J.C. Bose University of Science & Technology, YMCA Faridabad

(NAAC Accredited "A" Grade University of State Govt. established by Haryana StateLegislative Act No.21 of 2009)

Department of Life Sciences
(w.e.f.2021)

Syllabi for
M.Sc.
Biotechnology

(Semester III and IV)

PROGRAM OUTCOMES OF PG PROGRAM OF FACULTY OF SCIENCES

PO1	**Knowledge**	Capable of demonstrating comprehensive disciplinary knowledge gained during course ofstudy
PO2	**Research Aptitude**	Capability to ask relevant/appropriate questions for identifying, formulating and analyzing the research problems and to draw conclusion from the analysis
PO3	**Communication**	Ability to communicate effectively on general and scientific topics with the scientific community and with society at large
PO4	**Problem Solving**	Capability of applying knowledge to solve scientific and other problems
PO5	**Individual and Team Work**	Capable to learn and work effectively as an individual, and as a member or leader in diverse teams, in multidisciplinary settings.
PO6	**Investigation of Problems**	Ability of critical thinking, analytical reasoning and research-based knowledge including design of experiments, analysis and interpretation of data to provide conclusions
PO7	**Modern Tool usage**	Ability to use and learn techniques, skills and modern tools for scientific practices
PO8	**Science and Society**	Ability to apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional scientific practices
PO9	**Life-Long Learning**	Aptitude to apply knowledge and skills that are necessary for participating in learning activities throughout life
PO10	**Ethics**	Capability to identify and apply ethical issues related to one‘s work, avoid unethical behavior such as fabrication of data, committing plagiarism and unbiased truthful actions in all aspects ofwork
PO11	**Project Management**	Ability to demonstrate knowledge and understanding of the scientific principles and apply these to manage projects

PROGRAM SPECIFIC OUTCOMES (PSOs)

The program specific outcomes (PSO ‘s) are the statement of competencies/abilities that describes the knowledge and capabilities of the post-graduate will have by the end of program studies.

After successful completion of M. Sc. Biotechnology, the students will be able to

PSO1	The detailed functional knowledge of theoretical concepts and experimental aspects ofBiotechnology.
PSO2	To integrate the gained knowledge with various contemporary andevolving areas in Life sciences like Genetic Engineering, Forensic sciences etc.
PSO3	To understand, analyze, plan and implement qualitative as well asquantitative analytical synthetic and phenomenon-based problems inBiotechnology
PSO4	Provide opportunities to excel in academics, research or Industry

SEMESTER-III

Sr. No.	Course Code	Subject	Teaching Hours per week			Maximum Marks			Credits	Category Code
			L	T	P	Int	Ext	Total		
1	MBT−301	PlantBiotechnology	4			25	75	100	4	DCC
2	MBT−302	AnimalBiotechnology	4			25	75	100	4	DCC
3	MBT−303	Immunology	4			25	75	100	4	DCC
4	MBT−304	Genetics	4			25	75	100	4	DCC
5	MBT−305	LabCourse−I(Basedon MBT301−302)			6	30	70	100	3	DCC
6	MBT−306	LabCourse−II(Based onMBT303−304)			6	30	70	100	3	DCC
7	MBT-307	Seminar				25		25	1	DCC
8	XXX	*Open Elective Course	3	0	0	25	75	100	3	OEC
	Total							**725**	**26**	

DCC-Disciplinecorecourse

***OEC –** Open Elective Course- The students have to choose one Open elective course related to another branch of Science/Engg. /Other discipline required for enhancing professional performance as provided by the department/university-

OES-301A- Waste Management in Daily Life

OES-302A- Environmental Conservation

OCH 307A- Chemistry for sustainable Development

L– Lecture;T-Tutorial,P–Practical

SEMESTER-IV

Sr. No.	Course Code	Subject	Teaching Hours per week			Maximum Marks			Credits	Category Code
			L	T	P	Int l	Ext	Total		
1	MBT−401	Enzymology andBioprocessEngineering	4			25	75	100	4	DCC
2	MBT−402	Environmental Biotechnology	4			25	75	100	4	DCC
3	MBT−403	Genomics, ProteomicsandMetabolomics	4			25	75	100	4	DCC
4	MBT−404	LabCourse−I(BasedonMBT401)			6	30	70	100	3	DCC
5	MBT−405	Lab Course− II (BasedonMBT402-403)			6	30	70	100	3	DCC
6	MBT-406	ProjectReport	0	0	12	30	70	100	6	
Total								**600**	**24**	

CourseCode:MBT-301

MaximumMarks:100
Theoryexam:75
Sessional: 25

Subject:PlantBiotechnology
No.ofcredits: 4

L	P
4	0

Course Objectives: The goal of this course is to introduce biotechnological methods in plants and toexpose the students to advanced knowledge in the field and consolidate the knowledge already acquiredinothercourse by handlingof classicalandmodern techniques inplantbiotechnology.

UnitI

Plantgenomeorganization,Organizationandexpressionofchloroplastgenomeandmitochondrialgenome,Cytoplasmicmalesterility.Intergenomicinteraction.Conventionalmethodsofcropimprovement,selection, mutation,polyploidyandclonalselection.

UnitII

HistoryofPlantTissueCulture,Sterilizationmethods,Mediapreparation,PlantGrowthRegulators,Micropropagation, Callus culture, Cell Culture, Protoplast Culture and Fusion, Organogenesis and Somaticembryogenesis.Applicationoftissueculturefor cropimprovementinagriculture,horticultureandforestry. Seed storage proteins, Methods for Plant Conservation, Haploid production: - Anther, Pollen,Embryoandovule cultureandtheirapplications. Somaclonal variations.

UnitIII

Secondary metabolite: Basic biosynthetic pathways, Role of Sec. Metabolites: Defense, Communicationininsects,plants,animals,ChemicalEcology,Interactionbetweenorganismusingsecondarymetabolites,Productionofbioactive secondarymetabolites byplanttissueculture.

UnitIV

Genetic engineering of plants for bacteria, fungi, virus, pest and herbicide resistance. Production of viralantigens and peptide hormones in plants, biodegradable plastics in plants. Applications of secondarymetabolites:Isolationandcharacterization–
drugdevelopment,Biopesticides,growthregulators,Biofertilizers.Valueaddition viabiotransformation.Biocatalyst, Bioremediation,Bio fuels.
Genetically Modified Organism, Regulatory Guidelines for Recombinant DNA Technology.

SuggestedReadings:

1. RazdanMK(2019)AnintroductiontoPlantTissueculture.Oxford&IBHPublishingCo,NewDelhi.3rd Edition
2. CMGovil,AggarwalA,SharmaJ(2017)PlantBiotechnologyandGeneticEngineering.PHILearningPvt. Ltd. 1stEdition
3. Slater, ScottNW,FowlerMR(2008)PlantBiotechnology:TheGeneticManipulationofPlants.OxfordUniversity Press. 2nd Edition
4. BuchananBB,GruissemW,JonesRL(2015) Biochemistry&MolecularBiologyofPlants.JohnWiley&Sons. 2nd Edition
5. DixonRA,Gonzales(2006)Plantcellculture,APracticalapproach.OxfordUniversityPress.2ndEdition
6. HarborneJB(2008)PhytochemicalMethodsAGuidetoModernTechniquesofPlantAnalysis.Springer,New Delhi. 3rd Edition

CourseOutcomes:

Aftercompletionofthecoursethelearners-

CO1:havegot knowledgeofplanttissueculture.

CO2: Learntplantmolecularfarmingandunderstoodthebiosyntheticpathwaysinvolvedintheproductionof Secondary metabolites.

CO3: Understoodthegeneticengineeringapplicationinbioticandabioticstress.

CO4: Understoodtheimportanceofplantsecondarymetabolitesandtheirimmenseindustrialapplications.

Mapping of CO and PO for MBT 301

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	3	2	2	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	2	3	3	2	2	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3	2	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

CourseCode:MBT-302

Subject: Animal BiotechnologyNo.ofcredits: 4

L	P
4	0

MaximumMarks:100
Theory exam:75Sessional: 25

CourseObjectives: Studentswilllearnaboutanimaltissueculture,culturemedia,stemcell,Transgenicproduct, Geneediting tools.

UnitI

Introduction to animal cell and tissue culture, its advantages and limitations, Applications ofanimalcellandtissueculture.Basictechniquesinanimalcellculture:Disaggregationoftissueandsetting up of primary culture, established cell line cultures, maintenance of cell culture, culturemediaand role of serumin cell culture, organculture

UnitII

Biology and characterization of the cultured cells, measurement of growth, measurement ofviability and cytotoxicity. Scale up of animal cell culture, cell cloning, cell synchronization andtransformation

UnitIII

Stem cell cultures: Embryonic and adult stem cells, their isolation, culture and applications,animalcloning.Transgenicanimals:Constructionoftransgenicanimals,geneknockouts, ethicalandbiosafety considerations. Stem Cell Bank.

UnitIV

Animal cloning basic concept, cloning from embryonic cells and adult cells, Ethical, social andmoral issues related to cloning, Transgenic manipulation of animal embryo and its applications,Transgenicanimalproductionandapplicationinexpressionoftherapeuticproteins,biopharming,Gene editing, gene correction, gene silencing. Molecular markers linked to disease resistancegenes, Application of RFLP in forensic, disease prognosis, genetic counselling and pedigreeanalysis.

SuggestedReadings:

1. AmandaCDandFreshney,RI(2021)Freshney'sCultureofAnimalCells:AManualofBasicTechniqueandSpecializedApplications.JohnWiley&SonsPublishers.8th edition.
2. DasHK (2017)Textbookof biotechnology.Wiley Publisher.5th edition.
3. SinghBD(2015)Biotechnologyexpandinghorizons.Kalyanipublishers.4thedition.
4. GuptaPK(2020).Molecularbiologyandgeneticengineering.RastogiPublication.4th Reprint1st edition.
5. BrownTA(2020)GenecloningandDNAanalysis:anintroduction.JohnWiley&Sons.8th edition
6. GlickBRandPattenCL(2017) Molecularbiotechnology:principlesandapplicationsof recombinant DNA. JohnWiley &Sons.5th edition

CourseOutcomes:

Aftercompletionofthecoursethelearners-

CO1:Learnttheanimal cellcultureandestablishasuccessfulcelllinerepositoryindependently.

CO2:characterizedand authenticateagivencellline/culture.

CO3: Isolateandculturestemcellfromagivensample.

CO4: Understood thebasic knowledgeof molecular methods usedin animal biotechnology.

Mapping of CO and PO for MBT 302

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	3	3	3	3	2	3	3	3	2	3	3	3	3
CO3	3	3	2	3	3	3	2	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3	2	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

CourseCode:MBT-303

Subject:

ImmunologyNo.ofcredits: 4

L	**P**
4	**0**

MaximumMarks:100
Theoryexam: 75
Sessional: 25

Course Objectives: This course includes a detailed description of the immune response madein humans to foreign antigens including microbial pathogens. A description of cells involved inthe immune response either innate or acquired. How the immune system recognizes self fromnon-self.B and Tcell maturation and specificresponses.

UnitI

Cellsandorgansofimmunesystem.Primary,secondaryandtertiarylymphoidorgans.Typesofimmunity - Innate and adaptive, Humoral and cell-mediated, Active and passive, PAMP: TLR,Clonal selection theory. Immunological memory, Antigens and immunogens, B and T cellepitopes; Haptens. Structure and functions of antibodies. Classes of immunoglobulins. CDRs,Valence,affinityand avidity.Antibody variants-Isotypes,allotypes andIdiotypes

UnitII

The immunoglobulin genes: organization and assembly; generation of immunological diversity;Allelicexclusion.Majorhistocompatibilitycomplex(MHC):structureandorganizationofMHC.Antigen processing and antigen presentation. T cell Receptor: Superantigens. B cell activationandmaturation.Tcelldevelopmentandactivation.CytotoxicTcellmediatedkilling.Complementsystemandmechanismofitsfixation.Complementdeficiencies.V(D)Jrecombination, somatic hypermutation and class switch recombination of immunoglobulins:mechanismand regulation

UnitIII

Immunological tolerance. Autoimmunity and associated disorders. Allergy and hypersensitivity,typesofHypersensitivity.Transplantationimmunology-Graftrejection,graftversushostreaction.Immuneresponsetoinfectiousdiseases–viral,bacterial,protozoal.Immunosuppression-immunodeficiencydiseases. Communicative Viral Diseases.

UnitIV

Role of cytokines, lymphokines and chemokines.Vaccine and its different types. Different types of Vaccines for COVID-19 . HybridomaTechnology:Productionof murine monoclonalantibodies(MoAbs)-Fusionstrategies,HATSelection;StrategiesforproductionofhumanMoAbs-Humanizationandantigenizationof MoAbs-Chimeric,CDR-grafted

SuggestedReadings:

1. PuntJ, Stranford SA, Jones PP,andJudithAO(2019)Kubyimmunology.WH Freeman.8th edition.
2. AbbasAK,LichtmanAH,andPillaiS(2016)CellularandMolecularImmunology.Saunders.9th edition.
3. MaleDK,BrostoffJ,RothD,andIvanR(2012)Immunology.GowerMedicalPublishingLondon. 8th edition.
4. GuptaSK(2010)Essentials ofImmunology.Arya Publication. 2nd edition.
5. KhanFH (2009)TheElementsof Immunology.Pearson EducationIndia.1st edition.

CourseOutcomes:

Aftercompletion ofthe coursethelearners-

CO1-Understood theconceptof innate and adaptiveimmunity.

CO2-Understoodthevariousmechanismsthatregulateimmuneresponsesandmaintaintolerance.

CO3-Elucidatedthereasonsforimmunizationandawareness ofdifferentvaccination.

CO4-Understoodthestagesoftransplantationresponseandsuccessofvarioustransplantprocedures.

Mapping of CO and PO for MBT 303

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	2	3	2	3	3	3	2	2	3	3	3	2	3	3	3
CO3	3	3	3	2	3	3	2	3	3	3	3	3	2	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3	2	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

CourseCode:MBT-304

MaximumMarks: 100
Theoryexam: 75
Sessional:25

Subject:
GeneticsNo.of
credits:4L P
4 0

CourseObjectives: Todevelopanddemonstrateanunderstandingofthestructureandfunctionof genes and the organization of the human genome; the patterns of inheritance and clinicalmanifestations of genetic diseases; chromosomes, chromosomal abnormalities, and the clinicalfeaturesof common chromosomal disorders.

UnitI

Mendelianvs.Non-Mendelianinheritance,monohybridanddihybridcrosses,MendelianPrinciples-Dominance,SegregationandIndependentassortment.ExtensionsofMendelianprinciples:Codomina nce,Incompletedominance,MultipleAllelism.Geneinteractions-Epistasis,Collaboratorygeneaction,Duplicategenes,ComplementaryGeneaction,Complementatio nTest.Pleiotropy.Phenocopy.ProbabilityandPedigreeanalysis.sexlimitedandsexinfluencedcharact ers.Quantitativegenetics:Polygenicinheritance,heritabilityanditsmeasurements,QTL. ExtrachromosomalInheritance, Maternal effect.

UnitII

Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction andsex-duction,mapping genesbyinterrupted mating,finestructure analysisof genes. Linkagemaps,recombination,tetradanalysis(OrderedandunorderedTetradanalysis),mappingwith molecularmarkers,mapping byusing somaticcell hybrids.LinkageGroup

UnitIII

Cytogenetics:Chromosome:structureandnomenclature,centromereandtelomere;Structuralandnum ericalalterationsofchromosomes:Deletion,duplication,PericentricandParacentricinversion,Inversi onheterozygotes,Inversionhomozygotes.Reciprocalandnonreciprocaltranslocation, Homozygotes as well as Heterozygote Trans locants. ploidy (Aneuploidy andEuploidy)and theirgenetic implications.

UnitIV

Mutation: Types, causes and detection, mutant types – lethal, conditional, Base substitution andframe shift Mutation. Biochemical, loss of function, Gain of function, Germinal verses Somaticmutants,Ames Test.

Epigenetics: Introduction, methylation, histone modifications.

Allele frequency, Gene Frequency, Hardy Weinberg Equilibrium

SuggestedReadings:

1. GardnerEJ(2005)PrinciplesofGenetics.JohnWiley &Sons Ltd.8th edition.
2. Tamarin RH (2017) Principles of Genetics. Tata McGraw-Hill Publishing Comp. Ltd.7thedition.
3. Pierce BA (2016) Genetics – A conceptual approach. WH Freeman Company. 6thedition.
4. Snustad DP and Simmons MJ (2015) Principles of Genetics. John Wiley and Sons. 7thedition.
5. HartlandJones(2017) Genetics-PrinciplesandAnalysis.Jones &Bartlett.9th edition.

CourseOutcomes:

Aftercompletion ofthe coursethelearners-

CO1-

Understoodthebuildingblockforgeneticsi.e.,lifecyclesofmodelorganisms,basicgeneticexperiments, polyploidy, andQTL.

CO2-

Learnttheorganizationofgenomeandspecializedchromosomes,chromosomaltheoryofinheritance, linkage, inheritance modes in nature, maternal inheritance,crossing over, andrecombination.

CO3- Understood the important hereditary diseases, their inheritance patterns, and pedigreeanalysis

CO4-Understoodthesignificance andimpactof mutations.

Mapping of CO and PO for MBT 304

Course Outcome s	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	2	3	3	3	3	3	2	2	3	2	3	3	2	3	3
CO3	3	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	2	3	2	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

CourseCode-MBT-305

Subject: Lab Course-I (Based on MBT 301-302)No.ofCredits-3

L P
0 6

1. Toknowtherequirementforthesettingupof plant/animaltissueculturelaboratory.
2. Tounderstandthefunctionandworkingofequipmentusedinplant/animaltissueculturelaboratory.
3. Toperform cleaningand surfacesterilizationofglassware,explantandLaminarAirFlowchamber.
4. Toperformsubculturing ofselected plantunderinvitro conditions.
5. Toestablishcellsuspension culturefromfriablecallus.
6. Topreparesolidand liquidMS media.
7. Tocultureexcised leavesand shoottips
8. Toperformcellcounting usingnauber'schamber/hemocytometer.
9. Toperform cell viabilityassayusing trypanbluedye.
10. Toperform cellcloningbydilutionmethod.
11. Toperformsub culturing/splittingofmonolayerculture.
12. ToperformHoecsht/PIstainingto detectapoptosis.
13. Topreserveandstorecell linesusingDMSO/FBS.
14. Toisolatemetagenomic DNAfromsoilsamples/watersamples.
15. Toperformpolymerasechainreaction(PCR)amplificationofplant/metagenomicDNAwith 16S/18Sprimers/ genespecificprimers.

Aminimumofeightpractical'sshouldbedonefromtheabove-mentionedlist

****Additionordeletionofthelabexperimentscanbedoneaspertheavailabilityofresourcesin lab.***

At theendof laboratorycourse,learners-

CO1-Understood thebasic infrastructurerequirements inatissueculturelab

CO2-Performedplantandanimalcellcultureexperiments

CO3-Demonstratedvarioustechniquesusedincellculture

Mapping of CO and PO for MBT 305

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	2	3	2	3	3	3	3	2	3	3	3
CO3	3	3	3	3	3	3	2	3	3	3	3	3	2	3	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

CourseCode-MBT-306

Subject: Lab Course-II (Based on MBT 303-304)No.ofCredits-3

L	P
0	6

1. Toperform experimentusingammoniumsulphateprecipitationofantibodiesinserum.
2. Toperform experimentonthepreparationofantigen-adjuvant(FCA)emulsion.
3. Toperform experimentonthecollectionofbloodfrommiceandseparationofserum.
4. Toperform experimentonantibodypurificationfromtheserumcollectedfromimmunizedmice:affinity purification/chromatography.
5. Toperform experimentondoublediffusionand Immune-electrophoresis
6. Toperform experimenton radialimmune diffusion
7. To perform experiment of Band analysis of different types of plasma antibodies by SDSPAGE
8. ToperformagglutinationReaction:a)TubeAgglutinationReactionb)SlideAgglutinationReactionc)Indirect Agglutination Inhibition Reaction
9. To perform experiment for Identification of histological slides of lymphoid tissue - Spleen,thymus,lymph node and bonemarrow
10. Toperformexperimentof Mitosis- Onionroot tipsquashpreparation-PreparationofKaryotypes,Determination ofMitoticindex.
11. ToperformexperimentonMendelianInheritanceandgeneinteractionsusingsuitableexamples/ seeds
12. To perform experiment on study of Linkage, Recombination, gene mapping using theavailabledata
13. Toperform experimentofcentromeremapping bytetradanalysis
14. Analysisofpatternofinheritanceofgivenpedigree.
15. Calculationofrecombinationfrequency
16. Toperform experimentonBacterialgenemappingbyinterruptedconjugationmethod
17. Calculationofco-transformationandco-transductionfrequency
18. Calculationofdeviationinphenotypicratiosofdifferentintergenicgeneinteractions
19. Toperform experimentoncomparisonofploidylevelwithrespecttogivenexample.

Aminimumofeightpractical'sshouldbedonefromtheabove-mentionedlist.
Additionordeletionofthelabexperimentscanbedoneaspertheavailabilityofresourcesin lab.

SkillDeveloped-

At theendof laboratorycourse,learners-

CO1-understoodthebasicImmunologicalaspectstobeperformedinthelaboratory.

CO2-learnt toanalyzegeneticproblemsandwill beabletoapproacharesearchproblemstatistically.

CO3-understoodthecentromeremappingaswellastocalculatephenotypicratiosofdifferentgeneinteractions

Mapping of CO and PO for MBT 306

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

Seminar:

Seminar will be of 30-45minute duration during which the presentationwill be followed byquestions session by the audience comprising of faculty and students. Every student shall berequiredtosubmitthetopicofhis/herseminarinconsultationwiththeHeadoftheDepartment/Facultymembers/studentadvisorswellinadvancesothatthesamemaybedisplayedon the notice board. The presenter has to write an Abstract to be distributed during Seminar inaddition to two copies of write-up giving relevant details of the background of the subject,methods used and references/List of sources from where the material for presentation has beencollected.

J. C. Bose University of Science and Technology, YMCA, Faridabad

(Established by Haryana State Legislative Act No. 21 of 2009 & Recognized by UGC Act 1956 u/s 22)

Accredited 'A' Grade by NAAC

DEPARTMENT OF LIFE SCIENCES

Program M.Sc. (Biotechnology)

Scheme Course Index of the Year 2020-21 (BOS Dated 12/04/2021)

Mapping of the Courses with the Employability/Entrepreneurship/Skill Development

M.Sc. Biotechnology Semester III (Program Code: 755)

Sr. No.	Course Code	Course Name	Employability	Entrepreneurship	Skill Development
1	MBT−301	PlantBiotechnology	√	√	√
2	MBT−302	AnimalBiotechnology	√	√	√
3	MBT−303	Immunology	√		√
4	MBT−304	Genetics	√		√
5	MBT−305	LabCourse−I(Basedon MBT301−302)	√		√
6	MBT−306	LabCourse−II(BasedonMBT303−304)	√	√	√
7	MBT-307	Seminar	√	√	√
8	XXX	OEC-Research Methodology	√		√

SEMESTER-IV

Sr. No.	Course Code	Subject	Teaching Hours perweek			MaximumMarks			Credits	Category Code
			L	T	P	Internal	External	Total		
1	MBT−401	Enzymology andBioprocessEngineering	4			25	75	100	4	DCC
2	MBT−402	Environmental Biotechnology	4			25	75	100	4	DCC
3	MBT−403	Genomics, ProteomicsandMetabolomics	4			25	75	100	4	DCC
4	MBT−404	LabCourse−I(BasedonMBT401)			6	30	70	100	3	DCC
5	MBT−405	Lab Course− II(Based onMBT402-403)			6	30	70	100	3	DCC
6	MBT-406	ProjectReport	0	0	12	30	70	100	6	
Total								**600**	**24**	

CourseCode: MBT401

Subject:EnzymologyandBioprocessEngineering

No.ofcredits: 4	**Maximum Marks:100**
L P	**Theoryexam:75**
4 0	**Sessional:25**

Course Objectives- The major learning objective of the course is to understand the theories ofenzyme kinetics, the mechanisms of enzyme catalysis, and the mechanisms of enzyme regulationin the cell. As well as to provide the basic principles of reactor designforbioprocessand biotechnologyapplications.

UnitI:

Enzymology: Introduction, General characteristics of enzymes, Activation energy, Coupledreactions,Activesiteand itsimportance,ThermodynamicsandEquilibrium;Enzymeactivity;Specific activity and Units; Isozymes; Ribozymes; Zymogens; Abzymes; Classification andnomenclatureof enzymes.

UnitII:

Enzyme kinetics: Significance; Rapid Equilibrium and Steady State approach, Henry Michaelis-Menten's and Haldane equations, Significance of Km, Catalytic efficiency and turnover number;Kinetic perfection. Order of kinetics. Methods of plotting enzyme kinetics data: Lineweaver-Burk,Hanes-Woolf, Woolf Augustinsson-Hofstee, Eadie-Scatchard; Direct linear plot; Advantages anddisadvantages; Integrated form of the Henry-Michaelis-Menten equation; Effect of pH andtemperature

UnitIII:

Introduction to concepts of bioprocess engineering, Overview of bioprocesses with their variouscomponents,Isolation,screeningandmaintenanceofindustriallyimportantmicrobes;Strainimprovement for increased yield and other desirable characteristics, Microbial growth and deathkinetics with respect to fermenters, optimization of bioprocesses, yield coefficient, doubling time,specific growth rate, metabolic and biomass productivities, effect of temperature, pH and saltconcentrationon productformation. Basics of Metabolic Engineering.

UnitIV:

ConceptsofbasicmodeoffermentationprocessesBioreactordesigns;Typesoffermenters;Conceptsofbasicmodesoffermentation-Batch,fedbatchandcontinuous;Solidsubstrate,surfaceandsubmergedfermentation;Fermentationmedia;Designandtypesofculture/productionvessels-Batch, Fed batch, CSTBR, airlift, packed bed and bubble column fermenter; Impeller, Baffles,Sparger.

Upstream and downstream processing: Media formulation; Inocula development and Sterilization;Aeration and agitation in bioprocess; Measurement and control of bioprocess parameters; Scale upandscale down process. Bio separation techniques.

SuggestedReadings:

1. CookPF,ClelandWW(2007)EnzymeKineticsandMechanism,GarlandSciencePublishing, London, England and NewYork, USA. 1st edition.
2. PalmerTandBonnerP(2007)Enzymes:Biochemistry,Biotechnology,ClinicalChemistry,

AffiliatedEast-West Press,England.2nd edition
3. PriceNCandStevensL(2000)FundamentalsofEnzymology:Cellandmolecularbiologyofcatalyticproteins. Oxford University Press. 3rdedition.
4. JacksonAT(1991)BioprocessEngineeringinBiotechnology,PrenticeHall,EngelwoodCliffs,USA. 1st edition.
5. KargiFandShulerML(2002).BioprocessEngineering:Basicconcepts.PrenticeHall,USA.2ndedition.
6. StanburyP,WhitakerAandHallSJ(2016)PrinciplesofFermentationTechnology,Pergamonpress, Oxford,United Kingdom. 3rdedition.
7. MansiEMTEL,BryceC FA(2012).FermentationMicrobiologyandBiotechnology.Taylor&Francis Ltd. United Kingdom.3rdEdition.

CourseOutcomes:

Aftercompletion ofthe coursethelearners-

CO1.-Understoodhowenzymesworkandhowthisisaffectedbythestructureofenzymesandbythe reaction conditions. Present unit operations together with fundamental principles for basicmethodsin production techniques for biologicallybased products.

CO2- Describedthethermodynamic basisofenzymereactionsandenzyme kinetics.Uponcompletion of the course the student will recognize different ways to produce and purify enzymesanddescribedifferent industrial applications of enzymes.

CO3-Understoodmethods relatedtobiotechnologicalprocesses

CO 4- Understood to apply different biotechnological methods used in the recombinant proteinproduction,in fermentation processesand in proteinpurification

Mapping of CO and PO for MBT 401

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3	2	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

CourseCode: MBT402

Subject:EnvironmentalBiotechnology

No.ofcredits: 4	**MaximumMarks: 100**
L P	**Theoryexam:75**
4 0	**Sessional:25**

CourseObjectives: The courseexplainstheapplicationofbiotechnology inenvironment.

UnitI

overview, concept, scope and market biological control of air pollution. Bacterial examination ofwater for potability. Solid waste: Sources and management (composting, vermicomposting andmethaneproduction). Wastewatercharacterization:COD,BOD

UnitII

Measurement of water pollution, sources of water pollution, Waste water collection, Waste water.Biologicalwastewatertreatment-
.Inorganicconstituents,solids,biologicalcomponents.Principlesandaimsofbiologicalwastewatertreatmentprocesses,Biochemistryand microbiology ofinorganic phosphorusand nitrogen removal.
Anaerobic Processes: Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanketreactors.

UnitIII

Treatmentschemesforwastewatersofdairy,distillery,tannery,sugar,antibioticindustries.Suspendedgrowthtechnologies:Activatedsludge,oxidationditches,wastestabilizationponds etc. Fixed film technologies: Trickling filters, rotating biological contactors, fluidized bedetc. Anaerobicwaste watertreatment systems:RBC, UASB, Anaerobicfilters. Electronic waste, Biomedical waste and disposable of these wastes.

UnitIV

Microbiology of degradation of Xenobiotics in Environment Ecological considerations, decaybehavior&degradativeplasmids;Hydrocarbons,substitutedhydrocarbons,oil,pollution,surfactants, pesticides, Bioremediation of contaminated soils and waste land. Biopesticides inintegrated pest management. Solid wastes; sources and management (composting wormicu1tureandmethaneproduction.
Environmental Monitoring: Biosensors for environmental applications, BOD sensor, ammoniasensor, Nitrite sensor and sulphite ion sensor. Indicator organisms: Safety indicators and Qualityindicators

SuggestedReadings:

1. G M Evans, Furlong JC (2003) Environmental Biotechnology-Theory and Applications,JohnWiley & Sons. 1st edition
2. Hans-Joachim Jordening, Josef Winter (2005) Environmental Biotechnology: ConceptsandApplications, John–Wiley and Sons.1st edition
3. ShekharThakur Indu(2011)EnvironmentalBiotechnology:Basicconcepts andApplications,IKInternationalsPvtLtd. 2nd edition
4. ScraggAH(1999)Environmental Biotechnology,Longman.2nd edition
5. Evans GG, Furlong, J. (2011) Environmental biotechnology: theory and application. JohnWiley& Sons.2nd edition

CourseOutcomes:

Aftercompletion ofthe coursethelearners-

CO1-Understoodandassimilatedtheconceptsandspecificterminologyofenvironmentalbiotechnology

CO2-Understoodtodetect,preventandremediatetheemissionofpollutantsintotheenvironmentin a numberof ways

CO 3- Obtained knowledge on basic principles and technologies of decontamination of persistentorganicpollutants(dangerouscontaminantsoftheenvironment)mainlybymeansofthebiologi calapproachesi.e. using bioremediation etc

CO4-

Learntabouttheprinciplesandtechniquesunderpinningtheapplicationofbiosciencestotheenvironment.

Mapping of CO and PO for MBT 402

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	3	3	2	3	2	3	2	3	3	3	3	3	3
CO3	3	3	2	3	3	3	2	3	3	3	3	2	3	2	3
CO4	3	3	3	3	2	3	3	3	3	3	3	3	3	2	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

CourseCode: MBT403

Subject:Genomics,ProteomicsandMetabolomics

No.ofcredits: 4	**MaximumMarks:100**
L P	**Theoryexam: 75**
4 0	**Sessional:25**

Course Objective-The course aims to appraise the students to the vital concepts of technologiespertinent to Genomics and Proteomics, their applications and demonstrate skills to apply theknowledgein scientificqueries.

UnitI:

Introductorygenomics,IntroductiontoGenomics,Anatomyofprokaryoticandeukaryoticgenome,content of genome, C-value paradox, Cot curve analysis, repetitive DNA, tools to study genomeAppliedGenomics-
Strategiesformajorgenomesequencingprojects,approachesandassemblymethods,NGS methods and advantages, geneanalysis and annotation.

UnitII:

TranscriptomicsandexpressionprofilingGenomeexpressionanalysis,RNAcontentandprofiling,geneticmapping, Microarray (cDNAand proteinmicroarray)
Introductoryproteomics-Importanceofproteomics,strategiesinanalysisofproteome:2-DPAGE,Mass spectrometry, Protein sequencing method (Edman degradation, MALDI TOF/TOF). Proteinsolubilityand interaction with solvents and solutes,activity of proteins.

UnitIII:

Quantitationproteomics–ICAT,SILAC,iTRAQ,applicationsofquantitationproteomics.Proteomic profiling for host-pathogen interaction, Understanding proteomics for post-translationalmodifications.Applicationofproteomicsfordrugdiscovery.Biomarkersanddrugtargetsidentification.Validation ofdrugtargetsandassessment of its toxicology

Unit-IV:

Introductiontometabolomicsworld.Metabolicfingerprinting,andmetabolicprofiling.Biotechnologicalpotentials ofmetabolomics. Proteomicsapproaches inmetabolomics.
Applicationforcellularmetabolomicsformetabolicpathwaystructure.
Sizeofmetabolome,metaboliteidentification,pathwayidentificationandpathwayintegration.Computationalapproachesformetaboliteidentificationand translationofresults intobiologicalknowledge.

SuggestedReadings:

1. PalzkillT(2002)Proteomics.KluwerAcademicPublishers,NewYork,USA.1st Edition
2. Kambhampati D (2005) Protein Microarray Technology. Wiley-VCH Verlag GmbHWeinheim,Germany. 1st Edition
3. LeskAM(2007) IntroductiontoGenomics. OxfordUniversitypress,UK.3rd Edition
4. Villas-Boas SG (2007) Metabolome Analysis: An Introduction. Wiley-Blackwell, USA. 1st Edition
5. Nikolau BJ, Wurtele ES (2007) Concepts in Plant Metabolomics. Springer, USA. 1st Edition
6. GibsonG, MuseSV(2009) APrimer ofGenome Science. Sinauer Associates. 3rd Edition
7. BrownTA(2017) Genome.Garland SciencePublishers.4th Edition

- **CourseOutcomes:**
- Afterthesuccessfulcompletionofthiscourse learners-
- **CO1-** Understoodthecrucialconceptsandtechniquesappliedingenomics,transcriptomicsandproteomics.
- **CO2-**Learntaboutthecomplexityofgenome/proteomestructuralandfunctionalorganization.
- **CO3-** Formulateandassessexperimentaldesignforsolvingtheoreticalandexperimentalproblemsin Genomics and Proteomics fields
- **CO4-**Understoodthe conceptofmetabolomicsanditsapplicationinscience

Mapping of CO and PO for MBT 403

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	3	2	3	3	3	3	3	3	3	3
CO3	2	3	3	3	3	3	2	3	3	3	3	3	3	3	2
CO4	3	3	3	3	2	2	3	3	3	3	3	3	3	2	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

CourseCode:MBT 404

Subject: Lab Course - I (Based on MBT 401)Numberof Credits: 3

L P
0 6

1. Toperformtheexperimentofextractionandanalysisof Specificactivityofperoxidase
2. TodetermineofKm,Vmax,
3. TodeterminepHoptimaforanenzyme.
4. Todetermineeffect of temperatureon thestability andactivity of theenzyme.
5. Toperform experimentofisolationofenzymefromplants/bacteria.
6. Estimationofenzymeactivityandammoniumsulphatefractionation/centrifugation-basedsizefractionation.
7. Toperform experimentofEnzymeimmobilization.
8. Isolationofindustriallyimportantmicroorganismsformicrobialprocesses(citric/lactic/alphaamylase)and improvement ofstrain forincreaseyield bymutation.
9. TodetermineofThermalDeathPoint(TDP)andThermalDeathTime(TDT)ofmicroorganismsfordesign of asterilizer.
10. Todeterminegrowthcurveofasuppliedmicroorganismandalsodeterminessubstratedegradationprofile.
11. ExtractionofCitricacid/Lacticacid bysaltprecipitation.
12. Tomonitorofdissolvedoxygenduring aerobicfermentation.
13. ToPreserveofindustriallyimportantbacteriabylyophilization.
14. Toperform experimentonproductconcentration byvacuumconcentrator

Aminimumofeight practical's shouldbedonefrom theabove-mentionedlist.
Additionordeletionofthelabexperimentscanbedoneaspertheavailabilityofresourcesinlab.

SkillDeveloped-

At theendof laboratorycourse,learners-

CO1-understoodthebasictechniques for enzyme kinetics and enzymes isolation and enzyme immobilization

CO2-learnt tosetup a basics of fermentation technology steps

CO3-understoodthemodeling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems.

Mapping of CO and PO for MBT 404

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	3	3	3	3	3	3	3	3	3	2	3
CO2	3	3	3	3	3	3	2	3	2	3	3	3	2	3	3
CO3	3	3	3	3	3	3	2	2	3	3	3	3	3	3	2

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

CourseCode:MBT 405

Subject: Lab Course - II (Based on MBT 402-403)NumberofCredits: 3

L P
0 6

1. Todetectcoliformsfordeterminationofthepurifyofpotablewater
2. Todetermineoftotaldissolved solidsof water
3. Todeterminedissolvedoxygenconcentrationofwatersample.
4. Todeterminebiochemicaloxygendemand(BOD)ofasewagesample.
5. Todetermineof chemicaloxygendemand(COD) ofsewagesample
6. To determine bacterial numbers in sample by Standard plate count technique
7. Toisolatexenobiont degradingbacteriabyselectiveenrichmenttechniques
8. Testfordegradationofaromatichydrocarbonsbybacteria
9. Toestimateheavymetalsinwater/soilbyspectrophotometry
10. ToestimationnitrateindrinkingwaterStudyonbiogenicmethaneproductionindifferenthabitats
11. Toperform experimentofspectrophotometricdeterminationofDNA
12. Toperform experimentfordifferentialgeneexpressionofgiventissue/sample
13. ToPrecipitateproteinfrom asolutionby saltingoutmethod
14. Toestimateprotein profilingofgiven biologicalsample
15. Toperform2Dgelelectrophoresis
16. Toperform experiment onCoomassie/ silverstainingofproteingel
17. Toperform experimentonProteinDNAinteractionstudybyElectromobilityshiftassay

Aminimumofeightpractical'sshouldbedonefrom theabove-mentionedlist.
Additionordeletionofthelabexperimentscanbedoneaspertheavailabilityofresourcesin lab.

SkillDeveloped-

At theendof laboratorycourse,learners-

CO1-learnt about environmental quality evaluation, monitoring, and remediation of contaminated environments

CO2-learnt toevaluate the potential of biodegradation of organic pollutants, taking microbial and physical/chemical environments,

CO3 familiar with the tools and techniques of genome and transcriptome analysis and gene expression regulation, production and characterization of recombinant proteins.

Mapping of CO and PO for MBT 405

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	3	3	3	3	3	3	3	3	3	3	2
CO2	3	3	3	3	3	3	2	3	3	3	2	3	2	1	3
CO3	3	3	2	3	3	3	2	3	3	3	2	3	2	3	3

**Mapping Scale: 1 to 3 (3: Strong; 2: medium; 1: weak)

CourseCode:MBT-406

Subject: Project
ReportNo.of credits:6

CourseObjectives:

The objective of this course is to provide students with a hands-on training in specialized areaofsciences

Contents:

- The student will be reading and analysing the published information in the chosen areaof science under direct mentoring of a faculty member and will participate in researchactivity.
- PreparationandsubmissionofReviewarticle

CourseLearningOutcomes:

Studentswill acquirethefollowing:

CO1: Knowledgeontechniquesandtoolsofresearch
CO2: Quantitativeandqualitativedataanalysis
CO3: Analysisandinterpretationofdataintheperspective ofexistingknowledge

DEPARTMENT OF LIFE SCIENCES

Program M.Sc. (Biotechnology)

Scheme Course Index of the Year 2020-21 (BOS Dated 12/04/2021)

Mapping of the Courses with the Employability/Entrepreneurship/Skill Development

M.Sc. Biotechnology Semester IV (Program Code: 755)

Sr. No.	Course Code	Course Name	Employability	Entrepreneurship	Skill Development
1	MBT−401	Enzymology andBioprocessEngineering	√	√	√
2	MBT−402	Environmental Biotechnology	√	√	√
3	MBT−403	Genomics, ProteomicsandMetabolomics	√	√	√
4	MBT−404	LabCourse−I(BasedonMBT401)	√		√
5	MBT−405	Lab Course− II (BasedonMBT402-403)	√	√	√
6	MBT-406	ProjectReport	√	√	√