MANIPAL UNIVERSITY
JAIPUR

Department of Biosciences
School of Basic Sciences
Manipal University Jaipur

Course Handout - (2019 - 20)

M.Sc. Biotechnology

BoS Coordinator

Director, SBS

Director Academics

HoD

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

DEPARTMENT OF BIOSCIENCES

PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

M.Sc. Biotechnology | Academic Year: **2019-20**

PROGRAM OUTCOMES

[PO.1]. **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.

[PO.2]. **Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO.3]. **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.4]. **Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. **Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO.6]. **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

[PO.7]. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. To understand fundamental principles of molecular biology, molecular cell biology and bioinformatics

[PSO.2]. Modern approaches in biotechnology: the 'omics technologies including proteomics, transcriptomic, metabolomics and bioprocessing

[PSO.3]. Management and communication skills, including problem definition, project design, data collection and interpretation using statistical tools, decision processes, teamwork, written and oral reports, scientific publications

PROGRAM ARTICULATION MATRIX

SEMESTER	COURSE CODE	PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES									
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
I	BT 6101	-	-	-	-	-		1	3	1	2
	BT 6102	1	2	-	-	2	-	1	2	2	1
	BT 6103	-	-	-	-	-	-	1	3	2	2
II	BT 6201	-	-	-	-	-	-	1	3	2	3
	BT 6202	1	-	2	2	-	3	2	1	3	2
	BT 6203	1	-	1	1	-	2	2	1	3	3
	BT 6205	3	2	-	-	1	1	-	3	-	1
AVERAGE		**1.5**	**2.0**	**1.5**	**1.5**	**1.5**	**2.0**	**1.3**	**2.3**	**2.2**	**2.2**

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Biosciences
Course Hand-out

Cell and Molecular Biology| BT 6101 | 4 Credits | 3 1 0 4

Session: Jul 2019 – Nov 2019 | Faculty: Dr. Mousumi Debnath | Class: I Semester

A. Introduction: This course is offered by Dept. of Biosciences as a core course in M.Sc. Biotechnology Programme targeting students who wish to pursue their career in the field of Cell sciences, Molecular Biology, Genomics, Proteomics, Transcriptomics, *etc.* The course imparts in depth knowledge of the cell structure, functions and signalling pathways involved in growth and development. Also the course connects the cellular functioning with the "omics" technology and the molecular genetics, enabling the students to explore and identify novel research leads for the greatest benefit of mankind and critically examine the data and interpretations presented by researchers.

B. Course Outcomes: At the end of the course, students will be able to:

[BT6101.1.] Understand the composition, structure and function of organelles and other cellular components in context of the cells they constitute and their biological activities

[BT6101.2.] Classify the cellular and subcellular specialisations, and characteristics of higher tissue assemblies and their contribution to the overall functioning of the organism, and how malfunctions at the subcellular level lead to diseases such as cancer.

[BT6101.3.] Discuss the phases of cell cycle, and its regulation, importance of cell cycle regulation for normal functioning of the body, abnormalities associated with improper cell cycle regulation

[BT6101.4.] Identify the methods and factors involved in cell death , consequences of abnormal functioning of Programmed Cell Death pathways, malfunctions associated and their prognosis

[BT6101.5.] Understand the mechanism of central dogma including DNA replication, transcription, translation and gene expression in prokaryotes and eukaryotes.

[BT6101.6.] Organize and analyse the principles and techniques of molecular biology which prepare students for further education, basic research, the health professions and increase their employability skills.

[BT6101.7.] Design different signalling pathways in eukaryotes and its impact on the growth and development of organisms

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.

[PO.2]. **Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

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[PO.7]. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

[PSO.1]. To understand fundamental principles of molecular biology, molecular cell biology and bioinformatics

[PSO.2]. Modern approaches in biotechnology: the 'omics technologies including proteomics, transcriptomic, metabolomics and bioprocessing

[PSO.3]. Management and communication skills, including problem definition, project design, data collection and interpretation using statistical tools, decision processes, teamwork, written and oral reports, scientific publications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Mid Term Exam 1 – IA 1	20
	Mid Term Exam 2 - IA 2	20
	CWS Assessment IA 3 10 marks of IA 3 are awarded based on the various assignments, class tests, seminar presentation etc.	20
End Term Exam (EX)	End Term Exam – EX 1	40
	Total	100

NOTE: A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.

E. SYLLABUS

Cell structure: Comparison between plant and animal cells; Plasma membrane; Electrical properties of membrane, Modification of plasma membrane and intracellular junctions; Organization of plant cell wall. Cell signalling: communication between cells and their environment. Introduction to cytoplasmic organelles and cytoskeleton: Protoplasm; Mitochondria; Chloroplast; ER; Golgi complex; Lysosome, endosome, Ribosome; Centriole; Nucleus. Chromosomes, chromatin and nucleosome: Chromosome structure in bacteria and eukaryotes, centromere, telomere, Hetero- and euchromatin, Nucleosome model and radial-loop scaffold model. Overview of Cell cycle: Stages of cell cycle, cell cycle control, Mitotic and meiotic cell division; Distinction between mitosis in plant and animal. Cell Death: Apoptosis and Necrosis. Nucleic acids structure: DNA as genetic material, Watson-Crick model, A, B and Z forms of DNA; RNA types, distinctions between RNA and DNA. The Central Dogma: Overview of synthesis of DNA, RNA and protein. The genetic code: Genetic code and its properties. Gene cloning: restriction endonuclease and cloning vector, screening of cloned DNA.

F. REFERENCES

R1. B. Alberts, A. Jahusan, J. Levis, M. Raff, K. Roberts and P. Walter. Molecular Biology of Cell, Garland Science, USA, 2002.

R2. H. Lodish and D. Baltimore. Molecular Cell Biology, WH Freeman and Company, USA, 2012.

R3. B. Lewin. Genes XII, Jones and Bartlett Publishers, USA, 2014.

R4. G. Karp. Cell and Molecular Biology – Concepts and Experiments, John Wiley & Sons, Inc. USA, 2009.

R5. *T.A. Brown. Genomes, Garland Science, New York, 2006.*

G. Lecture Plan

Lecture No.	**Topics**	**Session outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1.	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
2.	Discovery and basic properties & Classes ; Prokaryotic and eukaryotic cell ; plant and animal cell	Understand Prokaryotic and eukaryotic cell	Lecture	BT 61011	Mid Term I End term
3.	Cell structure - Membrane Functions, Structure of model membrane and lipid bilayer chemical composition	Get a clear concept of Cell structure - Membrane Functions, Structure of model membrane and lipid bilayer chemical composition	Lecture	BT 61011	Mid Term I End term
4.	Cell membrane Dynamics; diffusion, osmosis, ion channels, active transport, membrane pumps	Understand the dynamics of Cell membrane Dynamics ;membrane protein diffusion, osmosis, ion channels	Lecture	BT 61011	Mid Term I End term
5.	Tutorial	Tutorial	NA	NA	Class quiz
6.	Cell membrane Dynamics : membrane transport proteins, exocytosis and endocytosis , electrical properties of membranes	Understand what is active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes	Lecture	BT 61012	Mid Term I End term
7.	Modification of plasma membrane & Cell Junctions	Understand modification of plasma membrane & Cell Junctions	Lecture	BT 61011	Mid Term I End term
8.	Cell structure: Organization of plant cell wall.	Explain the organization of plant cell wall	Lecture	BT 61011	Mid Term I End term
9.	Tutorial	Tutorial	NA	NA	Class quiz
10.	Cell signalling: Hormones and their receptors, cell surface receptor	Appreciate cell signalling: Hormones and their receptors, cell surface receptor,	Lecture	BT 61017	Class quiz Mid Term I End term
11.	Signalling through G-protein coupled receptors, second messenger	Discuss the signalling through G-protein coupled receptors	Lecture	BT 61017	Mid Term I End term
12.	Signal transduction and regulation of signalling pathways	Intercept the idea off Signal transduction and regulation of signalling pathways	Lecture	BT 61017	Mid Term I End term
13.	Tutorial	Tutorial	NA	NA	Class quiz

14.	Structural organization and function of Protoplasm; Mitochondria	Understand Structural organization and function of Mitochondria	Lecture	BT 61011	Mid Term II End term
15.	Structural organization and function of Chloroplast	Understand Structural organization and function of Chloroplast	Lecture	BT 61011	Mid Term II End term
16.	Structural organization and function of, Golgi ER; Golgi complex; Lysosome, endosome, Ribosome	Compare the structural organization and function of, Golgi ER; Golgi complex; Lysosome, endosome, Ribosome	Lecture	BT 61011	Mid Term II End term
17.	Structural organization and function of Centriole; Nucleus	Understand Structural organization and function of Centriole; Nucleus	Lecture	BT 61011	Mid Term II End term
18.	Cytoskeleton, microtubules, microfilaments & intermediate filaments	Understand what are cytoskeleton and its use	Lecture	BT 61011	Mid Term II End term
19.	Tutorial	Tutorial	NA	NA	Class quiz
20.	Chromosomes, chromatin and nucleosome.	Understand the importance of Chromosomes, chromatin and nucleosome: Unique and repetitive DNA, interrupted genes, gene families, operon.	Lecture	BT 61011	Mid Term II End term
21.	Chromosome structure in bacteria and eukaryotes, centromere , telomere, heterochromatin and euchromatin, transposons	Clearcut idea of : structure of chromatin and chromosomes; heterochromatin, euchromatin, transposons	Lecture	BT 61011	Class quiz Mid Term II End term
22.	Nucleosome model and radial-loop scaffold model	Have a clear concept of Nucleosome model and radial-loop scaffold model	Lecture	BT 61011	Class quiz Mid Term II End term
23.	Tutorial	Tutorial	NA	NA	Class quiz
24.	Overview of Cell cycle: Brief discussion about Cell Cycle	of Cell cycle: Brief discussion about Cell Cycle and Its Control	Lecture	BT 61013	Mid Term II End term
25.	Cell cycle regulation and control; Check points of cell cycle	What are the molecular mechanisms for regulating Mitotic Events; Perceive Cell cycle: Checkpoints in Cell-Cycle Regulation	Lecture	BT 61016	Class quiz Mid Term II End term
26.	Tutorial	Tutorial	NA	NA	Class quiz
27.	Cell division : Mitosis and meiosis in plant and animal cell	Mitotic and meiotic cell division	Lecture	BT 61013	End term
28.	Cell Death: Programmed cell death & Necrosis	Understand Cell Death: Programmed cell death and its regulation & Necrosis	Lecture	BT 61013	End term
29.	Mechanism and regulation of cell programmed death	Understand the mechanism of Programmed cell death and its regulation	Lecture	BT 61013	Class quiz End term

30.	Extracellular control for cell division, cell growth and cell death	Know what is extracellular control of cell division	Lecture	BT 61014	End term theory
31.	Nucleic acids structure: DNA as genetic material, Watson-Crick model, A, B and Z forms of DNA	Explain Nucleic acids structure: DNA as genetic material, Watson-Crick model, A, B and Z forms of DNA	Lecture	BT 61015	Class quiz End term
32.	Nucleic acids structure: RNA types, distinctions between RNA and DNA, overview of The Central Dogma	Understand Nucleic acids structure: RNA types, distinctions between RNA and DNA, overview of The Central Dogma	Lecture	BT 61015	End term
33.	Tutorial	Tutorial	NA	NA	Class quiz
34.	DNA Replication (Prokaryotic & eukaryotic), fidelity of replication, extrachromosomal replicons	Conceive DNA Replication (Prokaryotic & eukaryotic), fidelity of replication, extrachromosomal replicons	Lecture	BT 61015	End term
35.	DNA damage and repair mechanisms, homologous and site-specific recombination	Apprehend DNA damage and repair mechanisms, homologous and site-specific recombination	Lecture	BT 61015	End term
36.	RNA synthesis and processing (transcription factors and machinery, RNA polymerases	Try to perceive RNA synthesis and processing (transcription factors and machinery, RNA polymerases	Lecture	BT 61015	End term
37.	Tutorial	Tutorial	NA	NA	Class quiz
38.	RNA Processing, RNA editing, splicing, and polyadenylation, types of RNA, RNA transport	Understand RNA Processing, RNA editing, splicing, and polyadenylation, types of RNA, RNA transport	Lecture	BT 61016	End term
39.	Protein translation and Aminoacylation of tRNA	Try to visualise the process of Protein translation and Aminoacylation of tRNA	Lecture	BT 61016	End term
40.	Termination and translational proof-reading	Finally understand Termination and translational proof-reading	Lecture	BT 61016	End term
41.	Tutorial	Tutorial	NA	NA	Class quiz
42.	Translational inhibitors, Post- translational modification of proteins	Conceive the idea od Translational inhibitors, Post- translational modification of proteins	Lecture	BT 61016	End term
43.	Genetic code and its property		Lecture	BT 61016	End term
44.	Gene cloning: restriction endonuclease	Know Gene cloning: restriction endonuclease	Lecture	BT 61016	End term theory
45.	Gene cloning: Cloning vector and screening of cloned DNA	Understand Gene cloning: cloning vector and screening of cloned DNA.	Lecture	BT 61016	End term theory
49.	Conclusion and Course Summarization	Conclusion and Course Summarization	Lecture	NA	Class quiz
	Lab session to understand the types of cells , DNA and RNA	Lab visit and lab session	Lecture	NA	End term theory End term practical

H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
[BT6101.1]	Understand the composition, structure and function of organelles and other cellular components in the context of the cells they constitute and their biological activities							1			
[BT6101.2]	Classify the cellular and subcellular specialisations, and characteristics of higher tissue assemblies and their contribution to the overall functioning of the organism, and how malfunctions at the subcellular level lead to diseases such as cancer.							1	3		
[BT6101.3]	Discuss the phases of cell cycle, and its regulation, importance of cell cycle regulation for normal functioning of the body, abnormalities associated with improper cell cycle regulation							1	3		
[BT6101.4]	Identify the methods and factors involved in cell death , consequences of abnormal functioning of Programmed Cell Death pathways, malfunctions associated and their prognosis							1	2		
[BT6101.5]	Understand the mechanism of central dogma including DNA replication, transcription, translation and gene expression in prokaryotes and eukaryotes.							1	2	1	
[BT6101.6]	Organize and analyse the principles and techniques of molecular biology which prepare students for further education, basic research, the health professions and increase their employability skills								2		2
[BT6101.7]	Design different signalling pathways in eukaryotes and its impact on the growth and development of organisms	1							2		2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Biosciences

Course Hand-out

FUNDAMENTAL & APPLIED MICROBIOLOGY | BT 6102 | 4 Credits | 3 1 0 4

Session: Jul 2019 – Nov 2019 | Faculty: Dr. Rakesh Kumar Sharma | Class: I Semester

A. Introduction: This course is offered by Dept. of Biosciences as a core course in M.Sc. Biotechnology. This course encompasses wide range of topics such as structure and metabolism of microbes, biotechnological strategies for isolation, identification and classification of novel microorganisms, importance of microbes to human and environment, methods to control microbial proliferation, *etc.* The diverse contents of the course allow the students to explore, understand and manifest the multiple utilities of microorganisms. This course thus provides a launch pad into a career that involves working knowledge of scientific research and academics, health clinics and industries.

B. Course Outcomes: At the end of the course, students will be able to:

[BT6102.1.] Understand and discuss the development of microbiology, general characteristics, classification, structure and function of microorganisms.

[BT6102.2.] Classify different microorganisms, microbial growth and their modification for development of microbial products.

[BT6102.3.] Execute the strategies for isolation, identification and characterisation of microorganisms for food and water quality assessment to enhance the competency for employment.

[BT6102.4.] Identify role and applications of microorganisms in industry and environmental protection

[BT6102.5.] Implementation of microorganisms in food, beverage and agriculture sector

[BT6102.6.] Develop methods for controlling the microbial growth and their application in clinics, labs and industry to enhance the employment skill

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.

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[PO.7]. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

[PSO.1.] To understand fundamental principles of molecular biology, molecular cell biology and bioinformatics

[PSO.2.] Modern approaches in biotechnology: the 'omics technologies including proteomics, transcriptomic, metabolomics and bioprocessing

[PSO.3.] Management and communication skills, including problem definition, project design, data collection and interpretation using statistical tools, decision processes, teamwork, written and oral reports, scientific publications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Mid Term Exam 1 – IA 1	20
	Mid Term Exam 2 - IA 2	20
	CWS Assessment IA 3 20 marks of IA 3 are awarded based on the various assignments, class tests, seminar presentation etc.	20
End Term Exam (EX)	End Term Exam – EX 1	40
	Total	100

Note: A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.

E. SYLLABUS

Applications of Microorganisms: Bacteria, Fungi, Protozoa, Algae, etc. Growth and Nutrition: Phases in bacterial growth, Growth Curve, Calculation of G-time, Physical and environmental requirements of growth, Microbial nutritional requirements, Types of culture media. Environmental Microbiology: Degradation of major macromolecules (lignin, cellulose, protein, starch etc.); Applications of Microbes in Bioremediation: Heavy metals, Textile, Pulp & paper, Leather industry; Microbial Ecology: Microbial ecotoxicology, Microbial community shift, Microbial interactions; Food & Dairy: Bakery, Brewery, Fermented food products, Yoghurt, Cheese; Concept of probiotics; Agricultural Microbiology: Plant microbe interactions, Plant growth promoting rhizobacteria, Biopesticides; Industrial Microbiology: Production of antibiotics, Vitamins, Enzymes, Organic acids; Applications in Energy: Production of biogas, Biohydrogen, Bioethanol, Microbial fuel cell; Control of Microorganisms: Physical, chemical and biological methods; Antimicrobial Compounds: Disinfectant, Antiseptic, Antibiotic; Mode of action of antibiotics; Drug resistance in bacteria. MRSA.

F. References:

R1. L.M. Prescott, J.P. Harley and D.A. Klein. Microbiology. McGraw-Hill Science, USA, 2004.

R2. M.J. Pelczar, E.C.S. Chan and N.R. Krieg. Microbiology: Concepts and Applications. McGraw-Hill Inc. USA, 1993.

R3. J. Saxena, M. Baunthiyal and I. Ravi. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology. Scientific Publishers, India, 2012

R4. R.W. Bauman. Microbiology with Diseases by Body System. Benjamin Cummings, USA, 2011.

R5. J.G. Capuccino and N. Sherman. Microbiology-A Laboratory Manual. Benjamin Cummings, USA, 2004.

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R7. J. Barnes and R. Brand. Microbiology Lab Manual, Kendall Hunt Pub Company, 1994

R8. T.R. Johnson, C.L. Case. Laboratory Experiments in Microbiology Lab Manual, Benjamin Cummings, USA, 1997.

R9. D. J. Brenner, N.R. Krieg and J. R. Staley. Bergey's Mannual of Systematic Bacteriology Vol. 1&2, Springer, USA, 2005.

G. Lecture Plan:

Lec No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1.	Introduction and Course Hand-out briefing	Understanding of the subject content	Lecture	NA	NA
2.	Applications of Microorganisms: Bacteria	Understanding of basic living units	Lecture	BT 6102.1	Mid Term I End term
3.	Fungi	Classify the microorganisms	Lecture	BT 6102.1	Mid Term I End term
4.	Tutorial	Classify different microorganisms	Lecture	BT 6102.1	Mid Term I End term
5.	Protozoa and Algae	Understand eukaryotic microbes	Lecture	BT 6102.1	Mid Term I End term
6.	Growth and Nutrition	Learn the concept of growth	Lecture	BT 6102.2	Mid Term I End term
7.	Phases in bacterial growth	Different levels of growth	Lecture	BT 6102.2	Mid Term I End term
8.	Tutorial	concept of growth	Lecture	BT 6102.2	Internal Class quiz
9.	Growth Curve, Calculation of G-time	Calculation of G time	Lecture	BT 6102.2	Mid Term I End term
10.	Physical and environmental requirements of growth	Understanding complexity of microbes	Lecture	BT 6102.2	Mid Term I End term
11.	Microbial nutritional requirements	Find out the best conditions for microbial growth	Lecture	BT 6102.2	Mid Term I End term
12.	Tutorial	Calculations related to growth	Lecture	BT 6102.2	Mid Term I End term
13.	Types of culture media	Differentiate among growth medium	Lecture	BT 6102.2	Mid Term I End term
14.	Environmental Microbiology	Complexity of microbes in environment	Lecture	BT 6102.4	Mid Term I End term
15.	Degradation of major macromolecules: lignin	Concept of microbial degradation	Lecture	BT 6102.4	Mid Term I End term
16.	Degradation of major macromolecules: cellulose, protein, starch	How different polymers are degraded	Lecture	BT 6102.4	Mid Term I End term
17.	Microbial nutritional requirements Types of culture media	Differentiate the microbes on the basis of their nutritional requirements	Lecture	BT 6102.2	Mid Term I End term
18.	Tutorial	Categorize the medium	Lecture	BT 6102.4	Internal

19.	Applications of Microbes in Bioremediation: Heavy metals	Concept of bioremediation	Lecture	BT 6102.4	Mid Term II End term
20.	Textile	Treatment of textile effluent		BT 6102.4	Mid Term II End term
21.	Pulp & paper, Leather industry	Treatment of industrial effluent	Lecture	BT 6102.4	Mid Term II End term
22.	Microbial Ecology: Microbial ecotoxicology	Existence of microbes		BT 6102.4	Mid Term II End term
23.	Tutorials	Existence of microbes		BT 6102.4	Mid Term II End term
24.	Microbial community shift	Factors influencing the microbial community	Lecture	BT 6102.4	Mid Term II End term
25.	Microbial interactions	How microbes interact		BT 6102.4	Mid Term II End term
26.	Food & Dairy: Bakery, Brewery	Use of microbes for food applications	Lecture	BT 6102.5	Mid Term II End term
27.	Fermented food products, Yoghurt, Cheese	Use of microbes for dairy applications		BT 6102.5	Mid Term II End term
28.	Concept of probiotics	Use of microbes for dietary intake	Lecture	BT 6102.5	Mid Term II End term
29.	Tutorial	Concept of edible microbes	Lecture	BT 6102.5	Class quiz Internal
30.	Agricultural Microbiology: Plant microbe interactions	Application of microbes in agriculture		BT 6102.5	Mid Term II End term
31.	Plant growth promoting rhizobacteria	Benefits of microbes	Lecture	BT 6102.5	Mid Term II End term
32.	Biopesticides	Benefits of microbes	Lecture	BT 6102.5	Mid Term II End term
33.	Tutorials	Discuss benefits of microbes	Lecture	BT 6102.5	Mid Term II End term
34.	Industrial Microbiology: Production of antibiotics	Use of microbes in industrial production		BT 6102.4	End term
35.	Vitamins, Enzymes	Use of microbes in the production of vitamins and enzymes	Lecture	BT 6102.4	End term
36.	Organic acids	Use of microbes in the production of organic acid	Lecture	BT 6102.4	Mid Term I End term
37.	Tutorial	Discuss industrial applications of microbes	Lecture	BT 6102.4	Class quiz Internal

38.	Applications in Energy: Production of biogas	Generate energy from microbes	Lecture	BT 6102.6	End term
39.	Biohydrogen, Bioethanol	Generate biofuels	Lecture	BT 6102.6	End term
40.	Microbial fuel cell	Designing a fuel cell	Lecture	BT 6102.6	End term
41.	Tutorial	Applications for Biofuel	Lecture	BT 6102.6	End term
42.	Control of Microorganisms: Physical	Concept of sterilization and controlling the microbial growth	Lecture	BT 6102.6	End term
43.	chemical and biological methods	Use of suitable chemical for microbial control	Lecture	BT 6102.6	End term
44.	Antimicrobial Compounds: Disinfectant Antiseptic, Antibiotic	Differentiate among different antimicrobial agents	Lecture	BT 6102.6	End term
45.	Mode of action of antibiotics	Finding suitable antibiotics	Lecture	BT 6102.6	End term
46.	Drug resistance in bacteria	Finding suitable antibiotics	Lecture	BT 6102.6	End term
47.	MRSA	Finding suitable antibiotics	Lecture	BT 6102.6	End term
48.	Tutorial	Microbial drug resistant	Lecture	BT 6102.6	End term

H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
[BT6102.1]	Understand and discuss the development of microbiology, general characteristics, classification, structure and function of microorganisms.	1						1	2	2	
[BT6102.2]	Classify different microorganisms, microbial growth and their modification for development of microbial products.		1							1	
[BT6102.3]	Execute the strategies for isolation, identification and characterisation of microorganisms for food and water quality assessment to enhance the competency for employment.	1									1
[BT6102.4]	Identify role and applications of microorganisms in industry and environmental protection							1	2		
[BT6102.5]	Implementation of microorganisms in food, beverage and agriculture sector		2								1
[BT6102.6]	Develop methods for controlling the microbial growth and their application in clinics, labs and industry to enhance the employment skill					2					1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Biosciences
Course Hand-out

Bio-analytical Techniques | BT6103 | 3 Credits | 3 1 0 4

Session: Jul 2019 – Nov 2019 | Faculty: Sandeep K Srivastava | Class: I Semester

A. Introduction: This course is offered by Dept. of Biosciences as a core course in M.Sc. Biotechnology Programme. The primary objectives of this course are to develop the scientific understanding of theory and practice of bio-analytical techniques. This course contains bio analytical techniques/instruments along with their theory, working principal, common instrumentation and possible applications.

B. Course Outcomes: At the end of the course, students will be able to

[BT6103.1.]	Define basic apparatus used in a Biotechnology lab.
[BT6103.2.]	Understand principals, tools and techniques of analytical techniques
[BT6103.3.]	Execute working principals, tools and techniques of microscopy.
[BT6103.4.]	Differentiate the principles and applications of different type of centrifuge, electrophoresis and chromatography in research and related experiments.
[BT6103.5.]	To develop characteristics of these impacts and hence develop employability skills.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO1.] Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.

[PO2.] Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO3.] Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO4.] Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO5.] Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO6.] Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO7.] Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

[PSO.1.] To understand fundamental principles of molecular biology, molecular cell biology and bioinformatics

[PSO.2.] Modern approaches in biotechnology: the 'omics technologies including proteomics, transcriptomic, metabolomics and bioprocessing

[PSO.3.] Management and communication skills, including problem definition, project design, data collection and interpretation using statistical tools, decision processes, teamwork, written and oral reports, scientific publications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Mid Term Exam 1 – IA 1	20
	Mid Term Exam 2 - IA 2	20
	CWS Assessment IA 3 20 marks of IA 3 are awarded based on the various assignments, class tests, seminar presentation etc.	20
End Term Exam (EX)	End Term Exam – EX 1	40
	Total	100

Note: A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.

E. SYLLABUS

Microscopy: Principles and applications of light microscopy, phase contrast, polarization, fluorescence, confocal and electron microscopy. Centrifugation: Principles of centrifugation. Concepts of RCF. Different types of instruments and rotors. Preparative, differential and density gradient centrifugation. Analytical ultracentrifugation, determination of molecular weights and other applications. Electrophoresis: Different types of electrophoresis; agarose gel, pulse gel, SDS-PAGE and native gel, isoelectric focusing, 2-D gel electrophoresis, capillary electrophoresis. Chromatography: Principles and applications of partition, TLC, affinity, size exclusion, ion exchange, liquid-liquid chromatography, GC, HPLC, UPLC. Spectrophotometry: Beer and Lambert law, Types of detectors (UV-VIS). Techniques in structural analysis: UV, IR, Mass Spectrometry, NMR, LASER/Raman spectroscopy, XRD, X-ray Crystallography. ORD, CD and ESR. Radioactivity: Stable and radioactive isotopes. Concepts of half-life and decay. Principle of scintillation counting. GM counters. Applications of isotopes. Isotope dilution technique. Autoradiography. Radiation hazards.

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F. REFERENCES:

R1. D. Frefilder. Physical Biochemistry, WH Freeman & Company, New York, 1983.

R2. K. Wilson and J. Walker. Practical Biochemistry– Principles and Techniques, Cambridge University Press, 2005.

R3. J. Jayaraman. Laboratory Manual in Biochemistry, New Age Publishers, New Delhi, 2011

R4. A.J. Ninfa, D.P. Ballou and M.B. Parsons. Fundamental Laboratory Approaches for Biochemistry and Biotechnology. Wiley Interscience, 2009.

R5. R. Boyer. Modern Experimental Biochemistry, Pearson Education, USA, 1986.

R6. K. Wilson and K.H. Goulding. A biologist's Guide to Principles and Techniques of Practical Biochemistry, ELBS, 1991.

R7. M. Holtzhauer. Basic Methods for the Biochemical Lab, Springer, USA, 2006.

R8. S.O. Farrell and L.E. Taylor. Experiments in Biochemistry: A Hands-on Approach, Cengage Learning, USA, 2005.

G. Lecture Plan:

LEC NO	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of assessing the outcome
1.	Microscopy: Principles and applications of light microscopy	Learn about principles and applications of microscopy	Lecture	BT 6103.1	MTE 1 Quiz End Term
2.	Introduction to phase contrast, polarization, fluorescence, confocal and electron microscopy.	Learn about principles and applications of microscopy	Lecture	BT 6103.1	MTE 1 Quiz End Term
3.	Tutorial	Recall the techniques	Discussion	BT 6103.1	Class Test/ Quiz
4.	Introduction to fluorescence, confocal and electron microscopy.	Electron microscope principle	Lecture	BT 6103.1	MTE 1 Quiz End Term
5.	Centrifugation: Principles of centrifugation.	Learn about method of centrifugation	Lecture	BT 6103.1	MTE 1 Quiz End Term
6.	Tutorial	Discussion on centrifuge	Lecture	BT 6103.1/ BT 6103.6	MTE 1 Quiz End Term
7.	Concepts of RCF. Different types of instruments and rotors.	Recall the techniques of protein separation	Discussion	BT 6103.1/ BT 6103.6	Class Test/ Quiz
8.	Preparative, differential and density gradient centrifugation.	Understand role of reagents to separate proteins	Lecture	BT 6103.1/ BT 6103.6	MTE 1 Quiz End Term
9.	Tutorial	Learn applications and method of protein separation	Lecture	BT 6103.1/ BT 6103.6	MTE 1 Quiz End Term
10.	Analytical ultracentrifugation techniques	Recall the techniques of protein separation	Discussion	BT 6103.1/ BT 6103.6	Class Test/ Quiz
11.	Determination of molecular weights and other applications.	Understand 2-D gels	Lecture	BT 6103.1/ BT 6103.6	MTE 1 Quiz End Term
12.	Tutorial	Learn the principle of 2D gels	Lecture	BT 6103.2	MTE 1 Quiz End Term
13.	Electrophoresis: Different types of electrophoresis	Understand details of electrophoresis	Lecture	BT 6103.2	MTE 1

					Quiz End Term
14.	Agarose gel electrophoresis	Recall electrophoresis	Discussion	BT 6103.2	Class Test/ Quiz
15.	Tutorial	Learn different types of electrophoresis	Lecture	BT 6103.2	MTE 1 Quiz End Term
16.	Pulse field gel electrophoresis	Understand various uses of electrophoresis	Lecture	BT 6103.2	MTE 1 Quiz End Term
17.	SDS-PAGE and native gel: principal and applications	Recall details of various electrophoresis	Discussion	BT 6103.2	Class Test/ Quiz
18.	Tutorial	Discuss principle behind working of electrophoresis	Lecture	BT 6103.3	MTE 1 Quiz End Term
19.	Isoelectric focusing,	Learn working of IEF	Lecture	BT 6103.3	MTE 1 Quiz End Term
20.	2-D gel electrophoresis,	2D Gel	Discussion	BT 6103.3	Class test/ Quiz
21.	Tutorial	Learn working of proteomics	Lecture	BT 6103.4	MTE 1 Quiz End Term
22.	Capillary electrophoresis.	Learn working of chromatography	Lecture	BT 6103.4	MTE 1 Quiz End Term
23.	Chromatography: Principles and applications	Learn working of chromatography	Lecture	BT 6103.4	MTE 1 Quiz End Term
24.	Tutorial	Recall chromatography	Discussion	BT 6103.4	Class test/ Quiz
25.	Partition chromatography	Understand techniques of separation of pigments	Lecture	BT 6103.5	MTE 1 Quiz End Term
26.	Thin layer chromatography	Understand techniques of separation of pigments	Lecture	BT 6103.5	MTE 2 Quiz End Term
27.	Tutorial	Recall techniques of pigment separation	Discussion	BT 6103.5	Class test/ Quiz
28.	Affinity, size exclusion, ion exchange, liquid-liquid chromatography,	Understand techniques of separation of proteins	Lecture	BT 6103.5	MTE 2 Quiz

					End Term
29.	GC, HPLC, UPLC: Principal and applications	Understand techniques of HPLC	Lecture	BT 6103.5	MTE 2 Quiz End Term
30.	Tutorial	Understand techniques of FPLC	Lecture	BT 6103.5	MTE 2 Quiz End Term
31.	Spectrophotometry: Beer and Lambert law, Types of detectors (UV-VIS).	Recall techniques of UV-Vis	Discussion	BT 6103.5	Class test/ Quiz
32.	Techniques in structural analysis: UV, IR spectrophotometer	Understand techniques of IR	Lecture	BT 6103.5	MTE 2 Quiz End Term
33.	Tutorial	Understand techniques of IR	Lecture	BT 6103.5	MTE 2 Quiz End Term
34.	Mass Spectrometric principals and applications	Recall techniques of mass spectrometry	Tutorial	BT 6103.5	Class test/ Quiz
35.	NMR, LASER/Raman spectroscopy,	Learn about NMR/Raman	Lecture	BT 6103.5	MTE 2 Quiz End Term
36.	Tutorial	Learn about Raman	Lecture	BT 6103.5	MTE 2 Quiz End Term
37.	XRD, X-ray Crystallography.	Learn atomic structures	Lecture	BT 6103.5	MTE 2 Quiz End Term
38.	ORD, CD sectroscopy	CD spectroscopy	Discussion	BT 6103.5	Class test/ Quiz
39.	Tutorial	Learn techniques of CD spectroscopy	Lecture	BT 6103.5	MTE 2 Quiz End Term
40.	ESR spectroscopy	Learn techniques of nucleic acid visualization	Lecture	BT 6103.5	MTE 2 Quiz End Term
41.	Radioactivity: Stable and radioactive isotopes.	Recall the techniques leant	Discussion	BT 6103.5	Class test/ Quiz
42.	Tutorial	Recall density based separation	Discussion	BT 6103.5	Class test/ Quiz
43.	Concepts of half-life and decay.	Learn techniques of t1/2 calculation	Lecture	BT 6103.5	MTE 2 Quiz End Term

44.	Principle of scintillation counting.	Learn techniques of counting	Lecture	BT 6103.5	MTE 2 Quiz End Term
45.	Tutorial	Recall the techniques leant	Discussion	BT 6103.5	Class test/ Quiz
46.	GM counters and their applications	Learn techniques of GM counters	Lecture	BT 6103.5	MTE 2 Quiz End Term
47.	Applications of isotopes. Isotope dilution technique. Autoradiography. Radiation hazards.	Learn about radiation hazards	Lecture	BT 6103.5	MTE 2 Quiz End Term
48.	Tutorial	Learn techniques of radio hazards	Lecture	BT 6103.5	MTE 2 Quiz End Term
Lab Sessions	Working principles of various available laboratory instruments: Laminar Air Flow Cabinet, centrifuge, spectrophotometer, oven, incubator, BOD incubator, autoclave. Study of UV absorption spectra of macromolecules (protein and nucleic acid). Determination of Lambda max of a dye solution. Determination of protein and nucleic acid concentration by spectrophotometric method. Separation and identification of amino acids using TLC.	Learn various techniques	Lab sessions	BT 6103.1 BT 6103.2 BT 6103.5	Experimental results lab sessions End Term Practical Examination

H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
[BT6103.1]	Define basic apparatus used in a Biotechnology lab.							1	1		2
[BT6103.2]	Understand principals, tools and techniques of analytical techniques								1	2	
[BT6103.3]	Execute working principals, tools and techniques of microscopy.							1			2
[BT6103.4]	Differentiate the principles and applications of different type of centrifuge, electrophoresis and chromatography in research and related experiments.							1	3		
[BT6103.5]	To develop characteristics of these impacts and hence develop employability skills.									2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Biosciences
Course Hand-out

Advanced Biochemistry| BT6201 | 4 Credits | 3 1 0 4

Session: Jan 2020 – May 2020 | Faculty: Sandeep K. Srivastava | Class: II Semester

A. Introduction: This course is offered by Dept. of Biosciences as a core course in M.Sc. Biotechnology Programme targeting students who wish to pursue their career in the research field of Biochemistry or higher studies in the field of enzymology, biochemical mechanisms and metabolism. The course offers in depth knowledge of the biochemistry and metabolism and the salient features of the metabolism in model organisms. Students are expected to have background knowledge of the biomolecules and chemical properties.

B. Course Outcomes: At the end of the course, students will be able to

[BT6201.1] Define five classes of polymeric biomolecules and their monomeric building blocks.
[BT6201.2] Classify fundamental biochemical principles, such as the structure/function of biomolecules
[BT6201.3] Interpret the specificity of different enzymes (biochemical catalysts), and the chemistry involved in enzyme action.
[BT6201.4] Differentiate metabolic pathways, and the regulation of biological/biochemical processes.
[BT6201.5] Investigate how fats and amino acids are metabolized, and explain how they can be used for fuel.
[BT6201.6] Develop employability skills for opportunities in diagnostic labs, hospitals. To train to operate automated instruments that help quantify and analyse the computer generated data

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.
[PO.2]. **Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
[PO.3]. **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.
[PO.4]. **Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
[PO.5]. **Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
[PO.6]. **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.
[PO.7]. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

[PSO.1]. To understand fundamental principles of molecular biology, molecular cell biology and bioinformatics
[PSO.2]. Modern approaches in biotechnology: the 'omics technologies including proteomics, transcriptomic, metabolomics and bioprocessing
[PSO.3]. Management and communication skills, including problem definition, project design, data collection and interpretation using statistical tools, decision processes, teamwork, written and oral reports, scientific publications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Mid Term Exam 1 – IA 1	20
	Mid Term Exam 2 - IA 2	20
	CWS Assessment IA 3 10 marks of IA 3 are awarded based on the various assignments, class tests, seminar presentation etc.	20
End Term Exam (EX)	End Term Exam – EX 1	40
	Total	100

Note: A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.

E. SYLLABUS

Principles of Biochemistry: pH, Buffer, Reaction kinetics, Thermodynamics, Colligative properties, Structure of atoms, Molecules and chemical bonds. Composition, Structure and Functions of Biomolecules: Water, Carbohydrates, Lipids, Proteins, Nucleic acids and Vitamins, Stabilizing interactions, Van der Waals Forces, Electrostatic Effects, Hydrogen bonding, Hydrophobic interactions. Proteins chemistry: Ramachandran plot, Secondary, Tertiary and Quaternary structure, Domains, Motif and folds, Protein Folding. Enzymology and Enzyme Kinetics: Principles of catalysis, Michaelis Menten equation, Km value, Enzyme inhibition, Regulation of enzyme activity, Feedback inhibition, Mechanism of enzyme catalysis, Isozymes and Ribozymes. Bioenergetics and Metabolism: Carbohydrates, Lipids, Amino Acids, Nucleotides, Coupled reaction, Group transfer, Biological energy transducers, Oxidative and photophosphorylation. Biological Membranes and Biosignalling: Composition and dynamics of membranes, Solute transport. Different types of membrane transporters, Molecular mechanism of signal transduction, Gated ion channels, GPCRs and second messengers, Signaling in microbes and plants.

F. REFERENCES

R1. T.A. Brown. Gene Cloning and DNA analysis: An Introduction, Blackwell Publishing Professional, USA, 2006.

R2. D. Nelson and M.M. Cox. Lehninger's Principles of Biochemistry, BI publications Pvt. Ltd. Chennai, India, 2008.

R3. D. Voet and J.G. Voet. Principles of biochemistry, CBS Publishers & Distributors, New Delhi, 2008.

R4. J.M. Berg, J.L. Tymoczko and L. Stryer. Biochemistry (5th Ed.), W.H. Freeman Publishers, 2005.

G. Lecture Plan:

LEC NO	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of assessing the outcome
1.	Introduction to Biochemistry: Structure and properties of important biomolecules	Learn about conventional electrophoresis and discovery	Lecture	BT6201.1	MTE I Quiz End Term
2.	Introduction to Biochemistry: Structure and properties of important biomolecules	Understand ways to separate DNA and its principle	Lecture	BT6201.1	MTE I Quiz End Term
3.	Tutorial	Recall the techniques of nucleic acid separation	Discussion	BT6201.1	Class Test/ Quiz
4.	Carbohydrates: Classification of carbohydrates, chemical structure and properties of monosaccharide	Understand role of reagents to separate nucleic acid	Lecture	BT6201.1	MTE I Quiz End Term
5.	Carbohydrates: Classification of carbohydrates, chemical structure and properties of disaccharides, oligosaccharides	Learn about method of DNA/RNA separation	Lecture	BT6201.1	MTE I Quiz End Term
6.	Tutorial	Learn about protein separation principle	Lecture	BT6201.1/ BT6201.6	MTE I Quiz End Term
7.	Carbohydrates: Classification of carbohydrates	Recall the techniques of protein separation	Discussion	BT6201.1/ BT6201.6	Class Test/ Quiz
8.	Chemical structure and properties of polysaccharides- Starch, cellulose and glycogen.	Understand role of reagents to separate proteins	Lecture	BT6201.1/ BT6201.6	MTE I Quiz End Term
9.	Tutorial	Learn applications and method of protein separation	Lecture	BT6201.1/ BT6201.6	MTE I Quiz End Term
10.	Lipids: Saturated and unsaturated fatty acids.	Recall the techniques of protein separation	Discussion	BT6201.1/ BT6201.6	Class Test/ Quiz
11.	Protein: Structure and classification of amino acids.	Understand 2-D gels	Lecture	BT6201.1/ BT6201.6	MTE I Quiz End Term
12.	Tutorial	Learn the principle of compound microscope	Lecture	BT6201.2	MTE I Quiz End Term
13.	Primary, secondary and tertiary structure of protein.	Understand details of compound microscope	Lecture	BT6201.2	MTE I Quiz

					End Term
14.	Primary, secondary and tertiary structure of protein.	Recall light microscope functioning	Discussion	BT6201.2	Class Test/ Quiz
15.	Tutorial	Learn different types of microscope	Lecture	BT6201.2	MTE 1 Quiz End Term
16.	Ramachandran Plot.	Understand various uses of microscope	Lecture	BT6201.2	MTE 1 Quiz End Term
17.	Vitamins: Structure and functions.	Recall details of various microscopes	Discussion	BT6201.2	Class Test/ Quiz
18.	Tutorial	Discuss principle behind working of pH meter	Lecture	BT6201.3	MTE 1 Quiz End Term
19.	Principles of thermodynamics: First and Second law of thermodynamics, concept of free energy.	Learn working of pH meter	Lecture	BT6201.3	MTE 1 Quiz End Term
20.	Enzymes: classification, nomenclature,	Recall pH meter	Discussion	BT6201.3	Class test/ Quiz
21.	Tutorial	Learn working of colorimeter	Lecture	BT6201.4	MTE 1 Quiz End Term
22.	Enzyme kinetics: Michalis-Menten equation	Learn working of spectroscopy	Lecture	BT6201.4	MTE 1 Quiz End Term
23.	Enzyme kinetics: significance of Km, kcat and turnover number	Learn working of spectroscopy	Lecture	BT6201.4	MTE 1 Quiz End Term
24.	Tutorial	Recall spectroscopy	Discussion	BT6201.4	Class test/ Quiz
25.	Mechanism of enzyme action (binding to substrate, lowering of activation energy),	Understand techniques of separation of pigments	Lecture	BT6201.5	MTE 1 Quiz End Term
26.	Holoenzyme, co-enzyme and cofactors	Understand techniques of separation of pigments	Lecture	BT6201.5	MTE 2 Quiz End Term
27.	Tutorial	Recall techniques of pigment separation	Discussion	BT6201.5	Class test/ Quiz
28.	Isozymes and ribozymes.	Understand techniques of separation of pigments	Lecture	BT6201.5	MTE 2 Quiz End Term

29.	Allosteric enzymes	Understand techniques of separation of pigments	Lecture	BT6201.5	MTE 2 Quiz End Term
30.	Tutorial	Understand techniques of separation of pigments	Lecture	BT6201.5	MTE 2 Quiz End Term
31.	Enzyme inhibition, factors controlling enzyme activity, role of enzymes as catalysts	Recall techniques of pigment separation	Discussion	BT6201.5	Class test/ Quiz
32.	Metabolic pathways: Glycolysis	Understand techniques of separation of pigments	Lecture	BT6201.5	MTE 2 Quiz End Term
33.	Tutorial	Understand techniques of separation of pigments	Lecture	BT6201.6	MTE 2 Quiz End Term
34.	Metabolic Pathways: Lipids metabolism	Recall techniques of pigment separation	Tutorial	BT6201.6	Class test/ Quiz
35.	Metabolic pathways: Amino Acids metabolism,	Learn separation of biomolecules on density	Lecture	BT6201.6	MTE 2 Quiz End Term
36.	Tutorial	Learn separation of biomolecules on density Learn separation of biomolecules on density	Lecture	BT6201.6	MTE 2 Quiz End Term
37.	Metabolic pathways: Nucleotides synthesis and degradation	Learn separation of biomolecules on density	Lecture	BT6201.6	MTE 2 Quiz End Term
38.	Oxidative phosphorylation, Coupled reaction,	Recall density based separation	Discussion	BT6201.6	Class test/ Quiz
39.	Group transfer, Biological energy transducers.	Learn techniques of nucleic acid visualization	Lecture	BT6201.6	MTE 2 Quiz End Term
40.	Tutorial	Learn techniques of nucleic acid visualization	Lecture	BT6201.6	MTE 2 Quiz End Term
41.	Isozymes and Ribozymes.	Recall the techniques leant	Discussion	BT6201.6	Class test/ Quiz
42.	Nucleic acids: A-, B-, Z-DNA,	Recall density based separation	Discussion	BT6201.6	Class test/ Quiz
43.	Tutorial	Learn techniques of nucleic acid visualization	Lecture	BT6201.6	MTE 2 Quiz End Term

44.	Structure and function of tRNAs	Learn techniques of nucleic acid visualization	Lecture	BT6201.6	MTE 2 Quiz End Term
45.	Structure and function of micro-RNA,	Recall the techniques leant	Discussion	BT6201.6	Class test/ Quiz
46.	Tutorial	Learn techniques of nucleic acid visualization	Lecture	BT6201.6	MTE 2 Quiz End Term
47.	Stability and synthesis of protein structure	Learn techniques of nucleic acid visualization	Lecture	BT6201.6	MTE 2 Quiz End Term
48.	Stability of nucleic acid structures, replication processes.	Learn techniques of nucleic acid visualization	Lecture	BT6201.6	MTE 2 Quiz End Term
Lab Sessions	Working principles of various available laboratory instruments: Laminar Air Flow Cabinet, centrifuge, spectrophotometer, oven, incubator, BOD incubator, autoclave. Study of UV absorption spectra of macromolecules (protein and nucleic acid). Determination of Lambda max of a dye solution. Determination of protein and nucleic acid concentration by spectrophotometric method. Separation and identification of amino acids using TLC.	Learn various techniques	Lab sessions	BT6201.1 BT6201.2 BT6201.6	Experimental results lab sessions End Term Practical Examination

H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
[BT6201.1]	Identify the five classes of polymeric biomolecules and their monomeric building blocks.								2		3
[BT6201.2]	Classify fundamental biochemical principles, such as the structure/function of biomolecules										
[BT6201.3]	Interpret the specificity of different enzymes (biochemical catalysts), and the chemistry involved in enzyme action.							1			2
[BT6201.4]	Differentiate metabolic pathways, and the regulation of biological/biochemical processes.							1	3		
[BT6201.5]	Investigate how fats and amino acids are metabolized, and explain how they can be used for fuel							1		1	2
[BT6201.6]	Develop employability skills for opportunities in diagnostic labs, hospitals.								1	2	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Biosciences

Course Hand-out

Plant Biotechnology | BT 6202 | 4 Credits | 3 0 14

Session: Jan2020 – May 2020 | Faculty: Dr. Rohit Jain | Class: II Semester

A. Introduction: This course is offered by Dept. of Biosciences as a core course in M.Sc. (Hons) Biotechnology. This course provides postgraduate-level knowledge of and expertise in Plant Biotechnology Tools and techniques. It illustrates the strategies and focuses on the theory and practice of plant tissue culture and experimental morphogenesis and its role in the propagation of endangered and economically & medicinally important plants species. Students will also gain knowledge about the mechanisms of gene transfer in the plants and various components used in gene transfer techniques including Ti and Ri vectors, binary vectors, 35S other promoters and reporter genes etc. The course also offers a understanding of biodiversity and Its conservation, plant germplasm collection and conservation of wild species and Cryopreservation.

B. Course Outcomes: At the end of the course, students will be able to:

[BT6202.1] Understand various components of experimental morphogenesis and plant tissue culture media, e.g. culture medium, micropropagation and growth factors,

[BT6202.2] Explain the various steps taken to establish and optimise media for micropropagation of economically and medicinally important plants

[BT6202.3] Perform hands on traing on advanced techniques of plant biotechnology such as artificial seed production and genetic transformation thereby enhancing the skills and employability opportunities

[BT6202.4] Analyse the food requirements of the population and develop competent solution in terms of sustainable crop improvement using genetic transformation technology for socio-economic developmet

[BT6202.5] Understand the concept of biodiversity and develop stratagies for its conservation by various biotechnological tools

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.

[PO.2]. **Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO.3]. **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.4]. **Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. **Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO.6]. **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

[PO.7]. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

[PSO.1.] To demonstrate competency in factual content and interpretation of the major biological concept areas of cell and molecular biology, genetics, organismal biology, and evolution and ecology.

[PSO.2.] To demonstrate the ability to identify significant biological research questions, develop research protocols, and properly analyze research questions through the use of the scientific method.

[PSO.3.] Enhance analytical and quantitative skills and demonstrate an understanding of basic computational and statistical techniques in the field of Biotechnology

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Mid Term Exam 1 – IA 1	20
	Mid Term Exam 2 - IA 2	20
	CWS Assessment IA 3 10 marks of IA 3 are awarded based on the various assignments, class tests, seminar presentation etc.	20
End Term Exam (EX)	End Term Exam – EX 1	40
	Total	100

Note: A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.

E. SYLLABUS:

Introduction: History and scope of plant biotechnology. Organogenesis: Direct and indirect methods of organogenesis. Embryo culture and embryo rescue. Protoplast isolation, culture and fusion; Selection of hybrid cells and regeneration of hybrid plants; Symmetric and asymmetric hybrids, cybrids. Anther, pollen and ovary culture for production of haploid plants and homozygous lines. Transfer and establishment of whole plants in soil. Plant Transformation Technology: Features of TI and RI plasmid, mechanisms of DNA transfer, Role of virulence genes, Use of TI and RI as vectors, binary vectors, use of 35S and other promoters, Use of reporter genes. Transformation for Productivity and Performance: Bt genes, Non-Bt like protease inhibitors, Alpha amylase inhibitor. Abiotic stresses. Chloroplast Transformation: Metabolic engineering and industrial products. Plant as chemical and pharmaceutical factories. Biodiversity and Its Conservation: Plant germplasm collection and conservation including wild species, Cryopreservation.

F. REFERENCES:

R1. S.S. Bhojwani, and M.K. Razdan. Plant Tissue Culture: Theory and Practice, Elsevier Science Publishers, New York, USA, 2011.

R2. H.S. Chawla: Biotechnology in Crop improvement, International Book Distributing Company, Lucknow, 1998.

R3. P.K. Gupta: Elements of Biotechnology, Rastogi and Co, Meerut, 1996.

R4. J. Hammond, P. McGarvey and V. Yusibov. Plant Biotechnology, Springer Verlag, USA 2000.

R5. T.J., Fu, G. Singh and W.R. Curtis. Plant Cell and Tissue Culture for the Production of Food ingredients, Kluwer Academic/Plenum Press, USA, 1999.

R6. R.J. Henry. Practical Application of Plant Molecular Biology, Garland Science, USA, 1997.

G. Lecture Plan:

LEC NO	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of assessing the outcome
1.	Introduction to Plant biotechnology: Scope and Prospects	Understand and define applications of plant biotechnology	Lecture	BT6202.1	MTE I ETE
2.	Totipotency, Experiemntal morphogenesis and plant tissue culture, genetic engineering, *etc.*	Concept of totipotency and cytodifferentiation	Lecture	BT6202.1 BT6202.2	MTE I Quiz/ETE
3.	Plant tissue culture: nutrient media and its components	Enlist different components of media used in plant tissue culture	Lecture	BT6202.1 BT6202.2	MTE I ETE
4.	Tutorial	Recall the status of research in plant biotechnology	Discussion	BT6202.1 BT6202.2	Test/Quiz
5.	Plant culture media and micropropagation	Understand Media compostition	Lecture	BT6202.1 BT6202.2	
6.	Plant Growth Regulators and elicitors used in the culture media	Define the role of different plant growth promoting regulators	Lecture	BT6202.1 BT6202.2	MTE I Quiz/Test ETE
7.	Modes of plant regeneration: direct and indirect regeneration, organogenesis and *de novo* regeneration	Differentiate between different modes of regeneration of plant *in vitro*	Lecture	BT6202.1 BT6202.2	MTE I ETE
8.	Tutorial	Recall the composition of plant growth media and role of different PGPRs	Discussion	BT6202.1 BT6202.2	Quiz/Test
9.	Somatic embryogenesis: history, methods for somatic embryogenesis	Explain the process of somatic embryogenesis	Lecture	BT6202.2	MTE I ETE
10.	Haploid plants and its production using anther and ovary culture	Utiltiy of haploids in plant biotechnology	Lecture	BT6202.1 BT6202.2	MTE I Assignment/Test ETE
11.	Somaclonal variation: concept and techniques	Understand the process of generating somaclonal variants	Lecture	BT6202.2	MTE I ETE
12.	Tutorial	Recall various methods of *in vitro* regeneration	Discussion	BT6202.3	Quiz/Test
13.	Genetic engineering: introduction and history	Understand the basic principle of genetic engineering	Lecture	BT6202.3 BT6202.4	MTE 2 ETE
14.	Restriction enzymes: basic features, types and mode of action	Differentiate between different types of restriction enzymes	Lecture	BT6202.3 BT6202.4	MTE 2 ETE
15.	Vectors for plant transformation: basic features of vectors Plasmid, phagemid, cosmid, YAC, BAC *etc*	Explain the characteristics of vectors used for genetic engineering	Lecture	BT6202.3 BT6202.4	MTE 2 ETE

16.	Tutorial	Recall the global status of plant genetic engineering	Discussion	BT6202.3	Quiz/Test
17.	Gene transfer methods: direct and indirect Basillus thuringiensis – Introduction and utilities	Understand the difference between direct and indirect mode of gene transfer	Lecture	BT6202.3	MTE 2 ETE
18.	Agrobacterium Mediated Gene Transfer: principle, method	Explain the principle and process of AMGT	Lecture	BT6202.3 BT6202.4	MTE 2 ETE
19.	Applications of AMGT, merits and demerits	Enlist various applications of AMGT	Lecture	BT6202.4 BT6202.5	MTE 2/Assignment/ETE
20.	Tutorial	Recall the applications and importance of somaclonal variants	Discussion	BT6202.4 BT6202.5	Quiz/Test
21.	Direct methods of gene transfer: methods, merits and demerits	Discuss the merits and demerits of direct gene transfer methods	Lecture	BT6202.3 BT6202.4	MTE 2 ETE
22.	Selectable marker and Reporter genes and its applications in plant genetic transfromation	Differentiate between selectable markers and reporter genes	Lecture	BT6202.3	MTE 2 ETE
23.	Applications of Genetic engineering in plant sciences: development of herbicide resistant, disease resistant, stress tolerant plants, *etc.*	Discuss the application and importance of genetic engineering in crop improvement	Lecture	BT6202.3 BT6202.4	Assignment ETE
24.	Tutorial	Recall and enlist various tools required for genetic engineering	Discussion	BT6202.3	Quiz/Test
25.	Crop improvement programs undertaken with the aid of genetic engineering	Analyse different programs formulated for crop improvement	Lecture	BT6202.4	Case Studies Assignment ETE
26.	Genetically modified crops: examples and their characteristics	Enlist different genetically modified plants	Lecture	BT6202.4	Case Studies Assignment/ETE
27.	GM Crops of the world and status of GMO in India	Understand the reasons behind lower share of India in GM technology	Lecture	BT6202.4	Case Studies Assignment/ETE
28.	Tutorial	Recall the different methods used for gene transfer	Discussion	BT6202.6	Quiz/Test
29.	Flavr-Savr Tomato, BT Brinjal	Process of development of GM crops	Process of development of GM crops	Process of development of GM crops	Process of development of GM crops
30.	BT Cotton, BT Mustard	BT 6202	Process of development of GM crops	Process of development of GM crops	Process of development of GM crops
31.	Genetic Engineering Approval Committee: Biosafety regulations	Understand the rules and regulations of GEAC for releasing GM crop	Lecture	BT6202.4	Quiz/Test ETE
32.	Tutorial	Critically evaluate different methods of gene transfer based on their merits and demerits	Discussion	BT6202.4 BT6202.5	Quiz/Test

33.	Environmental risk analysis and assessment of GM crops and products	Discuss different parameters for risk assessment of GM crops and products	Lecture	BT6202.4	Quiz/Test ETE
34.	Current status of GM crops & products in India, ethical issues associated with commercialisation of GM	Understand the various socio-economical concerns associated with GM crop commercialisation	Lecture	BT6202.3 BT6202.4	Quiz/Test ETE
35.	Plant as cell factories for secondary metabolite production	Concept of metabolite production	Lecture	BT6202.3 BT6202.4	Quiz/Test ETE
36.	Tutorial		Discussion	BT6202.3	Quiz/Test
37.	Chloroplast transformation: Process and Principle	Chloroplast genome transfer	Lecture	BT6202.3 BT6202.4	Quiz/Test ETE
38.	Biodiversity: Concept and scope	Understand the role of biodiversity	Lecture	BT6202.5	Quiz/Test ETE
39.	Conservation stratagies: Ex situ and in situ conservation	Understadnd the various stratagies for conservation of species	Lecture	BT6202.5	Quiz/Test ETE
40.	Tutorial	Discussion – Conservation	Discussion	BT6202.5	ETE
41.	In situ conservation: Biological parks, national parks, biospehere reserve	Concept of the national parks and sanctuaries	Lecture	BT6202.5	Quiz/Test ETE
42.	Ex situ conservation: Gene bank, seed bank, micropropagation , artificial seeds	Consept of conservation outide the natural areas	Lecture	BT6202.5	Quiz/Test ETE
43.	Gerenplasm and its centres for collection and conservation	Consept of conservation outide the natural areas	Lecture	BT6202.5	Quiz/Test ETE
44.	Tutorial	Recall different applications of genetic engineering in crop improvement with relevant examples and case studies	Discussion	BT6202.4 BT6202.5	Quiz/Test
45.	NBPGR and NAPGR New Delhi – Nodal; centres for germ plasm conservation	Process work flow of germplsm conservation in India	Lecture	BT6202.5	Quiz/Test ETE
46.	Cryopreservation- Scope and applications	Understand the conservation process under ultra low temperature	Lecture	BT6202.5	Quiz/Test ETE
47.	Cryopreservation – Use of Liq. N_2 in cryopreservation. Precautions in cryopreservation and its utility in biodiversity conservation	Understand the conservation process under ultra low temperature	Lecture	BT6202.5	Quiz/Test ETE
48.	Tutorial	Recall the various regulatory and safety concerns associated with GM crops	Discussion	BT6202.5	Quiz/Test
Lab Sessions	To optimize *in vitro* regeneration protocol for different plants To optimize protocol for gene transfer using *Agrobacterium* in *in vitro* raised cultures of different plants	Develop genetically transformed plants using AMGT Conduct mass multiplication of important plant species using micropropagation strategies	Lab Sessions	BT6202.3 BT6202.6	Experimental results in 24 lab sessions End Term Practical Examination

H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
[BT6202.1]	Understand various components of experimental morphogenesis and plant tissue culture media, e.g. culture medium, micropropagation and growth factors,	1						1	1		
[BT6202.2]	Explain the various steps taken to establish and optimise media for micropropagation of economically and medicinally important plants								1		
[BT6202.3]	Perform hands on traing on advanced techniques of plant biotechnology such as artificial seed production and genetic transformation thereby enhancing the skills and employability opportunities	1			2					2	1
[BT6202.4]	Analyse the food requirements of the population and develop competent solution in terms of sustainable crop improvement using genetic transformation technology for socio-economic developmet			2	2		1	1		3	2
[BT6202.5]	Understand the concept of biodiversity and develop stratagies for its conservation by various biotechnological tools						3	2		2	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Biosciences

Course Hand-out

Genetic Engineering & Its Applications| BT6203 | 4 Credits | 3 1 0 4

Session: Jan 2020 – May 2020| Faculty: Dr. Mousumi Debnath| Class: II Semester

A. Introduction: This course is offered by Dept. of Biosciences as a core course in M.Sc. Biotechnology Programme targeting students who wish to pursue their career in wide range of sectors such as forensics, gene cloning and biopharmaceuticals, gene therapy etc. This course is aimed to sensitize the students with the emerging need for gene analysis techniques that can be developed and used for understanding how genes in normal organisms function and how they differ if there is a defect in some genes. The course also highlights the importance of recombinant DNA technology along with the current examples.

B. Course Outcomes: At the end of the course, students will be able to:

[BT6203.1] Attain knowledge about Scope, discoveries and milestones related to genetic engineering

[BT6203.2] Understand the techniques of gene transfer and their potential benefits

[BT6203.3] Understand more about the enzymes used in genetically modified organisms

[BT6203.4] Understand basic concepts and vectors related to recombinant DNA technology

[BT6203.5] Delineate the steps used in gene amplification along with its benefits

[BT6203.6] Apply advanced techniques in genetic engineering to help the biomedical scientists

[BT6203.7] Optimise their experiments in research hence develop employability skills.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.

[PO.2]. **Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO.3]. **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.4]. **Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. **Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO.6]. **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

[PO.7]. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

[PSO.1]. To understand fundamental principles of molecular biology, molecular cell biology and bioinformatics

[PSO.2]. Modern approaches in biotechnology: the 'omics technologies including proteomics, transcriptomic, metabolomics and bioprocessing

[PSO.3]. Management and communication skills, including problem definition, project design, data collection and interpretation using statistical tools, decision processes, teamwork, written and oral reports, scientific publications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Mid Term Exam 1 – IA 1	20
	Mid Term Exam 2 - IA 2	20
	CWS Assessment IA 3 10 marks of IA 3 are awarded based on the various assignments, class tests, seminar presentation etc.	20
End Term Exam (EX)	End Term Exam – EX 1	40
	Total	100

NOTE: A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.

E. SYLLABUS

Genetic engineering: Scope, early discoveries and milestones, introduction to gene cloning , basic steps of genetic engineering; types and functions of enzymes used in genetic engineering: restriction endonucleases, DNA ligases, DNA polymerases, Reverse transcriptase, Polynucleotide kinases, modification of enzymes, sticky and blunt ends, end labelling and other processes used in rDNA technology. Safety measures and regulations for recombinant DNA work. Gene cloning vectors: plasmids, cosmids, phage vectors, phagemids, Ti plasmid, shuttle vectors, artificial chromosomes (YAC, BAC), expression and binary vectors. Nucleic acid amplification and its applications. Nucleic acid sequencing. cDNA synthesis and cloning. Genomics & Proteomics: Different approaches and basics. Gene regulation and Homologous Recombination: Site directed mutagenesis and protein engineering; primer extension, SI mapping, Reporter assay. Different types of blotting techniques. Antisense RNA and ribozyme technology. RNAi technology. Molecular mapping of genome- genetic and physical maps, fluorescence in situ hybridization in genome analysis, RFLP, RAPD, AFLP analysis and their application in mapping of genome.

F. REFERENCES:

R1. A.J.F. Griffiths, W.M. Gelbart, R.C. Lewontin and J.H. Miller. Modern Genetic Analysis Integrating Genes and Genomes, WH Freeman and Company, New York, 2002.

R2. J.D. Watson, A.A. Candy, R.M. Myers and J.A., Witkowski. Recombinant DNA (Genes and Genomes – A short Course), WH Freeman and Company, New York, 2006.

R3. K.V. Chaitanya. Cell and Molecular Biology: A Lab Manual, Phi Publisher, India, 2013.

R4. J. Saxena, M. Baunthiyal and I. Ravi. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology. Scientific Publishers, India, 2012.

R5. J.W. Dale and M. Von Schantz. From Genes to Genomes (Concepts and Applications of DNA Technology), John Wiley and Sons Ltd., USA, 2011.

R6. S.B. Primrose and R.M., Twyman. Principles of Gene Manipulation and Genomics, Blackwell Publishing, 2006.

R7. E.L. Winwacker. From Genes to Clones–Introduction to Gene Technology, Panima Publishing Corporation, 1997.

R8. M.S. Clark. Plant Molecular Biology - A Laboratory Manual, Springer, USA, 2014.

G. Lecture Plan:

LEC NO	TOPICS	Session outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1.	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	To acquaint and clear teachers expectations and understand student expectations	ALL COs	NA
2.	Introduction to genetic engineering	Introduce to the concept of the course	Lecture	BT 6203.1 BT 6203.2	MTE I Quiz, End Term
3.	Scope of Genetic engineering	Understand why this course is important in the present era	Lecture	BT 6203.2	MTE I
4.	Genetic engineering: Early discoveries and milestones	Know the work done in this field	Lecture	BT 6203.2 BT 6203.4	Class Test MTE I, End Term
5.	Introduction to gene cloning	Differentiate between the concepts	Lecture	BT 6203.2 BT 6203.4	Class Test MTE I, End Term
6.	Tutorial	Assess what was taught in the earlier classes	Discussion	BT 6203.2 BT 6203.4	Class Test
7.	Basic steps of genetic engineering	Understand the steps of Genetic engineering	Lecture	BT 6203.2 BT 6203.4	Class Test MTE I, End Term
8.	Types and functions of enzymes used in genetic engineering	Analyse the types and functions of enzymes	Lecture	BT 6203.2 BT 6203.4	Quiz MTE I, End Term
9.	Tutorial	Assess what was taught in the earlier classes	Discussion	BT 6203.2 BT 6203.4	Class Test/Quiz
10.	Restriction endonucleases, DNA ligases	Are restriction endonucleases and DNA ligases the same functionally	Lecture	BT 6203.2 BT 6203.4	Quiz MTE I, End Term
11.	DNA polymerases, Reverse transcriptase	Understand DNA polymerases and reverse transcriptases	Lecture	BT 6203.2 BT 6203.4	Class Test MTE I, End Term
12.	Tutorial	Assess what was taught in the earlier classes	Discussion	BT 6203.2	Class test/Quiz
13.	Polynucleotide kinases, modification of enzymes	Understand Polynucleotide kinases, modification of enzymes	Lecture	BT 6203.6	Class Test MTE 2, End Term
14.	sticky and blunt ends		Lecture	BT 6203.4	Class Test MTE 2, End Term
15.	Tutorial	Assess what was taught in the earlier classes	Discussion	BT 6203.6	Quiz
16.	End labelling and other processes used in rDNA technology	Understand the concept of end labelling	Lecture	BT 6203.4	Quiz MTE 2, End Term
17.	Safety measures and regulations for recombinant DNA work.	Know the safety measures and regulations for recombinant DNA work	Lecture	BT 6203.6	Class Test MTE 2, End Term
18.	Tutorial	Assess what was taught in the earlier classes	Discussion	BT 6203.2	Quiz

19.	Gene cloning vectors: plasmids	Introduce to gene cloning vectors: plasmids	Lecture	BT 6203.2 BT 6203.4	Class Test MTE 2, End Term
20.	Gene cloning vectors: plasmids	Understand how Gene cloning vectors like plasmids function	Lecture	BT 6203.3	Quiz MTE 2, End Term
21.	Tutorial	Assess what was taught in the earlier classes	Discussion	BT 6203.3	Class Test/Quiz
22.	Cosmids, phage vectors	Understand Cosmids, phage vectors	Lecture	BT 6203.3	Class Test MTE 2, End Term
23.	phagemids, Ti plasmid	Understand phagemids, Ti plasmid	Lecture	BT 6203.4 BT 6203.6	Class Test
24.	Tutorial	Assess what was taught in the earlier classes	Discussion	BT 6203.3 BT 6203.7	Class Test
25.	shuttle vectors, artificial chromosomes (YAC, BAC)	What do you mean by chromosomes (YAC, BAC)	Lecture	BT 6203.4	Class Test End Term
26.	Expression and binary vectors	Differentiate between Expression and binary vectors	Lecture	BT 6203.4	Class Test End Term
27.	Expression and binary vectors	Know how these vectors help in expression of genes	Discussion	BT 6203.4	Class Test/Quiz
28.	Tutorial	Assess what was taught in the earlier classes	Lecture	BT 6203.6	Class Test End Term
29.	Nucleic acid amplification and its applications	What is Nucleic acid amplification State its functions	Lecture	BT 6203.6	Class test End Term
30.	Nucleic acid amplification and its applications	Sate the concept and application of nucleic acid	Discussion	BT 6203.6	Quiz
31.	Tutorial	Assess what was taught in the earlier classes	Lecture	BT 6203.5	Class Test End Term
32.	Nucleic acid sequencing. cDNA synthesis and cloning	What do you mean by Nucleic acid sequencing? cDNA synthesis and cloning	Lecture	BT 6203.5	Class Test End Term
33.	Genomics & Proteomics: Different approaches and basics	Different approaches and basics of Genomics & Proteomics	Discussion	BT 6203.5	Class Test
34.	Tutorial	Assess what was taught in the earlier classes	Lecture	BT 6203.5	Class Test End Term
35.	Gene regulation and Homologous Recombination	How does Gene regulation and Homologous Recombination occur	Lecture	BT 6203.5	Class Test End Term
36.	Site directed mutagenesis and protein engineering	Understand Site directed mutagenesis and protein engineering	Discussion	BT 6203.5	Quiz
37.	Tutorial	Assess what was taught in the earlier classes	Discussion	BT 6203.5	Class Test

38.	primer extension, SI mapping, Reporter assay	What do you mean by primer extension, SI mapping, Reporter assay	Lecture	BT 6203.5	Class Test End Term
39.	Different types of blotting techniques.	Introduce to blotting	Lecture	BT 6203.5	Class Test End Term
40.	Tutorial	Assess what was taught in the earlier classes	Discussion	BT 6203.5	Quiz
41.	Different types of blotting techniques.	Differentiate between the different types of blotting	Lecture	BT 6203.5	Class Test End Term
42.	Antisense RNA and ribozyme technology. RNAi technology	Understand the meaning of Antisense RNA , ribozyme technology and also RNAi technology	Discussion	BT 6203.5	Quiz
43.	Tutorial	Assess what was taught in the earlier classes	Discussion	BT 6203.5	Class Test
44.	Molecular mapping of genome- genetic and physical maps	Understand Molecular mapping of genome- genetic and physical maps	Lecture	BT 6203.5	Class Test End Term
45.	Fluorescence in situ hybridization in genome analysis, RFLP	Discuss Fluorescence in situ hybridization in genome analysis	Lecture	BT 6203.5	Class Test End Term
46.	Tutorial	Assess what was taught in the earlier classes	Discussion	BT 6203.5	Quiz
47.	RAPD, AFLP analysis and their application in mapping of genome	Understand the different types of DNA fingerprint	Lecture	BT 6203.5	Class Test End Term
48.	Conclusion and summarisation	Summarise the contents of the course	Lecture	NA	NA
49.	Lab sessions	Hands on training	Lab sessions	BT 6203.1 BT 6203.3 BT 6203.6	End Term Practical Examination

H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
[BT 6203.1].	Knowledge about Scope, discoveries and milestones related to genetic engineering	1							1		
[BT 6203.2].	Understand the techniques of gene transfer and their potential benefits			1	1		2	1	1		
[BT 6203.3].	Understand more about the enzymes used in genetically modified organisms	1					2	1	1	2	
[BT 6203.4].	Basic concepts and vectors related to Recombinant DNA Technology	1						1		2	2
[BT 6203.5].	Delineate the steps used in gene amplification along with its benefits						1				3
[BT 6203.6].	Basic understanding of advanced techniques that are required to help the biomedical scientists optimise their experiments in research hence develop employability skills.						1	2		3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Computing and Information Technology

Department of Biosciences
Course Hand-out

Research Methodology and Technical Writing | MA 6205 | 3 Credits | 2 1 0 3

Session: Jan 2020 – May 2020 | Faculty: Dr. Vivek Singh | Class: II Semester

A. Introduction: This course is offered by Dept. of Mathematics and Statistics for M.Sc. Biotechnology students, targeting students who wish to pursue research methodology and technical writing or higher studies in field of Biotechnology. It offers in depth knowledge of foundations of research, understanding the language of research, research process; features of a good research design; statistical techniques and tools; paper writing, ethical issues related to publishing of a research paper, plagiarism.

B. Course Outcomes: At the end of the course, students will be able to

[MA6205.1]	Students able to identify and analysis of scientific research problem.
[MA6205.2]	Develop understanding on various kinds of descriptive and experimental research designs.
[MA6205.3]	Have adequate knowledge on measurement and scaling techniques as well as the quantitative data analysis in research.
[MA6205.4]	Have the concept of statistical tools, estimation and hypothesis testing to choose the appropriate analytical tools.
[MA6205.5]	Students able to understand basics about the components of writing and evaluate an excellent research report.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1].	**Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.
[PO.2].	**Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
[PO.3].	**Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.
[PO.4].	**Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
[PO.5].	**Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
[PO.6].	**Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.
[PO.7].	**Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

[PSO.1].	To understand fundamental principles of molecular biology, molecular cell biology and bioinformatics
[PSO.2].	Modern approaches in biotechnology: the 'omics technologies including proteomics, transcriptomic, metabolomics and bioprocessing
[PSO.3].	Management and communication skills, including problem definition, project design, data collection and interpretation using statistical tools, decision processes, teamwork, written and oral reports, scientific publications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Closed Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

E. SYLLABUS:

Foundations of Research: Meaning, objectives, motivation, utility, empiricism, deductive and inductive theory, characteristics of scientific method , understanding the language of research; Research Process: Problem identification & formulation, research question, investigation question, measurement issues, hypothesis, qualities of a good hypothesis, types of hypothesis; Research Design: Concept and importance in research, features of a good research design, exploratory research design, descriptive research designs, experimental research design; Types of Data: Classification of data, uses, advantages, disadvantages, sources; Measurement: Concept of measurement, problems in measurement in research, validity and reliability, levels of measurement; Statistical Techniques and Tools: Introduction of statistics, functions, limitations, graphical representation, measures of central tendency, measure of dispersion, skewness, kurtosis, correlation, regression, tests of significance based on t, F, Chi-square, Z and ANOVA test; Paper Writing: Layout of a research paper, Scopus/Web of Science journals, impact factor of journals, when and where to publish, ethical issues related to publishing, plagiarism and self-plagiarism. Introduction to LATEX and MATLAB.

F. References:

R1. C.R. Kothari, Research Methodology Methods & Techniques, New Age International Publishers, Reprint 2008.

R2. R. Singh, Research Methodology, Saga Publication, 4th edition, 2014.

R3. J. Anderson and M. Poole, Thesis and Assignment Writing, Wiley India 4th edition, 2011.

R4. Mukul Gupta and Deepa Gupta, Research Methodology, PHI Learning Private Ltd., New Delhi, 2011.

R5. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 1999.

G. Lecture Plan:

Lec No.	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1.	Introduction and Course Hand-out briefing of Research Methodology and Technical Writing	To understand basics about Research Methodology and Technical Writing	Lecture	-	Class Quiz Mid Term I End Term
2.	Foundations of Research: Meaning, objectives	To develop understanding of the basic framework of research process.	Lecture	MA 6205.1	Class Quiz Mid Term I End Term
3.	Foundations of Research: Motivation, utility, empiricism	To develop understanding of the basic framework of research process.	Lecture	MA 6205.1	Class Quiz Mid Term I End Term
4.	Research: deductive and inductive theory	To develop understanding of the basic framework of research process.	Lecture	MA 6205.1	Class Quiz Mid Term I End Term
5.	Characteristics of scientific method	To develop understanding of the basic framework of research process.	Lecture	MA 6205.1	Class Quiz Mid Term I End Term
6.	Understanding the language of research	To develop understanding of the basic framework of research process.	Lecture	MA 6205.1	Class Quiz Mid Term I End Term
7.	Research Process: Problem identification & formulation	To develop understanding of the basic framework of research process.	Lecture	MA 6205.1	Class Quiz Mid Term I End Term
8.	Research question	To develop understanding of the basic framework of research process.	Lecture	MA 6205.1	Class Quiz Mid Term I End Term
9.	Research Process: Investigation question, measurement issues	To develop understanding of the basic framework of research process.	Lecture	MA 6205.1	Class Quiz Mid Term I End Term
10.	Hypothesis, qualities of a good hypothesis, types of hypothesis	To develop understanding of the basic framework of research process.	Lecture	MA 6205.1	Class Quiz Mid Term I End Term
11.	Research Design: Concept and importance in research	To develop an understanding of various research designs and techniques	Lecture	MA 6205.2, MA 6205.3	Class Quiz Mid Term I End Term
12.	Features of a good research design,	To develop an understanding of various research designs and techniques	Lecture	MA 6205.2, MA 6205.3	Class Quiz Mid Term I End Term

13.	Exploratory research design, descriptive research designs, experimental research design;	To develop an understanding of various research designs and techniques	Lecture	MA 6205.2, MA 6205.3	Class Quiz Mid Term I End Term
14.	Types of Data: Classification of data, uses, advantages, disadvantages, sources	To develop an understanding of various research designs and techniques	Lecture	MA 6205.2, MA 6205.3	Class Quiz Mid Term II End Term
15.	Measurement: Concept of measurement, problems in measurement in research,	To develop an understanding of various research designs and techniques	Lecture	MA 6205.2, MA 6205.3	Class Quiz Mid Term II End Term
16.	Measurement: Validity and reliability, levels of measurement;	To develop an understanding of various research designs and techniques	Lecture	MA 6205.2, MA 6205.3	Class Quiz Mid Term II End Term
17.	Statistical Techniques and Tools: Introduction of statistics, functions, limitations, graphical representation,	To understand basics about	Lecture	MA 6205.4	Class Quiz Mid Term II End Term
18.	Statistical Techniques and Tools: Measures of central tendency, measure of dispersion,	To understand conceptual framework of Statistical Inference.	Lecture	MA 6205.4	Class Quiz Mid Term II End Term
19.	Skewness, kurtosis,	To understand conceptual framework of Statistical Inference.	Lecture	MA 6205.4	Class Quiz Mid Term II End Term
20.	Correlation, regression,	To understand conceptual framework of Statistical Inference.	Lecture	MA 6205.4	Class Quiz Mid Term II End Term
21.	Tests of significance based on t, F	To understand conceptual framework of Statistical Inference.	Lecture	MA 6205.4	Class Quiz Mid Term II End Term
22.	Tests of significance based on Chi-square, Z-test	To understand conceptual framework of Statistical Inference.	Lecture	MA 6205.4	Class Quiz Mid Term II End Term
23.	ANOVA test;	To understand conceptual framework of Statistical Inference.	Lecture	MA 6205.4	Class Quiz Mid Term II End Term
24.	Problem Solving Class	To understand conceptual framework of Statistical Inference.	Lecture	MA 6205.4	Class Quiz Mid Term II End Term
25.	Paper Writing: Layout of a research paper,	To understand basics about the components of writing and evaluate quality research.	Lecture	MA 6205.3, MA 6205.5	Class Quiz End Term
26.	Paper Writing: Scopus/Web of Science journals, impact factor of journals,	To understand basics about the components of writing and evaluate quality research.	Lecture	MA 6205.3, MA 6205.5	Class Quiz End Term

27.	Paper Writing: Technical Sections -Examples of reports, Journal papers, Conference papers	To understand basics about the components of writing and evaluate quality research.	Lecture	MA 6205.3, MA 6205.5	Class Quiz End Term
28.	When and where to publish, ethical issues related to publishing,	To understand basics about the components of writing and evaluate quality research.	Lecture	MA 6205.3, MA 6205.5	Class Quiz End Term
29.	Brief information about Plagiarism and self-plagiarism.	To understand basics about the components of writing and evaluate quality research.	Lecture	MA 6205.5	Class Quiz End Term
30.	How to avoid Plagiarism and self-plagiarism.	To understand basics about the components of writing and evaluate quality research.	Lecture	MA 6205.5	Class Quiz End Term
31.	Introduction to LATEX	To understand basics about LATEX	Lecture	MA 6205.5	Class Quiz End Term
32.	Practical Class of LATEX	To understand basics about LATEX	Lecture	MA 6205.5	Class Quiz End Term
33.	Introduction to MATLAB.	To understand basics about MATLAB.	Lecture	MA 6205.5	Class Quiz End Term
34.	Practical Class of MATLAB.	To understand basics about MATLAB.	Lecture	MA 6205.5	Class Quiz End Term
35.	Revision Class-I	-	Lecture	-	Class Quiz End Term
36.	Revision Class-II	-	Lecture	-	Class Quiz End Term

H. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
[MA 6205.1]	To develop understanding of the basic framework of research process.	3	2			1		1			1
[MA 6205.2]	To develop an understanding of various research designs and techniques.	1	2								2
[MA 6205.3]	To identify various sources of information for literature review and data collection.										2
[MA 6205.4]	To develop an understanding of the ethical dimensions of conducting applied research.							1			3
[MA 6205.5]	To develop an understanding the components of writing and evaluate quality research.	1	2								1

1.Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

I. Course Outcome Attainment Level Matrix:

CO	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES **THRESHOLD VALUE: 40%**							ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
[MA 6205.1]	To develop understanding of the basic framework of research process.	3	2			1		1			1
[MA 6205.2]	To develop an understanding of various research designs and techniques.	1	2								2
[MA 6205.3]	To identify various sources of information for literature review and data collection.										2
[MA 6205.4]	To develop an understanding of the ethical dimensions of conducting applied research.							1			3
[MA 6205.5]	To develop an understanding the components of writing and evaluate quality research.	1	2								1

1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment