funded. Oxford University press.
3. Locke, L.F., Spirduso, W.W., Silverman, S.J. (2013) Proposals that work: A Guide for Planning Dissertations and Grant Proposals, (Sixth Edition). SAGE publication.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 488**
Title	**Biosafety Issues in Biotechnology**
Credits	**02**
Prerequisites	**MB 321**
Compulsory / Optional	**Optional**
Time allocation	**Lectures: 30 hrs.**

Aims:

1. Provide an overview and international guidelines of regulating the products from genetically modified organisms.
2. Impart the skills of formulating a biosafety framework based on scientific experimentation for proper regulation of genetically modified organisms in a country.
3. Explain the diverse opinions of public on the use of genetic engineering to produce genetically modified organisms.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. describe the current status of genetically modified organisms and international treaties available for regulation,
2. identify the factors affecting on gene flow from genetically modified organisms to wild relatives,
3. explain the safety guidelines for the research involving recombinant DNA,
4. outline the steps in designing experiments to release genetically modified organisms to a given country / location,
5. describe the experiments required to confirm the food safety issues of genetically modified organisms and
6. be able to draft a biosafety framework for a country based on food and environmental safety issues for the sustainable and safe use of genetically modified organisms for national development.

Course Syllabus / Course Description:

Status of molecular biotechnology in the world, use of genetically modified organisms in food industry and medicine, international treaties on biosafety such as Cartagena protocol, potential risks and their assessment, transgene introgression from genetically modified crops to their wild relatives (gene flow issues), the international guidelines for research involving recombinant DNA molecules, the release of genetically modified crops into the environment, food safety, biosafety framework for a country, the role of science in making informed decisions through transparent dialogues, globalization and the international governance of modern biotechnology for safe use.

Recommended References:

1. Ludlow, K., Smyth, S.J., Falck-Zepeda J. (2014) Socio-Economic Considerations in Biotechnology Regulation. Springer.
2. Grumet, R., Hancock, J.F., Maredia, K.M., Weebadde, C. (2011) Environmental Safety of Genetically Engineered Crops, Michigan State University Press, USA.
3. Knechtges, P.L. (2011) Food Safety: Theory and Practice. Jones and Bartlett Learning.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 489**
Title	**Quantitative Genomics and Molecular Breeding**
Credits	**03**
Prerequisites	**None**
Compulsory / Optional	**Optional**
Time allocation	**Lectures: 45 hrs.**

Aims:

1. Provide extensive knowledge on the concepts of Quantitative Genomics and Molecular Breeding.
2. Explain the computational procedures related to marker assisted selection.
3. Impart the skills on the use of statistical software in Genomic and Molecular Breeding applications.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. explain the principles of Quantitative Genomics and Molecular Breeding,
2. describe and use computational procedures for marker assisted selection and
3. use statistical software related to Quantitative and Molecular Breeding applications.

Course Syllabus / Course Description:

Advanced quantitative genetics and genomics, parametrical and non-parametrical statistical methods and related software, genome mapping and molecular markers, QTL theory, haplotype analysis, marker assisted selection as the basis of molecular breeding, association mapping, SNP platforms and GBS data, assessment and estimation of genomic diversity in germplasm conservation and management, definition of core-collections.

Recommended References:

1. Xu, S. (2013) Principles of Statistical Genomics, Springer.
2. Khatib, H. (2015) Molecular and Quantitative Animal Genetics, Wiley Blackwell.
3. Xu, Y. (2010) Molecular Plant Breeding, CAB International.

Assessment Criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 490**
Title	**Independent Study**
Credits	**01**
Prerequisites	**None**
Compulsory / Optional	**Optional**
Time allocation	**Equivalent to 30 Practical hours**

Aims:

1. Provide an opportunity to conduct an independent study on a novel topic.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. carry out independent studies on scientific issues and problems and
2. report the details and opinions derives from independent studies effectively to the scientific audience.

Course Syllabus / Course Description:

The student will work on a selected Molecular Biology or Biotechnology topic of interest under the guidance of a faculty member who agrees to supervise such work, and write a comprehensive report according to the specifications provided by the Department. This could preferably be a library research.

Recommended References:

None.

Assessment criteria:

Continuous Assessment 100%

Code	**MB 491**
Title	**Molecular Developmental Biology**
Credits	**03**
Prerequisites	**MB 311**
Compulsory / Optional	**Compulsory for Special**
Time allocation	**Lectures: 45 hrs.**

Aims:

1. Describe molecular mechanisms of plant and animal development.
2. Explain the uses of model organisms such as *Arabidopsis thaliana*, *Caenorhabditis elegans* and *Drosophila* in studies of development.
3. Outline and describe the importance of studying Molecular Developmental Biology and Biotechnology.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. outline and explain the steps of plant and animal development and associated molecular pathways,
2. describe the developmental mechanisms in model organisms frequently used in Molecular Developmental Biology and
3. state the potential applications of learning Molecular Developmental Biology in Biotechnology.

Course Syllabus / Course Description:

Plant development; *Arabidopsis* as a model plant for plant molecular genetics, basic strategy and molecular mechanisms of sexual reproduction in flowering plants, germination, involvement of environmental and hormonal signals in coordinating developmental events of the seedlings, switch from meristematic growth to flower formation and cell signaling. Animal development; Basic anatomical features of animals, proteins mediating cell interactions and gene regulation, regulatory DNA, interactions between cells of embryo, inductive signals, asymmetric cell division, positive feedback, signaling pathways controlling developmental patterning, *Caernorhabditis elegans* as a model for the study of development, *Drosophila* and the molecular genetics of pattern formation, homeotic selector genes and the patterning of the anteroposterior axis, organogenesis and the patterning of appendages, cell movements and the shaping of the vertebrate body, mammalian development and neural development.

Recommended References:

1. Gilbert, S.F. (2013) Developmental Biology, (Tenth Edition). Sinauer Associates, Inc.
2. Moore, K.L., Cersaud, T.V.N., Torchia, M.G. (Eds) (2015). The Developing Human: Clinical Oriented Embryology (Tenth Edition). Elsevier.
3. Henning, L., Köhler, C. (Eds) (2010) Plant Developmental Biology: Methods and Protocols (Methods in Molecular Biology). Human Press.
4. Fornara, F. (Ed) (2014) Advances in Botanical Research: The Molecular Genetics of Floral Transition and Floral Development. Volume 72. Elsevier.

Assessment Criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 492**
Title	**Applications of Nanobiotechnology**
Credits	**03**
Prerequisites	**MB 322**
Compulsory / Optional	**Optional**
Time allocation	**Lectures: 45 hrs.**

Aims:

1. List and explain the applications of Nanobiotechnology.
2. Explain the current and future industrially potential advancements of Nanobiotechnology.
3. Describe the recent developments in Nanobiotechnology research and industry.

Intended Learning outcomes:

At the end of the successful completion of course students will be able to,

1. list and explain diverse applications of Nanobiotechnology in different fields,
2. describe the multidisciplinary nature of Nanobiotechnology,
3. state the procedure of risk assessment in conducting a Nanobiotechnological project and
4. state recent advancements of Nanobiotechnology.

Course Syllabus / Course description:

Nanobiotechnological applications in environment and food, applications in health and disease, lab on a chip concept, protein biomolecular motors, molecular nanosystems, nanobiosensors and their applications, nanoparticle based molecular labels, engineering gene circuits, nanopore methods for DNA detection and sequencing, nanodiamonds and its applications, nanomaterials for cell detection, nanomembranes, nanoparticles as non-viral transfection agents, nanoparticles for electrochemical bioassays, microbial nanoparticle production, Nanobiotechnologies in adult stem cell research, nanotechnology in tissue engineering, enzyme reactors based on nano-structured materials, nanotoxicity, recent advances in Nanobiotechnology research and development.

Recommended References:

1. Mirkin, C.A., Niemeyer, C.M. (2004) Nanobiotechnology: Concepts, Applications and Perspectives, (First Edition). Wiley VCH.
2. Mirkin, C.A., Niemeyer, C.M. (2007) Nanobiotechnology II: More Concepts and Applications, (First Edition). Wiley VCH.
3. Vo-Dinh, T. (2007) Nanotechnology in Biology and Medicine: Methods, Devices and Applications, (First Edition). CRC Press.
4. Xie, Y. (2012) The Nanobiotechnology Handbook, (First Edition). CRC Press.
5. Nicolini, C. (Ed.) (2015) Nanobiotechnology in Energy, Environment and Electronics: Methods and Applications (Pan Stanford Series on Nanobiotechnology). CRC Press.

Assessment criteria:

Continuous Assessment 40%
End-Semester Examination 60%

Code	**MB 495**
Title	**Seminar**
Credits	**01**
Prerequisites	**None**
Compulsory / Optional	**Compulsory for Special**
Time allocation	**Completed within a semester**

Aims:

1. Impart skills to conduct review of literature, summarization, preparation of visual aids and presentation based on a chosen topic.
2. Demonstrate and explain the conventions and standards in preparing and delivery a seminar.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. conduct summarization, preparation of visual aids and presentation based on a chosen topic,
2. explain conventions and standards in preparing and delivery a seminar.

Course Syllabus / Course Description:

The student will present a seminar on a topic based on the latest developments in an area of Molecular Biology, Biotechnology or a related field. Upon announcement of the commencement of the seminar course, the student should get the consent for the selected topic from the Department coordinator for the seminar course.

Recommended References:

1. Gallo, C. (2009) The Presentation Secretes of Steve Jobs. How to be insanely great in front of any audience. The McGraw-Hill Companies.

Assessment criteria:

Continuous Assessment 20%
End-Semester Examination (Oral presentation) 80%

Code	**MB 499**
Title	**Research Project**
Credits	**08**
Prerequisites	**None**
Compulsory / Optional	**Compulsory for Special**
Time allocation	**One Year**

Aims:

1. Provide training to carry out research project, write reports and publish manuscripts.
2. Impart the skills to work in teams and inculcate ability to cope up with stresses.
3. Impart the skills of project management and develop the soft skills such as presentation and communication competences.

Intended Learning Outcomes:

At the end of the successful completion of course students will be able to,

1. plan and write research proposal,
2. carry out research under limited resources conditions, in team environments,
3. conduct data analysis, report writing, publishing and
4. monitor the progress of the research and take evasive action for the corrections.

Course Syllabus / Course Description:

The student will carry out a research project under the supervision of a faculty member. The student is required to give a seminar on the project, display a poster and submit a report according to the specification given by the Department. The selection and planning of the project should commence during the second semester of the third Academic year.

Recommended References:

1. Graustein, J.S. (2013) How to Write an Exceptional Thesis or Dissertation: A Step-By-Step Guide from Proposal to Successful Defense, Atlantic Publishing Group.
2. Shamoo, A.E., Resnik, D.B. (2015) Responsible Conduct of Research. Oxford University Press.
3. Schimel, J. (2011) Writing Sciences: How to Write Papers that Get Cites and Proposal that Get Funded. Oxford University Press.

Assessment criteria:

Continuous Assessment 100%

Notes:

Refer http://sci.pdn.ac.lk/docs/Handbook-2014-15.pdf for other details and non-MB courses listed in the curriculum.