KARNATAK UNIVERSITY, DHARWAD
ACADEMIC (S&T) SECTION

ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಧಾರವಾಡ
ವಿದ್ಯಾಮಂಡಳ (ಎಸ್&ಟಿ) ವಿಭಾಗ

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'A' Grade 2014

website: kud.ac.in

No. KU/Aca(S&T)/JS/MGJ(Gen)/2023-24/59 Date: 04/09/2023

ಅಧಿಸೂಚನೆ

ವಿಷಯ: 2023–24ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಎಲ್ಲ ಸ್ನಾತಕ ಪದವಿಗಳಿಗೆ 5 ಮತ್ತು 6ನೇ ಸೆಮೆಸ್ಟರ್ NEP-2020 ಪಠ್ಯಕ್ರಮವನ್ನು ಅಳವಡಿಸಿರುವ ಕುರಿತು.

ಉಲ್ಲೇಖ: 1. ಸರ್ಕಾರದ ಅಧೀನ ಕಾರ್ಯದರ್ಶಿಗಳು(ವಿಶ್ವವಿದ್ಯಾಲಯ 1) ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆ ಇವರ ಆದೇಶ ಸಂಖ್ಯೆ: ಇಡಿ 104 ಯುಎನ್ಇ 2023, ದಿ: 20.07.2023.
2. ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ನಿರ್ಣಯ ಸಂಖ್ಯೆ: 2 ರಿಂದ 7, ದಿ: 31.08.2023.
3. ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಆದೇಶ ದಿನಾಂಕ: 04/09/2023

ಮೇಲ್ಕಾಣಿಸಿದ ವಿಷಯ ಹಾಗೂ ಉಲ್ಲೇಖಗಳನ್ವಯ ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಆದೇಶದ ಮೇರೆಗೆ, 2023–24ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಅನ್ವಯವಾಗುವಂತೆ, ಎಲ್ಲ B.A./ BPA (Music) /BVA / BTTM / BSW/ B.Sc./B.Sc. Pulp & Paper Science/ B.Sc. (H.M)/ BCA/ B.A.S.L.P./ B.Com/ B.Com (CS) / BBA & BA ILRD ಸ್ನಾತಕ ಪದವಿಗಳ 5 ಮತ್ತು 6ನೇ ಸೆಮೆಸ್ಟರ್‌ಗಳಿಗೆ NEP-2020ರ ಮುಂದುವರೆದ ಭಾಗವಾಗಿ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ಅನುಮೋದಿತ ಕೋರ್ಸಿನ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲ www.kud.ac.in ದಲ್ಲಿ ಭಿತ್ತರಿಸಲಾಗಿದೆ. ಸದರ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲದಿಂದ ಡೌನಲೋಡ ಮಾಡಿಕೊಳ್ಳಲು ಸೂಚಿಸುತ್ತ ವಿದ್ಯಾರ್ಥಿಗಳ ಹಾಗೂ ಸಂಬಂಧಿಸಿದ ಎಲ್ಲ ಬೋಧಕರ ಗಮನಕ್ಕೆ ತಂದು ಅದರಂತೆ ಕಾರ್ಯಪ್ರವೃತ್ತರಾಗಲು ಕವಿವಿ ಅಧೀನದ/ಸಂಲಗ್ನ ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ ಸೂಚಿಸಲಾಗಿದೆ.

04/9/23
ಕುಲಸಚಿವರು.

ಅಡಕ: ಮೇಲಿನಂತೆ

ಗೆ,
ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯದ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಬರುವ ಎಲ್ಲ ಅಧೀನ ಹಾಗೂ ಸಂಲಗ್ನ ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ. (ಕ.ವಿ.ವಿ. ಅಂರ್ತಜಾಲ ಹಾಗೂ ಮಿಂಚಂಚೆ ಮೂಲಕ ಬಿತ್ತರಿಸಲಾಗುವುದು)

ಪ್ರತಿ:

1. ಕುಲಪತಿಗಳ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
2. ಕುಲಸಚಿವರ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
3. ಕುಲಸಚಿವರು (ಮೌಲ್ಯಮಾಪನ) ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
4. ಅಧೀಕ್ಷಕರು, ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ / ಗೌಪ್ಯ / ಜಿ.ಎ.ಡಿ. / ವಿದ್ಯಾಂಡಳ (ಪಿ.ಜಿ.ಪಿಎಚ್.ಡಿ) ವಿಭಾಗ, ಸಂಬಂಧಿಸಿದ ಕೋರ್ಸುಗಳ ವಿಭಾಗಗಳು ಪರೀಕ್ಷಾ ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
5. ನಿರ್ದೇಶಕರು, ಕಾಲೇಜು ಅಭಿವೃದ್ಧಿ / ವಿದ್ಯಾರ್ಥಿ ಕಲ್ಯಾಣ ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.

KARNATAKUNIVERSITY,DHARWAD

B.Sc.in BIOTECHNOLOGY

SYLLABUS

With Effect from2023-24

DISCIPLINE SPECIFIC CORE COURSE (DSCC) FOR SEM V &VI,

SKILLENHANCEMENTCOURSE(SEC)FOR SEMV

INTERNSHIP FOR SEM VI

ASPER NEP-2020

KarnatakUniversity,Dharwad

B.Sc.in **Biotechnology**

Effective from2023-24

Sem.	Type ofCourse	Theory/Practical	Course Code	CourseTitle	Instructionhour/week	Totalhours /sem	DurationofExam	Marks			Credits
								Formative	Summative	Total	
V	DSCC-9	Theory	035BIT011	**Genetic Engineering**	04hrs	56	02hrs	40	60	100	04
	DSCC-10	Practical	035BIT012	**Genetic Engineering**	04hrs	56	03hrs	25	25	50	02
	DSCC-11	Theory	035BIT013	**Plant and Animal Biotechnology**	04hrs	56	02hrs	40	60	100	04
	DSCC-12	Practical	035BIT014	**Plant and Animal Biotechnology**	04hrs	56	03hrs	25	25	50	02
	Other Subject										04
	Other Subject										04
	Other Subject										04
	SEC-3	Practical	035BIT061	**Quality Control Methods in Biology (Practical)**	04hrs	56	03hrs	25	25	50	02
	Total							**155**	**170**	**350**	
VI	DSCC-13	Theory	036BIT011	**Immunology**	04hrs	56	02hrs	40	60	100	04
	DSCC-1**4**	Practical	036BIT012	**Immunology**	04hrs	56	03hrs	25	25	50	02
	DSCC-15	Theory	036BIT013	**Bioprocess and Environmental Biotechnology**	04hrs	56	02hrs	40	60	100	04
	DSCC-16	Practical	036BIT014	**Bioprocess and Environmental Biotechnology**	04hrs	56	03hrs	25	25	50	02
	Other Subject										04
	Other Subject										04
	Other Subject										04
	Internship-1		036BIT091		04hrs	56	03hrs	50	0	50	02
	Total							**180**	**170**	**350**	

B.Sc. Semester–V

DisciplineSpecific Core CourseDSCC-9

Course Title:Genetic Engineering

Course Code:035 BIT 011

Type ofCourse	Theory /Practical	Credits	Instructionhour/week	TotalNo.ofLectures/Hours /Semester	Durationof Exam	FormativeAssessmentMarks	Summative assessment Marks	TotalMarks
DSCC-9	**Theory**	**04**	**04**	**56hrs.**	**2hrs.**	**40**	**60**	**100**

CourseObjectives

1. Understandthefundamentalprinciplesandtechniquesofgeneticengineering.
2. Exploretheapplicationsofgeneticengineeringinagriculture,medicine,biotechnology,and environmentalscience.
3. Developpracticalskillsingeneticengineeringtechniquesandlaboratoryprocedures.
4. Gainknowledgeofgeneexpressionregulationandgeneticmodificationmethods.
5. Enhancecriticalthinkingandproblem-solvingskillsthroughdiscussionsandcasestudies.
6. Stayupdatedonemergingtrendsandadvancementsingeneticengineering.

CourseOutcomes

1. Demonstrateathoroughunderstandingofthefundamentalprinciplesandtechniquesofgeneticengineering.
2. Applytheknowledgeofgeneticengineeringtodiverseapplicationsinagriculture, medicine, biotechnology,and environmentalscience.
3. Performlaboratoryproceduresanddeveloppracticalskillsingeneticengineeringtechniques.
4. Explain gene expression regulation mechanisms and apply geneticmodificationmethodseffectively.
5. Evaluategeneticengineering'sethical,social,andlegalimplicationsandproposeresponsiblesolutions.
6. Stayupdatedwithrecentadvancementsingeneticengineering,criticallyevaluateemergingtrends,andassesstheirpotentialimpactonvariousfields.

Genetic Engineering-ContentofTheory	56hrs
UnitI-FundamentalsofGeneticEngineering	**14**
Definition, scope, and historical overview of genetic engineering. Importance and applications invariousfields. **DNA Structure and Manipulation**- Techniques for DNA isolation and purification. Methods forquantificationandcharacterizationofDNAsamples. **RNA Analysis and Gene Expression**- Methods for RNA isolation and purification. Analysis ofgeneexpression. **Recombinant DNA technology** – Introduction to molecular cloning. Overview of cloning vectors.Plasmids, phage, cosmid, BAC, and YAC. Features and applications of cloning vectors in geneticengineering. Enzymes used in recombinant DNA technology: Restriction endonucleases, DNAmodifying enzymes, other nucleases, Polymerases, Ligase, kinases, and phosphatases.TechniquesformolecularcloningofDNAorRNAfragmentsinbacterialandeukaryoticsystems.	
UnitII-PracticesinGeneticEngineering	**14**
RecombinantProteinExpressionandPurification,affinitytags.Techniquesforexpressingrecombinant proteins using bacterial, animal, and plant expression systems. Strategies for proteinpurification and characterization. Hybridization techniques, Southern, Northern, Western, FISH,Polymerase Chain Reaction (PCR) and its types, molecular probes, DNA sequencing- Sanger's,NextGeneration Sequencing **Gene Manipulation Techniques** - Methods of gene delivery. Physical, chemical, and biologicalmethods.Transformation,transfection,electroporationandmicro-injection.Geneknockouttechniquesinbacterialandeukaryoticorganisms. **Genome Editing**- Introduction to genomeediting techniques- Principles and applicationsofgenomeeditingtechniques.CRISPR-Cas9,site-directedmutagenesis,andothergenomeediting methods.	
UnitIII-ApplicationsofGeneticEngineering	**14**
Introduction to Applications. Overview of the diverse applications of genetic engineering. Genetherapy and its potential in treating genetic disorders. Strategies for gene delivery in therapeuticapplications.DiagnosticApplications.DNAfingerprintinganditsapplicationsinforensics. Molecular diagnostic techniques and their role in disease diagnosis. Use of genetic engineering inthedevelopmentoftherapeuticsandvaccines.ProductionofbiopharmaceuticalsusingrecombinantDNAtechnology.	
UnitIV-AdvancesinGeneticEngineeringandEthics	**14**

Industrial Applications. Industrial applications of genetic engineering, such as enzyme production,biofuel production, and bioremediation. Scale-up techniques and process optimization in industrialsettings. Introduction to synthetic biology and its integration with genetic engineering. Design andconstructionofartificialbiologicalsystems

Ethical and Regulatory Considerations- Discussion of ethical implications associatedwithgenetic engineering. Introduction to regulatory guidelines and safety considerations for geneticengineeringresearchandapplications

Pedagogy: Lectures, Seminars, Industry Visits, Debates, Quiz and Assignments

FormativeAssessmentforTheory	
AssessmentOccasion/type	**Marks**
InternalAssessmentTest1	10
InternalAssessmentTest2	10
Quiz/Assignment/SmallProject	10
Seminar	10
Total	**40Marks**
FormativeAssessmentasperguidelines.	

B.Sc. Semester–V

DisciplineSpecific Core Course(DSCC)-10

Course Title:Genetic Engineering

Course Code:035BIT012

Type ofCourse	Theory /Practical	Credits	Instructionhour / week	TotalNo.ofLectures/Hours /Semester	Durationof Exam	FormativeAssessmentMarks	Summative assessment Marks	TotalMarks
DSCC-10	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**25**	**25**	**50**

PracticalContent

1. **IntroductiontoLaboratoryTechniques-**Safetyguidelinesandlaboratoryprotocols Asepticteчniquesandproperhandlingofmaterials.Basicequipmentandinstrumentoperation, Preparationofreagentsandmedia
2. **NucleicAcidExtractionandQuantification-** DNAextractionfromdifferentsources(e.g.,bacteria, plant, animal). RNA extraction and purification methods. Quality assessment andquantification ofnucleicacids(spectrophotometry, gelelectrophoresis).
3. **PolymeraseChainReaction(PCR)** PrimerdesignandoptimizationPCRsetupandcyclingconditionsAgarose

gel electrophoresisforPCRproductanalysis

4. **CloningandPlasmidManipulation**Re strictionenzymedigestionLigationrea ctions
   Transformationofbacterialcellswithrecombinantplasmids Colonyselec tionandscreeningforsuccessfulcloning
5. **GelElectrophoresisandDNAAnalysis**
   AgarosegelelectrophoresisforDNAfragmentseparationandanalysis, DNAsizedetermination usingmolecularweightmarkers
   DNAbandvisualizationtechniques(e.g.,ethidiumbromidestaining,DNAintercalatingdyes)

PracticalAssessment

FormativeAssessment		**SummativeAssessment**	**TotalMarks**
AssessmentOccasion/type	**Weightage inMarks**	**PracticalExams**	
Scheme of Practical Examination (distribution of marks): 25 marks for Semester end examination Major Question ---------- 10 Marks Minor Question ---------- 06 Marks Identify and comment ----------3x1 = 03 Marks Viva----------03Marks Practical Records--- 03Marks		25	**50**
Total	**25**	**25**	

The same shall be used for semester end Examination

References

1. PrinciplesofGeneManipulationandGenomics(2016)8thed.,Primrose,SB,andTwyman,R,Wiley Blackwell,ISBN:978-1405156660.
2. GeneCloningandDNAAnalysis:AnIntroduction(2019)7thed.,Brown,TA,WileyBlackwe ll,ISBN:978-1119072560.
3. Genome4(2017)4thed.,Brown,TA,GarlandScience,ISBN:978-0815345084.
4. IntroductiontoGenomics(2015)2nded.,Lesk,AM,OxfordUniversityPressIndia,ISBN:978-0198745891.
5. GenomicsandPersonalizedMedicine:WhatEveryoneNeedsto Know(2016)1sted.,Snyder,M,OUP-USA,ISBN:978-0190234768.
6. MolecularBiologyoftheGene(2014)7thed.,Watson,JD,Baker,TA,Bell,SP,Gann,A,Levine,M,an dLosick,R,Pearson,ISBN:978-0321762436.
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8. Genomes(2018)4thed.,Brown,TA,GarlandScience,ISBN:978-0815345084.
9. IntroductiontoGenomicsandProteomics(2015)2nded.,Burrell,MM,Wiley,ISBN:978-0470850075.
10. Genomics:TheScienceandTechnologyBehindtheHumanGenomeProject(2019)2nded.,Gibson, G,andMuse,SV, OxfordUniversity Press,ISBN:978-0198786207.
11. GenomicsandEvolutionofMicrobialEukaryotes(2019)1sted.,Katz,LA,andBhattacharya, D,OxfordUniversityPress,ISBN:978-0198830202.
12. EssentialsofGenomicandPersonalizedMedicine(2016)2nded.,Ginsburg,GS,andWillard,HF,Ac

ademicPress,ISBN:978-0124078652.
13. GenomicMedicine:PrinciplesandPractice(2014)2nded.,Ginsburg,GS,andWillard,HF,OxfordUniversityPress,ISBN:978-0199334468.
14. GenomicMedicineinResource-limitedCountries:Genomics forEveryNation(2019) 1sted., Wonkam,A,Puck,JM,andMarshall,CR,AcademicPress,ISBN:978-0128133003.
15. MolecularGenetics andGenomics (2020)1sted.,Krebs, JE, and Goldstein,ES,Jones&BartlettLearning,ISBN:978-1284154544.
16. Bioinformatics andFunctionalGenomics (2015)3rded.,Pevsner,J,Wiley-Blackwell,ISBN:978-1118581780.
17. Genomic Approaches for Cross-Species Extrapolation in Toxicology (2019) 1st ed., Wichard,J,andMaertens,A,CRCPress,ISBN:978-0815348023.
18. IntroductiontoGeneticAnalysis(2020)12thed.,Griffiths,AJF,Wessler,SR,Carroll,SB,andDoebley,J, W.H.Freeman,ISBN:978-1319149609.
19. GeneticEngineering:PrinciplesandMethods(2019)3rded.,Fowler,MR,CABI,ISBN:978-1789240605.

B.Sc. Semester–V

DisciplineSpecific Core CourseDSCC-11

Course Title: PlantandAnimalBiotechnology

Course Code: 035BIT013

Type ofCourse	Theory /Practical	Credits	Instructionhour / week	TotalNo.ofLectures/Hours /Semester	Durationof Exam	FormativeAssessmentMarks	Summative assessment Marks	TotalMarks
DSCC-11	**Theory**	**04**	**04**	**56hrs.**	**2hrs.**	**40**	**60**	**100**

CourseObjectives

1. Tounderstandthefundamentalaspectsofplantandanimalbiotechnology.
2. Learnaboutbiotechnologicaltoolsandtechniquesusedinplantandanimalresearch.
3. Explore methods ofintroducingforeigngenes into plants and animals throughtransformationtechniques.
4. Gainpracticalskillsinplanttissueculture andanimalcellculture forimprovement.
5. Designstrategiesforplantgeneticmanipulationagainstbioticandabioticstressors.
6. Hypothesizestrategiestoincreaseplantyieldandfruit/seedquality.
7. Apply knowledge to real-world challenges in agriculture, veterinary medicine,conservation,andbiomedicalresearch
8. Understandtheneedforanimalbiotechnologyforhumanwelfare.

CourseOutcomes

Aftercompletingthiscourse,thestudentisexpectedtolearnthefollowing:

1. Demonstrateacomprehensiveunderstandingofplant biology,physiology,genetics,andmolecularbiology.
2. Applybiotechnological tools and techniques used in plantresearchandagriculture,suchasplanttissueculture, geneticengineeringandtransgenics.
3. Executeplanttissueculture techniquesforcallus induction,somaticembryogenesis, andmicropropagation, and apply them in plant breeding andpropagation.
4. Perform plant transformation methods and demonstrate the ability to introduceforeigngenesinto plantsusing differenttechniques.
5. Applyknowledge aboutethicalconsiderationsand regulatoryframeworksassociatedwithplantbiotechnologyandgeneticallymodifiedcrops.
6. Understandthebiologyandcharacterizationofculturedcells,includingtheiradhesion,proliferation,differentiation,morphology,andidentification.
7. Gainpracticalskillsinbasicmammaliancellculturetechniques,measuringgrowthparameters, assessingcellviability,andunderstandingcytotoxicity.
8. Learn aboutgermplasm conservationtechniques andtheestablishmentof genebanks,alongwithlarge-scaleculturemethodsforcelllines.
9. Explore organ andhistotypicculture techniques,biotransformation,3Dcultures, whole embryo culture, somatic cell cloning, and the ethicalconsiderationssurroundingstemcellsandtheirapplications.

PlantandAnimalBiotechnology-ContentofTheory	56hrs
Unit–I–PlantTissueculturemethods	**14**
Introduction,history,definition,hypothesis,andconceptoftotipotency.Principlesofplanttissueculture,media and laboratory organization, types of culture, morphogenesis, differentiation, callus, direct,indirect organogenesis, and somatic embryogenesis, synthetic seeds.*In vitro* propagation andmicropropagation, Seed culture, embryo culture, Meristem culture, budculture, limitations andapplications. Secondarymetabolites,*Invitro*secondarymetaboliteproduction,Suspensioncultures,cellcultures, growth vs secondary metabolite production, bioreactors and scaling up of secondary metaboliteproduction,limitations,andapplications.	
Unit-IITransgenicPlantsandbiosafety	**14**
Overviewoftransgenicplants andtheirsignificanceinagriculture.-Techniquesforintroducingforeigngenesintoplants:Agrobacterium-mediatedtransformation,biolistics,andothermethods.Selectionandscreeningoftransformedplants.ApplicationsofTransgenicPlants-Improvedcroptraitsthroughgenetic engineering:pest resistance, herbicide tolerance, disease resistance, and abiotic stress tolerance.Biosafetyassessmentoftransgenicplants:potentialrisksandbenefits.Internationalregulatoryframeworksforreleasingandcommercializinggeneticallymodifiedorganisms(GMOs).Ethical and socio-economicimpactsoftransgeniccrops.Intellectualpropertyrightsandaccesstotransgenictechnologies.	
Unit–IIIAnimalCellculturemethods	**14**
Historyandlaboratoryorganisation,Media.Celltypesandculturecharacters.Pluripotency,Multipotency,Differentiation,TransdifferentiationReprogramming, Biology and characterization of cultured cells- cell adhesion, proliferation, differentiation, morphology ofcells,andidentification.Thebasictechniqueofmammaliancellcultureinvitro,Measuringparametersofgrowth in cultured cells, cell viability, and cytotoxicity. Large-scale culture of cell lines-monolayer,suspension,andimmobilizedcultures. Organ and histotypic culture**:** Technique, advantages, limitations, applications. Stem cells: types (embryonic, adult, induced pluripotent), isolation, identification, expansion, differentiation and uses,stemcellengineering, ethicalissues.	
Unit-IVGenetransferinanimalsandapplications	**14**
Gene constructs promoter/ enhancer sequences for transgene expression in animals. Selectable markersfor animal cells- thymidine kinase. Transfection of animal cells- calcium phosphate coprecipitation,electroporation, lipofection, peptides, direct DNA transfer, viral vectors, Retrovirus,microinjection.Transgeneidentificationmethods.Transgenicandgenome-editedanimals.Ethicalissuesintransgenesis.Recentadvancesand applicationsinthefield. Manipulation of animal reproduction and characterization of animal genes, Embryo transfer in cattle andapplications.Somaticcellcloning-cloningofDolly.Ethicalissues.Productionof recombinantvaccines.	

Pedagogy: Lectures, Seminars, Industry Visits, Debates, Quiz and Assignments

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
InternalAssessmentTest1	10
InternalAssessmentTest2	10

Quiz/Assignment/Small Project	10
Seminar	10
Total	**40 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–V

Discipline Specific Core CourseDSCC-12

Course Title: **PlantandAnimalBiotechnology**

Course Code: 035BIT014

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-12	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**25**	**25**	**50**

ContentofPractical

1. Laboratoryorganizationofbasicandcommercialplanttissueculture
2. Mediapreparation(MS,B5),solidmediapreparation,andLiquidmediapreparation
3. Explantpreparation–Leaf,bud,rhizome,andmeristem
4. Syntheticseedproduction
5. Callusculture-Initiationandestablishmentofdifferenttypesofcalluscultures
6. Micropropagationwithasuitableexample–Stage0.1,2,3,and4
7. Staining,cellviability,andcellcountofcellcultures
8. Preparationofcellculturemedia:Preparationofbasiccellculturemedia,suchasDulbecco'sModified Eagle Medium (DMEM),supplemented with fetalbovine serum (FBS), antibiotics,andotherrequiredadditives.
9. Aseptictechniquesandsterilehandling:Practicingaseptictechniques,includingproperlyhandling tools and equipment, working in a laminar flow hood, and maintaining sterilitythroughoutthe cellculture process.
10. Filtersterilization:Practicefiltersterilizationforsensitivemediaingredients.
11. Cell counting and viability assessment: Count cells using a hemocytometer or automated cellcounter,andperformviabilityassays(e.g.,trypan blueexclusion)todeterminethepercentageofviable cells.
12. Cellstainingandmicroscopy:Stainingtheculturedcellsusingdyessuchashematoxylinandeosin (H&E), and observe them under a light microscope to study cell morphology andstructure.
13. Contamination identification and troubleshooting: Learn to identify and troubleshootcommonissuesincellculture,suchascontaminationbybacteria,fungi,ormycoplasma,andimplement appropriatecorrectivemeasures.
14. Experimentaldesignanddataanalysis:Studentscandesignandexecutesimpleexperiments,record and analyze data, and interpret the results based on their observations andmeasurements.

PracticalAssessment			
FormativeAssessment		**SummativeAssessment**	**TotalMarks**
AssessmentOccasion/type	**Weightage inMarks**	**PracticalExams**	
Scheme of Practical Examination (distribution of marks): 25 marks for Semester end examination Major Question ---------- 10 Marks Minor Question ----------06 Marks Identify and comment ----------3x1 = 03 Marks Viva----------03Marks Practical Records 03Marks		25	**50**
Total	**25**	**25**	

The same shall be used for semester end Examination

References

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B.Sc. Semester–V

Skill Enhancement Course: SEC-3

Course Title:Qualitycontrolmethodsinbiology

Course Code: SEC-3

Type ofCourse	Theory /Practical	Credits	Instructionhour/week	TotalNo.ofLectures/Hours /Semester	Durationof Exam	FormativeAssessmentMarks	Summative assessment Marks	TotalMarks
SEC-3	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**25**	**25**	**50**

CourseOutcomes(COs):Attheendofthecoursethestudentshouldbeableto:

1. Demonstrate skills as per National Occupational Standards (NOS) of the "LabTechnician/Assistant" QualificationPack issued by the Life Sciences SectorSkillDevelopmentCouncil-LFS/Q0509.
2. Develop knowledge of laboratory safety procedures and protocols and acquireskillsinhandlingandmaintaininglaboratoryequipmentandinstruments.
3. Operateanalyticalequipmentandinstrumentsasperstandardoperatingprocedures(SOP)
4. Knowledgeaboutmajoractivitiesofthebiotechindustry,regulationsandcompliance, environment, health and safety (EHS), good laboratory practices(GLP),andGoodManufacturingPractices(GMP)aspertheindustrystandards.
5. Demonstrate soft skills, such as decision-making, planning, organizing, problem-solving, analyticalthinking,critical thinking,anddocumentation.

Content
Unit-1
Methodsandpracticesof cleaningandmanagementof lab: LearningandPracticeofIntegrated clean-in-place (CIP)and sterilize-in-place (SIP) as perindustry standards,materialrequirements for cleaning specific areas, equipment, ventilation area, personal protectiverequirementsCalibrationofanduseofmicropipette.
Unit-2
Preparation of Standard Operating Procedure (SOP) for various equipment in the QC Lab, Bestpracticesofusingandstoringchemicals:Knowledgeandpracticeinhandlingchemicals,labeling, and stock maintenance. SOP and material handling. Procedures to maintain chemicals,labeling,storage,anddisposal. **Handling andcalibrationoflabequipment-**weighingbalance, Autoclave, Hot airOven, Incubator, Centrifuge, Water bath, Colony Counter, and stability chamber, Preparation ofNormality,Molarity,and buffersolutions
Unit-3
Preparation of media: Maintenance and storage of purified water for media (plant tissueculture media, microbiological media, and animal cell culture media) preparation.Preparation and storage of concentrated stock solutions. Documentation and disposal ofexpired stocks. Collection of indents of media requirement, preparation, and storage. Mediacoding,documentation,andpurposeofusage. Demonstration, handling, and troubleshooting of High-Performance

LiquidChromatographyandGaschromatography.
Demonstration of Polymerase Chain Reaction (PCR), Hands-on training on colorimeter andspectrophotometer,Industryvisit,oranalyticallaboratoryvisit.

PracticalAssessment			
FormativeAssessment		**SummativeAssessment**	**TotalMarks**
AssessmentOccasion/type	**Weightage inMarks**	**PracticalExams**	
Scheme of Practical Examination (distribution of marks): 25 marks for Semester end examination Major Question ---------- 10 Marks Minor Question ----------06 Marks Identify and comment ----------3x1 = 03 Marks Viva----------03Marks Practical Records 03Marks		25	**50**
Total	**25**	**25**	

The same shall be used for semester end Examination

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B.Sc. in BIOTECHNOLOGY

VI Semester

W. e. f.: 2023-24

B.Sc. Semester–VI

DisciplineSpecific Core Course(DSCC)-14

Course Title:Immunology

Course Code:036BIT011

Type ofCourse	Theory /Practical	Credits	Instructionhour / week	TotalNo.ofLectures/Hours /Semester	DurationofExam	FormativeAssessmentMarks	Summative assessment Marks	TotalMarks
DSCC-14	**Theory**	**04**	**04**	**56hrs.**	**2hrs.**	**40**	**60**	**100**

CourseObjectives

1. To understand the various aspects of immunity, elicitation of immuneresponses, factors determining the outcome of immune responses andmajorplayersofimmunity,relevance betweennutritionalsupportandimmunity,and immunologicaltechniques.
2. To provide knowledge on essentialfeatures of antigens and antibodiesandtheirtypesanddifferenttheoriesofAntibodyformation.
3. Toacquireknowledgeontypesofimmunity,phagocytosis,interferons,and thecomplementsystem.
4. Toexplaintheconceptofhypersensitivity,autoimmunity,andtransplantation.
5. Toprovideknowledgeonimmunedeficienciesandseveralimmunologicaltechniques

CourseOutcomes

Attheendofthecourse,thestudentshouldbeableto:

1. Demonstratecomprehensionoftheunderlyingstructureandfunction oftheimmunesystemandrelateddisorders.
2. Demonstrate an understandingof theroleof cells andmolecules inimmunereactionsandresponses
3. Demonstratetechnicalskillsinimmunologicaltoolsandtechniques
4. Applythedomain-specificknowledgeandskillsacquiredinimmunologyforinnovative therapiesandImmunotechnologies
5. Understandthefundamentalconceptsofimmunity,and thecontributionsoftheorgansandcellsinimmuneresponses.
6. RealizehowtheMHCmolecule'sfunctionandhostencountersanimmuneinsult.
7. Understandtheantibodiesandcomplementsystem
8. Understandthemechanismsinvolvedintheinitiationofspecificimmuneresponses
9. Differentiatethehumoralandcell-mediatedimmunemechanisms
10. Comprehendtheoverreactionbyourimmunesystemleadingtohypersensitivecon ditionsand itsconsequences
11. Understanduniquepropertiesofcancercells,immunerecognitionoftum ors,immuneevasion ofcancers

Immunology-ContentofTheory	56Hrs
Unit–ICellsandOrgansoftheImmuneSystem	**14**
Introduction to the Immune System: History of Immunology, Types of Immunity: first and secondlineofdefense,innateandacquired/adaptiveimmunity,specificity,diversity. Cells of the immune system: Antigen-presenting cells (APCs), Role of B and T-lymphocytes inHumoralimmunityandcell-mediatedimmunity,primaryandsecondaryimmuneresponse,Immunization, memory. Organs of the Immune system: Thymus, bone marrow, spleen, LymphNode,peripherallymphoidorgans	
Unit-IIMoleculesoftheImmuneSystem	**14**
Antigens and haptens:Properties (foreignness,molecularsize,heterogeneity).Adjuvants.Antigenicityand Immunogenicity.Affinity andAvidity. B and Tcell epitopes,superantigensImmunoglobulins:Classification,structure,andfunction.Antibodydiversity,Monoclonalandpolyclonalantibodies. Major histocompatibility complexes: Classification, structure, and function. Antigen processingpathways – Cytosolic and Endocytic, ComplementPathways,Cytokines: Classification andfunction,Hypersensitivity:Reactions–TypesI,II,andIII.DelayedTypeHypersensitiveResponse.	
Unit-IIIImmunotechniquesandvaccines	**14**
Structure andpropertiesofantigens- iso- and allo-antigens,antigenspecificity,Cross-reactivity,Precipitation, Immunodiffusionreactions:Radialimmunodiffusion,Ouchterlonydoublediffusion,Immunoelectrophoresis. Agglutination: Agglutination reactions.ELISA,RIA.Immunocytochemistry,FluorescentTechniques. Vaccines:Conventional,peptide vaccines,subunit, DNAvaccines. Toxoids,antisera,ediblevaccines,plantibodies,andCancervaccines.	
Unit-IV	**14**
Transplantationimmunology:Phasesingraft rejection andimmuno-suppressors.AutoimmuneDisorders: Systemic and Organ-specificAutoimmune disorders with examplesImmunodeficiencies:Primaryandsecondaryimmune deficiencies;acquiredimmunodeficiencysyndrome Cancerandtheimmunesystem–immunesurveillance,immunologicalescape,cancerantigens,cancerimmunotherapy Microbial diseases in humans**:** Mode of infection, symptoms, epidemiology and control measures ofdiseases caused by Viruses (Hepatits-B),Bacteria (Typhoid), Fungi (Aspergillosis),Protozoa(Malaria).	

Pedagogy: Lectures, Seminars, Industry Visits, Debates, Quiz and Assignments

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
InternalAssessmentTest1	10
InternalAssessmentTest2	10
Quiz/Assignment/Small Project	10
Seminar	10

Total	40 Marks
Formative Assessment as per guidelines.	

B.Sc. Semester–VI

Discipline Specific Core CourseDSCC-14

Course Title: **Immunology**

Course Code: 036BIT012

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-12	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**25**	**25**	**50**

ContentofPractical

1. HemagglutinationofABOBloodgroups
2. DeterminationofRhfactor
3. WholeCountofWBCusingHemocytometer
4. CellsoftheImmuneSystem
5. Radialimmunodiffusion
6. Ouchterlonydoublediffusion
7. ELISA–Demonstrate
8. SerumImmunoelectrophoresis
9. WesternBlotting

PracticalAssessment

FormativeAssessment		**SummativeAssessment**	**TotalMarks**
AssessmentOccasion/type	**Weightage inMarks**	**PracticalExams**	
Scheme of Practical Examination (distribution of marks): 25 marks for Semester end examination Major Question ---------- 10 Marks Minor Question ----------06 Marks Identify and comment ----------3x1 = 03 Marks Viva----------03Marks Practical Records 03Marks		25	**50**
Total	**25**	**25**	

The same shall be used for semester end Examination

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B.Sc. Semester–VI

Discipline Specific Core Course(DSCC)-15

Course Title: BioprocessandEnvironmentalBiotechnology

Course Code:036BIT013

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-15	**Theory**	**04**	**04**	**56hrs.**	**2hrs.**	**40**	**60**	**100**

CourseObjectives:

1. Performsimulationsofmicrobialgrowthandmetabolism
2. Designbioreactorsfortheproductionofvariousproducts.
3. Presentknowledgeaboutmajormetabolicpathwaysandthoserelatedtobiofuelproduction frommicrobes.
4. Understandthefundamentalconceptsandprinciplesofenvironmentalbiotechnologyand Explore theinterrelationshipbetweenbiotechnologyandtheenvironment.
5. Gainknowledge ofthe variousapplications ofbiotechnology inenvironmentalconservation, pollutioncontrol,andsustainability.

6. Learnaboutmicrobialprocessesandtheirroleinenvironmentalbiotechnology.
7. Understand theprinciples ofbioremediation andits applicationin theclean-up ofenvironmentalpollutants.
8. Explorethepotentialofbioenergyproductionandwastemanagementthroughbiotech nologicalapproaches.
9. IdentifyandcharacterizethemostimportantcontaminantsintheBioprocessandotherindus trialwastes.
10. Reuse/recyclethebiologicalwastetocleantechnologysuchasenergy,biofuel,biofertili zerthrough bioremediation

Courseoutcomes:

- Exploitation of microorganisms for industrial use and their improvement,andformulationofmediaforefficientgrowthandproduction ofmicrobialorcell-based products.
- Thedesign,operation,andspecificapplicationsofvariousbioreactors.
- Demonstrateacomprehensiveunderstandingofthefundamentalconceptsandprinciplesofenvironmentalbiote chnology.
- Applyknowledgeofbiotechnologicaltechniques to addressenvironmentalchallenges,suchaspollutioncontrolandwastemanagement.
- Analyzeandevaluateenvironmentalbiotechnologycasestudies,researchfindings,andreal-worldapplications.
- Designandimplementbiotechnologicalapproachesforenvironmentalremediation,utilizingmicrobialprocesses andbiodegradationprinciples.
- Evaluate the ethical and sustainable aspects of environmental biotechnologypractices andmake informed decisions regarding their application inenvironmentalconservation.
- Communicate scientific concepts and research findings related toenvironmentalbiotechnology effectively, both in written and oralforms,todiverseaudiences.

BioprocessandEnvironmentalBiotechnology–ContentofTheory	**56hrs.**
UNIT-I–Introductiontobioprocesstechnology	**14**
Basic principle components of fermentation technology. Strain improvement of industrially importantmicroorganisms. Types of microbial culture and its growth kinetics– Batch, Fed-batch, andContinuousculture.Principlesofupstreamprocessing–Mediapreparation,Inocula development,and sterilization.	
UNIT-II-Bioreactorsanddownstreamprocessing	**14**
Bioreactors-SignificanceofImpeller,Baffles,Sparger;Specializedbioreactors-designandtheirfunctions: airlift bioreactor, tubular bioreactors, membranebioreactors, tower bioreactors, fluidizedbedreactor,packed bed reactors Downstreamprocessing-celldisruption,precipitationmethods,solid-liquidseparation,liquid-liquidextraction,filtration,centrifugation,chromatography,dryingdevices (Lyophilization andspray drytechnology),crystallization,biosensors-constructionandapplications,Microbialproductionofethanol,amylaseandSingleCellProteins.	
UnitIII-FundamentalsofEnvironmentalBiotechnology	**14**

IntroductiontoEnvironmentalBiotechnology-PrinciplesofEnvironmentalScience.RoleofBiotechnology in Environmental Conservation. Microbial Processes in EnvironmentalBiotechnology.Pollution and Biotechnology – Major issues in environmental pollution and the role of biotechnologyin addressing them. Biotechnological Methods of Pollution Detection-General bioassay methods forpollutiondetection. Cell biologicalmethods for assessingpollution levels.Use of biosensors inpollution monitoring. Biotechnological Methods in Pollution Abatement-Reduction of CO_2 emissionusing biotechnologicalapproaches. Addressing eutrophication through biotechnological interventions.Application ofcellimmobilizationtechniquesinpollutionabatement.		
UnitIV-	**BioremediationandWasteManagement**	**14**
Importance of bioremediation in environmental cleanup. Types of contaminants suitableforbioremediation. Microorganisms used in bioremediation. *In-situ* Bioremediation Methods. –Bioaugmentation.Biostimulation.Bioventing.Phytoremediation.*Ex-situ*BioremediationMethods– Composting, Land farming, Biopile and bioslurry systems. Xenobiotics. Bio metallurgy and bio-mining. WastewaterManagement.Wastewater Characterization and Composition.BiologicalProcesses inWastewaterTreatment.ActivatedSludgeProcessandBiologicalNutrientRemoval,Anaerobic Digestionand BiogasProduction.SolidWasteManagement.		

Pedagogy: Lectures,Seminars,IndustryVisits,Debates,QuizandAssignments

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
InternalAssessmentTest1	10
InternalAssessmentTest2	10
Quiz/Assignment/Small Project	10
Seminar	10
Total	**40 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–VI

Discipline Specific Core CourseDSCC-16

Course Title: BioprocessandEnvironmentalBiotechnology

Course Code: 036BIT014

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-16	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**25**	**25**	**50**

ContentofPractical

1. Estimation of BOD, COD, DO and microbial flora
2. Bacteriological examination of water by MPN method
3. Bacterialgrowthcurve.
4. Calculationofthethermaldeathpoint(TDP)ofamicrobialsample.
5. Studyoffermentor-Demonstration.
6. Productionofwine
7. Estimationofthepercentageofalcohol,totalacidity&volatileacidityinwine.
8. Productionandanalysisofethanol.
9. Productionandanalysisofamylase.
10. Productionandanalysisoflacticacid.
11. Isolationofindustriallyimportantmicroorganismsfromnaturalresources.

PracticalAssessment			
FormativeAssessment		**SummativeAssessment**	**TotalMarks**
AssessmentOccasion/type	**Weightage inMarks**	**PracticalExams**	
Scheme of Practical Examination (distribution of marks): 25 marks for Semester end examination Major Question ---------- 10 Marks Minor Question ----------06 Marks Identify and comment ----------3x1 = 03 Marks Viva----------03Marks Practical Records 03Marks		25	**50**
Total	**25**	**25**	

The same shall be used for semester end Examination

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Biotechnology InternshipforgraduateProgramme

Coursetitle	**InternshipDisciplinespecific**
Course code	036BIT091
Noofcontacthours	**56**
Nocredits	**2**
Methodofevaluation	**Presentations/Reportsubmission/Both**

ProjectAssessment

Type ofCourse	Theory /Practical	Credits	Instructionhour/week	TotalNo.ofLectures/Hours /Semester	Durationof Exam	FormativeAssessment Marks	Summative assessment Marks	TotalMarks
Internship	**Practical**	**02**	**04**	**56 hrs.**	**3hrs.**	**50**	**0**	**50**

- Internship shall be Discipline Specific of 60 hours (2 credits) with duration 1-2 weeks.
- Internship may be full-time/part-time (full-time during semester holidays and part-time in the academic session)
- Internship mentor/supervisor shall avail work allotment during 6th semester for a maximum of 20 hours.
- The student should submit the final internship report (90 hours of Internship) to the mentor for completion of the internship.
- The detailed guidelines and formats shall be formulated by the universities separately as prescribed in accordance to UGC and AICTE guidelines.

- Incase Internship in a company or institute not possible or college did not permit then mini projects on biotechnology topics may be given.Viz., Wine production, Human microbiome etc,

UG programme: 2023-24

GENERAL PATTERN OF THEORY QUESTION COURSE FOR DSCC/ OEC

(60 marks for semester end Examination with 2 hrs duration)

Part-A

1. Question number 1-06 carries 2 marks each. Answer any 05 questions : 10 marks

Part-B

2. Question number 07- 11 carries 05Marks each. Answer any 04 questions : 20 marks

Part-C

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks
(Minimum 1 question from each unit and 10 marks question may have sub questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 60 Marks

Note: Proportionate weight age shall be given to each unit based on number of hours Prescribed