KARNATAK UNIVERSITY, DHARWAD
ACADEMIC (S&T) SECTION

ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಧಾರವಾಡ
ವಿದ್ಯಾಮಂಡಳ (ಎಸ್&ಟಿ) ವಿಭಾಗ

ಸ್ವಾತಂತ್ರ್ಯದ ಅಮೃತ ಮಹೋತ್ಸವ

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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.

KARNATAK UNIVERSITY,DHARWAD

B.Sc.in MICROBIOLOGY

SYLLABUS

WithEffectfrom2023-24

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

SKILL ENHANCEMENT COURSE(SEC) FOR SEMV

INTERNSHIP FOR SEM VI

ASPER NEP-2020

Karnatak University, Dharwad

B.Sc.in **MICROBIOLOGY**

Effective from2023-24

Sem.	Type of Course	Theory/Practical	Course Code	Course Title	Instruction hour/week	Total hours /sem	Duration Of Exam	Marks			Credits
								Formative	Summative	Total	
V	DSCC-9	Theory	035MCB011	**Microbial genetics and molecular biology**	04hrs	56	02hrs	40	60	100	04
	DSCC-10	Practical	035MCB012	**Microbial genetics and molecular biology**	04hrs	56	03hrs	25	25	50	02
	DSCC-11	Theory	035MCB013	**Food and dairy microbiology**	04hrs	56	02hrs	40	60	100	04
	DSCC-12	Practical	035MCB014	**Food and dairy microbiology**	04hrs	56	03hrs	25	25	50	02
	Other Subject										04
	Other Subject										04
	Other Subject										04
	SEC-3	Practical	035MCB061	Microbial quality control in food and pharma industries(Practical)	04hrs	56	03hrs	25	25	50	02
	Total							**275**	**375**	**650**	**24**
VI	DSCC-13	Theory	036MCB011	**Immunology and medical microbiology**	04hrs	56	02hrs	40	60	100	04
	DSCC-14	Practical	036MCB012	**Immunology and medical microbiology**	04hrs	56	03hrs	25	25	50	02
	DSCC-15	Theory	036MCB013	**Genetic engineering and industrial microbiology**	04hrs	56	02hrs	40	60	100	04
	DSCC-16	Practical	036MCB014	**Genetic engineering and industrial microbiology**	04hrs	56	03hrs	25	25	50	02
	Other Subject										04
	Other Subject										04
	Other Subject										04
	Internship-1		036MCB091		04hrs	56	03hrs	50	0	50	02
	Total							**300**	**350**	**650**	**26**

B.Sc. Semester–V

DisciplineSpecific Core CourseDSCC-9

Course Title:Microbial genetics and molecular biology

Course Code:035 MCB 011

Type ofCourse	Theory /Practical	Credits	Instructionhou rperweek	TotalNo.ofLectu res/Hours /Semester	Durationof Exam	FormativeA ssessmentM arks	Summative assessment Marks	TotalMa rks
DSCC-9	**Theory**	**04**	**04**	**56hrs.**	**2hrs.**	**40**	**60**	**100**

CourseObjectives

1. Understandthefundamentalprinciplesandtechniquesof Molecular Biology.
2. StayupdatedonemergingtrendsandadvancementsinMolecular Biology.

CourseOutcomes (COs): Afterthesuccessful completion ofthe course, thestudent will be ableto:

1. Understandconceptsinvolvedinreplication,transcription,translation,regulationofgeneexpressionin bacteriaandEukaryotes.
2. Differentiatetheprocessofreplication,transcription,translation,regulationofgeneexpressioninbacteria and Eukaryotes.
3. Understandthegenetic switchin bacteriophages.
4. Compareandcontrasthousekeeping,constitutive,inducibleandrepressiblegenesCO5.Outlineregulatory mechanisms in bacteriato control cellularprocesses.

UNIT I: Mendelian and Classical Genetics	**14hr**
Mendel's principles of inheritance: Special features of pea plants as an ideal system to study genetics and Mendel's cross breeding experimental approach to prove genetic principles. Principles of dominance and Segregation; phenotype, genotype, traits controlled by genes, existence of alleles (dominant and recessive). Principle of segregation of alleles during the fertilization: Monohybrid (single character) cross, F1 and F2 generation, heterozygous, homozygous, test cross and back cross to test genotype of F1 plants. Principle of independent assortment; Dihybrid (two characters) cross, pattern of assortment of alleles. Chromosomal basis of inheritance; chromosome number, haploid (n), diploid (2n). Chromosomal theory of Heredity; Experimental evidence linking the inheritance of genes to chromosomes, Chromosomes as arrays of genes, Chromosomal basis of Mendel's principles of segregation and independent assortment.	
UNIT II: Molecular basis of Life and Genetic recombination	**14hr**
Molecular basis of Life: Historical developments of DNA as a genetic material; Griffith experiment of Transformation, Proof that genetic information stored in DNA, Enzymatic approach to prove DNA mediates transformation by A very, MacLeod and McCarty, Hershey and Chase experiment to prove DNA carries the genetic information in T2 bacteriophage. RNA stores the genetic information in some viruses, viroids and prions. Structure of Watson Crick model of DNA, Plasmid DNA. Organization of genes in mitochondria and chloroplast. **Genetic Recombination:** Bacterial Transformation: Types of transformation mechanisms found in prokaryotes, Natural and artificial methods of transformation. Bacterial Conjugation: U-tube experiment to prove physical contact between bacteria is essential for gene transfer, properties of the F plasmid, F^+ x F^- conjugation, sexductionF′x F^- conjugation, Hfr x F^- conjugation, Gene mapping in bacteria by conjugation. Transduction: Generalized and specialized transduction, plasmids and episomes. Genetics of Fungi: life cycle of Yeast and Neurospora, Terad analysis, unordered tetrad analysis in yeast, ordered tetrad analysis in Neurospora, two point and three-point test cross, detecting linkage and mapping genes in yeast and neurospora.	
UNIT III: DNA Replication and protein synthesis	**14hrs**
DNA Replication: IntroductionandMechanism of DNA replication, enzymes involved in replication and regulation. **Prokaryotic transcription:** Transcription bubble, Stages of transcription, Bacterial RNA polymerase - structure and mechanism, recognition of promoters and DNA melting, abortive initiation. Elongation, Termination, antitermination. **Eukaryotic Transcription**: Eukaryotic RNA polymerases - RNA polymerase I, II, III. Mechanism of RNA polymerase in detail. Promoters, Transcription factors, basal apparatus, promoter clearance, elongation. Enhancers, silencers, termination. **RNA splicing and Processing**: mRNA capping, pre-mRNA splicing, lariat, snRNPs, spliceosome, autocatalytic splicing, alternative splicing, polyadenylation, tRNA splicing and maturation, production of rRNA, Catalytic RNAs - auto splicing, ribozymes, rinonuclease, viroids and virusoids, RNA editing	

Translation: Genetic code, tRNA structure, charging of tRNA, differences between initiator tRNA and elongator tRNA, ribosome structure. Accuracy of translation. Stages of translation. Role of IFs in initiation of bacterial translation, Formation of initiation complex. Initiation of eukaryotic translation - Scanning model of mRNA, IRES, Role of eIFs. Elongation of polypeptide - EF-Tu, EF-G, peptide bond formation, peptidyl transferase activity, translocation, eEFs. Termination.	
UNIT IV: Protein folding and control of regulation of gene expression	**14hrs**
Post translational modifications of proteins: Protein maturation and secretion - protein splicing, molecular chaperones. Protein translocation and secretion in bacteriaRegulation of translation. **Regulatory mechanisms in bacteria:**Positive and negative transcriptional control in bacteria. Operon concept, polycistronic mRNA. *lac* operon - negative inducible, allolactose, mutants of *lac* operon structure of *lac* repressor, mechanism of binding of repressor to operator. Catabolite repression of *lac* operon. Regulation by lac repressor and CAP. *trp* operon regulation - repressor control& attenuator control. **Regulation through modification of gene structure:** DNase I hypersensitivity, histone modifications, chromatin remodelling, DNA methylation. Regulation through transcriptional activators, Co-activators and repressors, enhancers and insulators. Regulation through RNA processing and degradation. Regulation through RNA interference	

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:Microbial genetics and molecular biology

Course Code:035MCB012

Type ofCourse	Theory /Practical	Credits	Instructionhou rperweek	TotalNo.ofLectu res/Hours /Semester	Durationof Exam	FormativeA ssessmentM arks	Summative assessment Marks	TotalMa rks
DSCC-10	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**25**	**25**	**50**

PracticalContent

1. Good Laboratory Practices and Safety Measures of Biohazard materials.
2. Standard operating procedure for molecular biology tools/equipment's.
3. Extraction of crude DNA from bacteria and yeast by phenol/chloroform method.
4. Demonstration of estimation of DNA by spectrophotometric method.
5. Extraction and visualization of genomic DNA from bacterial cultures
6. Determination of DNA melting point and GC content
7. Extraction and visualization of plasmids from bacterial cultures
8. Characterization of DNA by SpectrophotometricAssay and Melting Temperature (Tm).
9. Study of semi-conservative replication of DNA through micrographs / schematic representations
10. DNA fingerprinting technique through micrographs / schematic representations
11. Determination of linkage and cross-over analysis
12. Experiments on probability and Chi-square test.
13. Demonstrationof monohybrid and Dihybrid cross by Punnett squares.

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	*Karp'sCellandMolecularBiology*byGeraldKarp,JanetIwasa,Wallace Marshall.NinthEdition. 2020
2	Lewin'sGenesXII.JocelynEKrebs,ElliottSGoldstein,StephenTKilpatrick.JonesandBartlett Learning.2017
3	JamesD.Watson,Tania A.Baker,StephenP. Bell,Alexander Gann,MichaelLevine,Richard Losick.MolecularBiology ofthe Gene, 7th edition.2017
4	Freifelder'sEssentialsof MOLECULARBIOLOGY.GeorgeMMalacinski,4th ed.2015
5	FreifelderD (2012).MolecularBiology,5th edition.NarosaPublishingHouse,India
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11	BlochKD;GrossmannB(1995).DigestionofDNAwithRestrictionEndonucleases. https://doi.org/10.1002/0471142727.mb0301s31
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13	ElkinsKM(2013). DNAExtractionForensic DNABiology.
14	FrederickM.Ausubel,RogerBrent,RobertE.Kingston,DavidD.Moore, J.G.Seidman,JohnA.Smith,KevinStruhl (2003).CurrentProtocols inMolecularBiology.JohnWiley &Sons, New York,UnitedStates.
15	JohnsonM(2019).RNA extraction,SynatomResearch,Princeton,NewJersey,UnitedStates. DOI//dx.doi.org/10.13070/mm.en.2.201.
16	LewisM.Agarosegelelectrophoresis (basicmethod).Department ofPathology, Universityof Liverpool.http://diyhpl.us/~bryan/irc/protocol-online/protocolcache/agarogel.html
17	RandallDR.(2009).MolecularBiologyLaboratorymanual.
18	SambrookJF,Russell DW(2001).MolecularCloning:a LaboratoryManual.3rd edition.Cold SpringHarbor,N.Y.ColdSpringHarborLaboratoryPress
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20	SurzyckiS (2000).Basic techniquesinmolecularbiology.Springer.
21	Yılmaz M, Ozic C, Gok İ (2012). Principles of Nucleic Acid Separation by Agarose GelElectrophoresis. Gel Electrophoresis - Principles and Basics, Dr. Magdeldin S (Ed.), ISBN: 978-953-51-0458-2, InTech.http://www.intechopen.com/books/gel-electrophoresis-principles-Andbasics

B.Sc. Semester–V

DisciplineSpecific Core CourseDSCC-11

Course Title:Food and dairy microbiology (Theory)

Course Code: 035MCB013

Type ofCourse	Theory /Practical	Credits	Instructionhou rperweek	TotalNo.ofLectu res/Hours /Semester	Durationof Exam	FormativeA ssessmentM arks	Summative assessment Marks	TotalMa rks
DSCC-11	**Theory**	**04**	**04**	**56hrs.**	**2hrs.**	**40**	**60**	**100**

Course Pre-requisite(s):

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

CO1. To understand the association of microbes in food and dairy, quality testing of food and dairy products
CO2. To understand the preservation and food safety protocols
CO3. To understand the methods of spoilage of food and the diseases associated with it
CO4. To learn the properties of milk and the types of preservation of milk.
CO5. To learn the human microbiota and its significance in Diet.

CONTENTS	56 Hrs
Unit I-Microbes and Food **Food as a substrate for microorganisms:** Intrinsic and extrinsic parameters affecting the growth of microbes. Microorganisms in food and their sources (molds, yeast and bacteria). **Food borne infections andIntoxication:**Causative agents, foods involved, symptoms and preventive measures for Salmonella, Shigella,*Yersinia enterocolitica, Staphylococcus, Clostridium. Salmonella, Bacillus cereus, Brucella, Listeria monocytogens,* Mycotoxin, Phycotoxins. **Fermented Food:** Fermented vegetable-sauerkraut, pickles. Meat- sausage. Beverages kombucha. Sourdough. Microbes as food- SCP, SCO. Neutrceuticals and Synbiotics.	**14 hrs**
Unit II-Spoilage of Food, Preservation and Food safety **Spoilage of Food :**Principles of food spoilage.Sources of food contamination, Types of spoilage. Spoilage of meat and poultry, Fish and sea foods. Spoilage cereals, fruits and vegetables. Spoilage of canned food. **Food Preservation**: Principles of food Preservation. Methods of preservation Physical (temperature, drying, irradiation), chemical (Class I and Class II). Bio preservation. Canning, Food Packaging- Types of packaging materials, properties and benefits. **Quality control in Food**-Food Sampling, preparation and handling, Surface and environmental monitoring in food industry, basic physical and chemical analysis of food, Microbiological analysis of food and food products, Rapid microbiological and molecular methods to detect food pathogens. **Food Sanitation and Safety:** Good Hygiene practices, GLP, GMP (Waste treatment disposal methods), Food Safety HACCP, FSSAI and Food safety and Standard act 2006, Food control agencies and their regulation.	**14hrs**

Unit III: Dairy Microbiology **History:** Introduction and Significance of Dairy microbiology, Hygienic milk production, Dairy associated microorganisms. Properties of milk. Types of milk- dried, liquid, condensed, Microorganisms associated with milk (beneficial and harmful) **Microbiology of milk:** Sources of contamination and spoilage of milk. Microbiological methods for milk testing in Diary Industry: Rapid platform tests (Organoleptic, COB, alcohol test, Phosphatase test, DMC, sedimentation test.). Reductase tests. SPC. Biochemical changes of milk-souring, gassy fermentation, proteolysis, lipolysis, ropiness. Effect of processing on microorganisms in milk. **Preservation of milk:** Pasteurization. Dehydration, sterilization, Packing of milk and dairy products. Effect of processing on microorganisms in milk. **Dairy products:** Therapeutic value ofYoghurt and Butter milk, Cheese (Types and production), Tofu, Yoghurt, Acidophilus milk. Prebiotics, Probiotics. Starter culture types and role (single, mixed). Antimicrobial substances in milk.	15 hrs
Unit IV: Human Microbiome and Diet **Human Microbiome:** Definition, origin, formation, development, structure and functions of human microbiome and its evolution. Factors affecting microbial diversity and functions of microbiome: -age, genetics, environment, diet, anatomy, physiology, immunity, and psychology of host(human). Dynamics microbiome changes from birth to death; pregnancy and the microbiome; personnel microbiome concepts. Geography, Ethnicity -Specific Variations in Human microbiome. “diseases of civilization” -allergies, diabetes, asthma, obesity, inflammatory bowel disease. Debate on “nature” vs. “nurture”. Biodiversity and major genera of human microbiome, human microbiome system as a "holobiont" or "superorganism” microbiome distributions in healthy Individuals- hands, neck, scalp, axilla, groin, toes, ear; anterior nares, oral cavity, throat, stomach, small intestine and large intestine and birth canal. **Human Diet and Microbiota**: Microbiome vs microbiota; microbiota development and functions in early life; Microbiota transmission-pregnancy, birth and postnatal. Microbiota perturbations: medical practices, hygiene and antibacterials. Nutritional modulation of the gut microbiome for metabolic health- animal models, human obesity, human type 2 diabetes, life longevity.	

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: Food and dairy microbiology

Course Code: 035MCB014

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**

ContentsofPractical
1. Standard procedures for food sampling, preparation and handling in food industry. 2. Standard procedures surface and environmental monitoring in food industry. 3. Isolation and enumeration of Aerobic Plate count and yeast and moulds from infected fruits and vegetables, ready to eat and cooked foods and fermented foods. 4. Enumeration of *E.coli, S.aureus, Salmonella, Shigella* and *Bacillus cereus*form ready to eat/cooked food using selective culture medias. 5. Reductase tests-MBRT, Resazurin and Litmus milk test. 6. Estimation of Titrable acidity in milk. 7. Estimation of Fat - Gerber's method 8. Bacterial examination of milk by SPC, DMC 9. Estimation of lactose in milk 10. Production of fermented foods 11. Detection of Mastitic milk. 12. Visit to Food and Milk processing, alcoholic beverage Industries and report should be written and submitted along with the practical record.

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	Adams,M.Rand Moss,MO. 1995.Food Microbiology.TheRoyalSociety ofChemistry,Cambridge.
2	James.M.Jay, 1992,Modernfood microbiology4ed.
3	Frazier W.C. and Westhoff C.D. 2008 Food Microbiology. Tata McGraw Hill Publishing CompanyLimited,New Delhi,India.
4	DoyleM.P.andBeuchatL.R.(2007).FoodMicrobiology-Fundamentals.Frontiers,ASMPress.
5	Garbutt J. (1997). Essentials of Food Microbiology, Armold- International Students edition,London.8. Marriott N. G. and Gravani R. B. (2006).
6	PrinciplesofFoodSanitation,FoodSciencetextSeries,Springer International,NewYork,USA.
7	ThomasJ.,Matthews,Karl;Kniel,KalmiaE(2017),FoodMicrobiology:AnIntroduction,AmericanSociety for (ASM).
8	DeakT.andBeuchatL.R.(1996).HandBookof FoodSpoilageYeasts,CRCPress,NewYork.

B.Sc. Semester–V

Skill Enhancement Course: SEC-3

Course Title:Microbial quality control in food and pharma industries

Course Type: SEC-3

Course Code:035MCB061

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.

Contents

1. SOP for Swab and food sampling, handling and homogenization in food industry.
2. Guidelines and procedure for GLP, GMP and GDP in quality control food and pharma industries.
3. Procedure for cleaning, disposal, decontamination, sanitation, fumigation and sterility in Microbiology laboratory.
4. Monitoring and validation of autoclave process bychemical and biological indicators in quality control microbiology.
5. Media preparation and its importance of media in pharmaceutical and food industries.
6. Pure cultures maintenance techniques in quality control microbiology.
7. Growth Promotion Test (GPT) to verify the fertility of culture media.
8. Physical and chemical analysis of raw water used in food and pharma industries.
9. Enumeration of Total Viable Count (TVC), Total Yeast and Mould Count (TYMC) and specified pathogens by membrane filtration techniques in pharma industries.
10. Enumeration of Total Coliforms and E.coli form drinking, raw and DM water by membrane filtration techniques.
11. Environmental monitoring of Surface and personal hygiene swabs in industries.
12. Perform BET and MLT sterility tests.
13. Visit to Pharma, Food and food processing, alcoholic beverage industries. Tour/Project Report should be submitted.

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. Baird, R. M., Hodges, N. A. and Denyer, S. P. (2005). Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.
2. Garg, N., Garg, K. L. and Mukerji, K. G. (2010). Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
3. Harrigan, W. F. (1998). Laboratory Methods in Food Microbiology, 3rd ed. Academic Press.
4. Jay, J. M., Loessner, M. J., Golden, D. A. (2005). Modern Food Microbiology, 7th edition. Springer.

B.Sc. in MICROBIOLOGY

VI Semester

W. e. f.: 2023-24

B.Sc. Semester–VI

DisciplineSpecific Core Course(DSCC)-13

Course Title:Immunology and medical microbiology

Course Code:036MCB011

Type ofCourse	Theory /Practical	Credits	Instructionhou rperweek	TotalNo.ofLectu res/Hours /Semester	Durationof Exam	FormativeA ssessmentM arks	Summative assessment Marks	TotalMa rks
DSCC-13	**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. Demonstratecomprehensionoftheunderlyingstructureandfunct ionoftheimmunesystemandrelateddisorders.
2. Demonstrate an understandingof theroleof cells andmolecules inimmunereactionsandresponses
3. Demonstratetechnicalskillsinimmunologicaltoolsandtechniques
4. Applythedomain-specificknowledgeandskillsacquiredinimmunologyforinnovati vetherapiesandImmunotechnologies
5. Understandthefundamentalconceptsofimmunity,and thecontributionsoftheorgansandcellsinimmuneresponses.
6. RealizehowtheMHCmolecule'sfunctionandhostencountersanimmuneinsult.
7. Understandtheantibodiesandcomplementsystem
8. Understandthemechanismsinvolvedintheinitiationofspecificimmuneresponses
9. Differentiatethehumoralandcell-mediatedimmunemechanisms
10. Comprehendtheoverreactionbyourimmunesystemleadingtohypersensitivecon ditionsand itsconsequences
11. Understanduniquepropertiesofcancercells,immunerecognitionoftum ors,immuneevasion ofcancers

Contents	**56Hrs**
UNIT-I **Normal microflora of the human body and host pathogen interaction** History and scope and development of Medical Microbiology, Normal microflora of the human body:Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract,urogenital tract. Microbiome in early life, factors affecting intestinal microflora. Outline of Dysbiosisand diseases. Host pathogen interaction: Definitions - Infection, Invasive and non-Invasive. Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS. Sample collection, transport and diagnosis.**Antibacterial agents**: General characteristics and mode of action Antibacterial agents: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism **Antifungal agents**: Mechanism of action of Amphotericin B, Griseofulvin **Antiviral agents**: Mechanism of action of Amantadine, Acyclovir, Azidothymidine .	**14hrs.**
UNIT-II	**14Hrs**
Medical Bacteriology The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control **Respiratory diseases**: *Streptococcus pyogenes, Mycobacterium tuberculosis* **Gastrointestinal Diseases**: *Escherichia coli, Salmonella typhi, Vibrio cholerae,* Others: *Staphylococcus aureus, Bacillus anthracis, Clostridium tetani* **Medical Virology, parasitology and Mycology** The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control **Viral Disease** : Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Corona, Influenza, swine flu, Ebola, Chikungunya, Japanese Encephalitis **Protozoan diseases**: Malaria, Kala-azar, Entamoeba **Fungal infections**- Cutaneous mycoses: Tinea, pedis (Athlete's foot) Systemic mycoses: Histoplasmosis Opportunistic mycoses: Candidiasis	
UNIT-III	**14Hrs**
Historical perspective and scope of immunology; Edward Jenner, Luis Pasteur, types of Immunity; Natural (active and passive) and artificial (active and passive) with example Innate and acquired, Humoral and cell mediated immunity.Immunological memory, Major Histocompatibility complex,outline of AutoimmunityClonal selection theory, Immunological tolerance **Cells, tissue and organs of immune system**: Hematopoiesis, cytokines, properties and functions of B and T Lymphocytes, Natural killer (NK) cells, Granulocytes (Neutrophils, Eosinophils and Basophils), Monocytes and macrophages, Dendritic cells and Mast cells. **Primary lymphoid organs**; Bone marrow and Thymus. **Secondary lymphoid organs and tissues**; Spleen and Lymph nodes, payers patches, MALT **Complement system**: Functions of complement components, Complement activation by classical, alternative and lectin pathway to develop membrane attack complex (MAC).	

UNIT-IV	14Hrs
Antigen: Immunogenicity and antigenicity, epitopes, haptens. Properties of antigen contribute to immunogenicity; Chemical nature (proteins, carbohydrates, lipids and nucleic acids), degree of foreignness, molecular weight, chemical composition and complexity, degradability. Adjuvants (alum, freunds incomplete and complete) and their importance. B and T cell epitopes. **Antibody**: Basic structure of antibody, light and heavy chain, variable and constant region, hinge region, Fab and Fc. Structure and functions of different types of antibodies (IgM, IgG, IgA, IgE, and IgD). Antigenic determinants on immunoglobulins: Isotype, allotype and idiotype. Monoclonal antibody production by hybridoma technology **Principles and applications of antigen-antibody interactions**: Definition of affinity and avidity. Immunoprecipitation; Radial (Mancini) and double (Ouchterlony) immunodiffusion. **Agglutination reactions:** Hemagglutination, Bacterial agglutination, passive agglutination, and agglutination inhibition. Enzyme linked immune-sorbent assay (ELISA): Direct, indirect, sandwich and competitive ELISA. Radioimmunoassay (RIA). Immunofluorescence. Complement mediated opsonization, complement fixation test. **Hypersensitive reactions:** Classification, Humoral Immunity mediated hypersensitivity; Type I (IgE), Type II (IgG and IgM-ADCC), Type III (Antigen-antibody complex), and Cell mediated hypersensitivity TypeIV (DTH).	

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 and medical microbiology

Course Code: 036MCB012

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	Identify pathogenic bacteria (any three of *E. coli*, *Salmonella*, *Pseudomonas*, *Staphylococcus*and *Bacillus*) on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, H_2S production, Nirate reduction, Urease production and catalase tests.
2	Study of composition and use of important differential media for identification of pathogenic bacteria: EMB Agar, MacConkey agar, Mannitol salt agar,Deoxycholate citrate agar, TCBS, Cetrimide agar.
3	Study of bacterial flora of skin by swab method
4	Perform antibacterial sensitivity by Kirby-Bauer method (Disk/well and MIC)
5	Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, HPV warts, AIDS (candidiasis), dermatomycoses (ring worms)
6	Study of various stages of Malarial parasite in RBCs using permanent mounts.
7	Identification of human blood group and calculation of allelic frequency.
9	Perform Differential Leukocyte Count of the given blood sample.
10	Separation of serum from the blood sample (demonstration).
11	Perform immunodiffusion by Ouchterlony method.
12	Perform DOT ELISA.
13	Perform immune electrophoresis.

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	Ananthanarayan R and Paniker C.K.J (2009) Textbook of Microbiology, 8th Edition, University Press, Publication.

2	Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3	Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4	Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
5	Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition
6	Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
7	Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition Wiley- Blackwell Scientific Publication, Oxford.
8	Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
9	Murphy K, Travers.P,Walport M. (2008).Janeway's Immunobiology.7th edition Garland Science,Publishers,New York.
10	Peakman.M.and Vergani D. (2009).Basic and Clinical Immunology,2nd edition Churchill ,Livingstone Publishers, Edinberg.
11	Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

B.Sc. Semester–VI

Discipline Specific Core Course(DSCC)-15

Course Title: Genetic engineering and industrial microbiology

Course Code:036MCB013

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. Presentknowledgeaboutmajormetabolicpathwaysandthoserelatedtobiofuelproducti onfrommicrobes.
4. UnderstandthefundamentalconceptsandprinciplesofenvironmentalMICROBIOLOGYandEx ploretheinterrelationshipbetweenMICROBIOLOGYandtheenvironment.
5. Gainknowledge ofthe variousapplications ofMICROBIOLOGY inenvironmentalconservation, pollutioncontrol,andsustainability.
6. Learnaboutmicrobialprocessesandtheirroleinenvironmental MICROBIOLOGY.
7. Understand theprinciples ofbioremediation andits applicationin theclean-up ofenvironmentalpollutants.
8. Explorethepotentialofbioenergyproductionandwastemanagementthroughbiotech nologicalapproaches.
9. IdentifyandcharacterizethemostimportantcontaminantsintheBioprocessandotherindus trialwastes.
10. Reuse/recyclethebiologicalwastetocleantechnologysuchasenergy,biofuel,biofertili zerthrough bioremediation

Courseoutcomes:

1. Exploitation of microorganisms for industrial use and their improvement,andformulationofmediaforefficientgrowthandproduction ofmicrobialorcell-based products.
2. Thedesign,operation,andspecificapplicationsofvariousbioreactors.
3. Demonstrateacomprehensiveunderstandingofthefundamentalconceptsandp rinciplesofenvironmentalMICROBIOLOGY.
4. Applyknowledgeofbiotechnologicaltechniques to addressenvironmentalchallenges,suchaspollutioncontrolandwastemanage ment.
5. AnalyzeandevaluateenvironmentalMICROBIOLOGYcasestudies,research findings,andreal-worldapplications.
6. Designandimplementbiotechnologicalapproachesforenviron mentalremediation,utilizingmicrobialprocessesandbiodegradat ionprinciples.
7. Evaluate the ethical and sustainable aspects of environmental MICROBIOLOGYpractices andmake informed decisions regarding their application inenvironmentalconservation.
8. Communicate scientific concepts and research findings related

toenvironmentalMICROBIOLOGY effectively, both in written and oralforms,todiverseaudiences.

GENETIC ENGINEERING AND INDUSTRIAL MICROBIOLOGY Contents	
Unit I: Introduction and tools of Microbial Genetic Engineering	14Hrs
Historical prospective: Definition of genetic engineering, milestones in genetic engineering, prospects and problems of genetic engineering. Tools in Microbial Genetic Engineering: Restriction modification systems- Types, Mode of action, nomenclature, applications of restriction enzymes in genetic engineering. DNA modifying enzymes and their applications: DNA polymerases, Methylases, Terminal deoxynucleotidyl transferase, kinases and phosphatases and DNA ligases. Cloning Vectors: Definition and Properties. Characteristics of cloning vectors. Plasmid vectors: pBR and pUC series. Bacteriophage lambda, cosmids, BACs, YACs. Use of linkers and adaptors. Expression vectors: Baculovirus based vectors, mammalian SV40-based expression vectors. Cloning host- Cloning in Escherichia coli, cloning in Saccharomyces cerevisiae,	
Unit II: Techniques and applications in Microbial Genetic Engineering	14 Hrs
Gene Library: Construction of cDNA library, genomic library. DNA transfer methods: Microinjection, Biolistic, Electroporation, Calcium phosphate and Liposome mediated DNA transfer. Identification and selection of recombinants: DNA hybridization, blue white selection, antibiotic selection, colony and plaque hybridization. Isolation and Detection of DNA: Isolation of DNA, restriction digestion and ligation of DNA, Agarose gel electrophoresis, Blotting techniques- Southern blotting, Northern blotting, dot blot, DNA microarray analysis, Western blotting. DNA sequencing- Sanger's method. PCR techniques and applications. Recombinant microorganisms: Application of recombinant microorganisms in basic research, industry, medicine, agriculture, environment. Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH, antisense molecules. Bt transgenic - cotton, brinjal, Gene therapy, recombinant vaccines. Biological, ethical and social issues of gene cloning and IPR.	
Unit III: Introduction to Industrial Microbiology	14 Hrs
Introduction to Industrial microbiology:History, scope and development of industrial microbiology. Isolation and screening (Primary and Secondary) of industrially important microorganisms, Strain improvement methods.Preservation of industrially important microbes.Basic features; design and components of a bioreactor, Specialized bioreactors and their applications: tubular bio reactors, fluidized bed reactor, packed bed reactors, membrane bioreactors, Photo-bioreactors and anaerobic bioreactors. Role of industrial microorganisms for ecovery of Minerals (Bioleaching) and Petroleum (Microbial Enhanced Oil Recovery-MOER). Role of microbes in production of biofuel by bacteria, algae and fungi.	
Unit IV: Fermentation Process and Scale up Fermentation Process:Types of fermentation process: Submerged fermentation, Solid state fermentation (Koji), batch fermentation, continuous fermentation, kinetics of fermentation process. Inoculum preparation. Media components and formulation (Crude media components, Anti-foam agents, Precursors, Inducers, Inhibitors and Buffering agents).Sterilization of media and raw materials and maintenance of Sterility at critical points during fermentation. Scale up of Fermentation: Upstream and Downstream processing,Objectives and significance of downstream processing: Overview of steps in extraction and purification ofproducts (Antibiotic, Enzyme, Hormones, Anti-cancerous compounds); Precipitation Filtration and centrifugation; cell disruption- Physical, chemical and biological methods; Product extraction; product purification, recovery drying, crystallization and product testing. Merits and demerits. Immobilization of cells and enzymes –Types, advantages and applicationsin fermentation industry.	

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: Genetic engineering and industrial microbiology

Course Code: 036MCB014

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. Preparation of buffers-TE, TAE and Lysisbuffer.
2. Isolation of genomic DNA from ***Escherichia coli***.
3. Preparation of master and replica plates.
4. Designing of primers for DNA amplification.
5. Demonstration of amplification of DNA by PCR(By chart).
6. Demonstration of southern, western and northern blotting techniques (By chart).
7. Preparation of wine from different fruits an Estimation of Alcohol by Specific gravity method.
8. Production and estimation of citric acid by *Aspergillus brasilensis*
9. Production of enzyme (amylase/protease/cellulose /invertase by submerged fermentation).
10. Production and estimation of any one secondary metabolite.
11. Immobilization of cells and enzymes by solid entrapment.
12. Preservation of microbes with glycerol/soil/oil/sand.
13. Visit to Molecular biology laboratories, Research institutes, Sugar Distillery, Alcoholic beverages industry and report should be written and submitted along with the practical record.

1.

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	Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA

2	Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
3	Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.
4	Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings
5	Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press
6	Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
7	Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed., Benjamin Cummings Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education.

Microbiology InternshipforgraduateProgramme

Coursetitle	**InternshipDisciplinespecific**
Course code	036MCB091
Noofcontacthours	**56**
Nocredits	**2**
Methodofevaluation	**Presentations/Reportsubmission/Both**

ProjectAssessment

Type ofCourse	Theory /Practical	Credits	Instructionhour/week	TotalNo.ofLectures/Hours /Semester	Durationof Exam	FormativeAssessmentMarks	Summative assessment Marks	TotalMarks
Internship-1	**Practical**	**02**	**04**	**56 hrs.**	**3hrs.**	**50**	**0**	**50**

- Internship shall be Discipline Specific of 56 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 Microbiology 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