RANI CHANNAMMA UNIVERSITY BELAGAVI

REVISED CURRICULUM FRAMEWORK FOR UNDER GRADUATE COURSE

STRUCTURE & SYLLABUS OF BACHELOR OF

SCIENCE

BIOTECHNOLOGY

1ST TO 2ND Semesters

w.e.f.

Academic Year 2024-25 and Onwards

Submitted by

Chairman,
Board of Studies (UG),
Bachelor of Science,
Rani Channamma University, Belagavi.

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RANI CHANNAMMA UNIVERSITY, BELGAVI

VIDYASANAGAMA

Accredited with B+ Grade by NAAC

FACULTY OF SCIENCE : DEPARTMENT OF BIOTECHNOLOGY

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Board of Studies in Biotechnology

Sl. No.	Name and Address	Designation
01	Prof. Basavaraj Padmashali Department of Chemistry Rani Channamma University Belagavi-591156	Chairman
02	Asst.Prof.(Smt).Ambruta Sane B.K.College, Belagavi	Member
03	Asst.Prof.(Smt). Danamma Shettar R.L.Science Institute Belagavi	Member

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RANI CHANNAMMA UNIVERSITY, BELGAVI

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FACULTY OF SCIENCE : DEPARTMENT OF BIOTECHNOLOGY

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COURSE STRUCTURE FOR B.Sc. PROGRAMME

Semester	Subjects	Teaching Hours/week	Duration of Exams	Marks			Credits
				IA	Exam	Total	
1	Major1 Theory	04	03	20	80	100	03
	Major1 Practical	04	04	10	40	50	02
	Major2 Theory	04	03	20	80	100	03
	Major2 Practical	04	04	10	40	50	02
	Major3 Theory	04	03	20	80	100	03
	Major3 Practical	04	04	10	40	50	02
	Language1	04	03	20	80	100	03
	Language2	04	03	20	80	100	03
	Compulsory-1	02	02	10	40	50	02
2	Major1 Theory	04	03	20	80	100	03
	Major1 Practical	04	04	10	40	50	02
	Major2 Theory	04	03	20	80	100	03
	Major2 Practical	04	04	10	40	50	02
	Major3 Theory	04	03	20	80	100	03
	Major3 Practical	04	04	10	40	50	02
	Language1	04	03	20	80	100	03
	Language2	04	03	20	80	100	03
	Compulsory-2	02	02	10	40	50	02
Total							**46**

First Semester B.Sc. Biotechnology Theory

Paper Title: Cell Biology and Genetics	**Marks: Th-80+IA-20**
Paper Code : SEPBSBT01	**Total hours: 60**
Teaching Hours: 4 Hours/Week	**Credits : 03**

UNIT-I: Introduction to Cell and Cellular organelles	**15 Hours**

Concept, Development and Scope of Biotechnology. Historical perspectives. Discovery of cell, the cell Theory, Ultra structure of a eukaryotic cell- (Both plant and animal cells).

Surface Architecture: Structural organization and functions of plasma membrane and cell wall of eukaryotes.

Cellular Organelles: Structure and functions of cell organelles – Endoplasmic reticulum, Golgi complex, Mitochondria, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus (Nuclear envelope with nuclear pore complex, Nucleolus, Nucleoplasm and Chromatin). Vacuole, Cytosol and Cytoskeleton structures (Microtubules, Microfilaments and Intermediate filaments).

Cell study techniques. Fixatives, Principles of staining, Types of stains, Auxochromes

UNIT-II : Study of cell cycle and Cell Division	**15 Hours**

General Introduction, Discovery, Morphology and structural organization – Centromere, Secondary constriction, Telomere, Chromonema, Euchromatin and Heterochromatin, Special type of chromosomes: Salivary gland and Lampbrushchromosmes.

Cell Division: Cell cycle, phases of cell division. Mitosis and meiosis, regulation of cell cycle ,cell cycle checkpoints and enzymes involved in regulation, Significance of cell cycle, Cell Senescence and programmed cell death.

Cell Signaling: Cell to cell signaling, endocrine signaling, intercellular signaling and signal peptides.

UNIT-III: History of Genetics	**15 Hours**

Introduction and brief history of genetics. Mendelian theory: Laws of inheritance- dominance, segregation, incomplete dominance, codominance with an example. Law of independent assortment, test cross, back cross. Deviations to Mendelian inheritance, complementary, supplementary and interaction of genes (13:3 ratio).

Maternal Inheritance: Plastid inheritance in Mirabilis, Petite characters in yeast and Kappa particles in paramecium, Sex-linked inheritance, Chromosome theory of inheritance.

Gene interaction: Supplementary factors: comb pattern in fowls, Complementary genes- Flower colour in sweet peas, Multiple factors–Skin colour in human beings, Epistasis– Plumage colour in poultry, Multiple allelism: Blood groups in Human beings.

UNIT-IV: Linkage and Crossing Over	**15 Hours**

Introduction, Coupling and repulsion hypothesis, Linkage in maize and Drosophila, Mechanism of

crossing over and its importance, chromosome mapping-linkage map in maize.

Mutations: Types of mutations, Spontaneous and induced, Mutagens: Physical and chemical, Mutation at the molecular level, Mutations in plants, animals and microbes for economic benefit of man.

Chromosomal variations: A general account of structural and numerical aberrations,chromosomal evolution of wheat and cotton.

Human Genetics: Karyotype in man, inherited disorders – Allosomal (Klinefelter syndrome and Turner'ssyndrome), Autosomal (Down syndrome and Cri-Du-Chat Syndrome).

Reference:

1. Molecular Biology of Cell - Bruce Alberts et al, Garland publications.
2. Animal Cytology and Evolution- MJD, White Cambridge University Publications
3. Molecular Cell Biology-Daniel, Scientific American Books
4. Cell Biology - Jack d Bruke, The William Twilkins Company
5. Principles of Gene Manipulations- Old & Primrose, Black Well Scientific Publications
6. Cell Biology-Ambrose &Dorothy M Easty, ELBS Publications
7. Fundamentals of Cytology- L. W. Sharp, McGraw Hill Company
8. Cytology-Willson&Marrison, Reinform Publications
9. Molecular Biology- Christopher Smith, Faber & Faber Publications
10. Cell Biology & Molecular Biology – EDP De Robertis& EMF Robertis, Saunder College.
11. Cell Biology- C.B Powar, Himalaya Publications
12. Basic Genetics- Daniel L. Hartl, Jones &Barlett Publishers USA
13. Human Genetics and Medicine lark Edward Arnold P London
14. Genetics – Monroe W Strickberger, Macmillain Publishers, New York
15. Genes V - Benjamin Lewin, Oxford University Press.
16. Genes I - Benjamin Lewin, Wiley Eastern Ltd., Delhi
17. Genes II - Benjamin Lewin, Wiley & Sons Publications
18. Genes III- Benjamin Lewin, Wiley & Sons Publications
19. Principles of Genetics- Sinnott, L.C. Dunn, Dobzhansky, McGraw-Hill.
20. Genetics – Edgar Altenburg Oxford & IBH publications
21. Principles of Genetics – E.J. Gardener, M.J. Simmons and D.P. Snustad, John Wiley & Son Publications
22. Genetics- P.K.Gupta, Rastogi Publication, Meert, India

First Semester B.Sc. Biotechnology Practicals

Paper Title: Cell Biology and Genetics	**Marks: Th-80+IA-20**
Paper Code : SEPBSBTP01	**Total hours: 60**
Teaching Hours: 4 Hours/Week	**Credits : 02**

Practical: Cell Biology and Genetics

1) Study and maintenance of simple and compound microscope.
2) Study of fixatives and stains: Preparation of formaldehyde (4-10%), Alcohol (70%), Bouin's fixatives, Carnoy's solution, Borox carmine (alcoholic), Eosin (alcoholic), Iron (Haematoxylin). Leishman's Stain, Ringer's Solution, Acetocarmine, Acetoorcein,Schiff's reagent (Feulgen), Giemsa's stain.
3) Use of Micrometer and calibration, measurement of onion epidermal cells and yeast.
4) Study of divisional stages in mitosis from onion root tips.
5) Study of divisional stages in meiosis in grasshopper testes/onion orRhoeo flower buds.
6) Mounting of polytene chromosomes.
7) Buccal smear - Barr bodies.
8) Isolation and staining of Mitochondria.
9) Isolation and staining of Chloroplast.
10) Simple genetic problems based on theory.

Examination

In the practical examination, in a batch at least 15 (Fifteen) students may be made. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:

Major Question	15 Marks
Miner Question	10 Marks
Comment and Identify	05 Marks
Journal	05 Marks
Viva Voce	05 Marks
Total	40 Marks

Second Semester B.Sc. Biotechnology Theory

Paper Title: Microbiological Methods	**Marks: Th-80+IA-20**
Paper Code : SEPBSBTTT02	**Total hours: 60**
Teaching Hours: 4 Hours/Week	**Credits : 03**

UNIT-I: Bio analytical techniques	**15 Hours**

Microscopy: Principles of Microscopy- resolving power, numerical aperture, working principle and applications of Compound microscope, Dark field microscope, Phase contrast microscope, Fluorescence Microscope, confocal microscope, Electron Microscopes- TEM and SEM.

Analytical techniques: Working principles and applications : Centrifuge, Ultracentrifuge, Spectrophotometer, Colorimeter, Chromatography (Paper chromatography and TLC)

Spectroscopy: Introduction, **UV spectroscopy (** Principle and working procedure).

UNIT-II: Sterilization and Microbial techniques	**15 Hours**

Definition of terms-sterilization, disinfectant, antiseptic, sanitizer, germicide, microbicidal agents, microbiostatic agent and antimicrobial agent.

Physical methods of control: Principle, construction and applications of moist heat sterilization Boiling, Pasteurization and autoclave. Dry heat sterilization-Incineration and hot air oven. Filtration :membrane filter and HEPA ;

Radiation : Ionizing radiation-γ rays and non ionizing radiation- UVrays

Chemical methods: Alcohol, Aldehydes, Phenols, Halogen, Metallic salts.

Microbiological techniques

Culture Media: Components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media

Pure culture methods: Serial dilution and plating methods (pour, spread, streak); cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria

Stains and staining techniques: Principles of staining, Types of stains-simple stains, structural stains and differential stains.

UNIT-III: Ultra structure of Microorganisms and microbial diseases and Antimicrobial agents	**15 Hours**

Ultra structure of Bacteria(*E. coli*), Virus(Bacteriophage and TMV), and Fungi (Penicillin).

Microbial Diseases and disease epidemiology

Causes, Mode of transmission, Symptoms, treatment and prevention of,

a. Bacterial diseases: Tetanus, Tuberculosis, Cholera and Typhoid.
b. Viral diseases: AIDS(HIV), COVID-19
c. Fungal diseases: Candidiasis, White blister

Antimicrobial agents

Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin
Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine
Antibiotic resistance, MDR, XDR, MRSA, NDM-1
Antibiotic sensitivity testing methods: Disc and Agar well diffusion techniques

UNIT-IV: Microbial spoilage of Food	**15 Hours**

Concepts of food and nutrients - Physicochemical properties of foods - Food and microorganisms – Importance and types of microorganisms in food (Bacteria, Mould and Yeasts) - Sources of contamination- Factors influencing microbial growth in food – pH, moisture, Oxidation-reduction potential, nutrient contents and inhibitory substances.
Food preservations: principles- methods of preservations-Physical and chemical methods- food sanitations- Quality assurance: Microbiological quality standards of food. Government regulatory practices and policies. FDA, EPA, HACCP, ISI. HACCP – Food safety- control of hazards.

References

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T. Brown Publishers.
2. Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall
3. Madigan MT, and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th edition. Parker J. Prentice Hall International, Inc.
4. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology.
5. 5th edition Tata McGraw Hill.
6. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht
7. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.
8. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition Pearson Education.
9. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
10. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited
11. Microbiology- Concepts and applications by Paul A. Ketchum, Wiley Publications
12. Fundamentals of Microbiology –Frobisher, Saunders & Toppan Publications
13. Introductory Biotechnology-R.B Singh C.B.D. India (1990)
14. Fundamentals of Bacteriology - Salley
15. Frontiers in Microbial technology-P.S. Bison, CBS Publishers.

Second Semester B.Sc. Biotechnology Practical's

Paper Title: Microbiological Methods	**Marks: Th-80+IA-20**
Paper Code : SEPBSBTP02	**Total hours: 60**
Teaching Hours: 4 Hours/Week	**Credits : 02**

1. Standard Operating Procedures of Biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology and Biotechnology laboratory.

2. Preparation and sterilization of culture media for bacteria, fungi and their cultivation.

3. Sterilization of glasswares using Hot Air Oven and assessment for sterility

4. Sterilization of heat sensitive material by membrane filtration and assessment for sterility
5. Plating techniques: Spread plate, pour plate and streak plate.
6. Isolation of bacteria and fungi from soil, water and air

7. Colony characteristics study of bacteria from air exposure plate

8. Staining techniques: Bacteria– Gram, Negative, Capsule, Endospore staining
9. Fungi – Lactophenol cotton blue staining

10. Water analysis - MPN test

11. Biochemical Tests – IMViC, Starch hydrolysis, Catalase test, Gelatin hydrolysis

12. Bacterial cell motility - hanging drop technique

13. Visit to Microbiology Labarotary/Research Lab

Examination

In the practical examination, in a batch at least 15 (Fifteen) students may be made. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:

Major Question	15 Marks
Miner Question	10 Marks
Comment and Identify	05 Marks
Journal	05 Marks
Viva Voce	05 Marks
Total	40 Marks

QUESTION PAPER PATTERN

Title of the paper: **Time: 3 Hours**
Max. Marks: 80

Q. I Answer any TEN of the following 10X2=20

1.
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12

Q.II Answer any SIX of the following 5X6=30

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19
20

Q.III Answer any THREE of the following 3X10=30

21
22
23
24
25

Instructions to the Question paper setting

Q. I Three questions from each Unit
Q.II Two questions from each Unit
Q.III Q. 21 and 22 from Unit I
Q. 23 from Unit II
Q. 24 from Unit III
Q. 25 from Unit IV

RANI CHANNAMNA UNNERSITY, BELAGAVI

REVISED CURRICULUM FRAMEWORK FORUNDER GRADUATE COURSE

STRUCTURE & SYLLABUS OF BACHELOR OF SCIENCE

BIOTECHNOLOGY

3rd to 4th Semesters

w.e.f.

Academic Year 2025-26 and Onwards

RANI CHANNAMMAUNIVERSITY,BELGAVI
VIDYASANAGAMA

RANI CHANNAMMA UNIVERSITY,BELGAVI
VIDYASANAGAMA
Accredited **with B+ Grade** by **NAAC**

FACULTY OF SCIENCE: DEPARTMENT OF BIOTECHNOLOGY

COURSE STRUCTURE FOR B.Sc. PROGRAMME

Semester	Subjects	Teaching Hours/week	Duration of Exams	Marks			Credits
				IA	Exam	Total	
3	Major 1 Theory	04	03	20	80	100	03
	Major 1 Practical	04	04	10	40	50	02
	Major2 Theory	04	03	20	80	100	03
	Major2 Practical	04	04	10	40	50	02
	Major3 Theory	04	03	20	80	100	03
	Major3 Practical	04	04	10	40	50	02
	Language 1	04	03	20	80	100	03
	Language2	04	03	20	80	100	03
	Elective 1	02	02	10	40	50	02
	Skill-1	02	02	10	40	50	02
4	Major1 Theory	04	03	20	80	100	03
	Major 1 Practical	04	04	00	40	50	02
	Major2 Theory	04	03	20	80	100	03
	Major2 Practical	04	04	10	40	50	02
	Major3 Theory	04	03	20	80	100	03
	Major3 Practical	04	04	10	40	50	02
	Language 1	04	03	20	80	100	03
	Language2	04	03	20	80	100	03
	Elective 2	02	02	10	40	50	02
	Skill-2	02	02	10	40	50	02
Total							48

Third Semester B.Sc. Biotechnology Theory

Paper Title: Biomolecules	Marks: Th-80+IA-20
Paper Code:	Total hours:60
Teaching Hours: 4 Hours/Week	Credits:03

UNIT-I:	15 Hours

a)Carbohydrates:

Introduction, sources, classification of carbohydrates.
Structure,function and properties of carbohydrates.
Monosaccharide- Glucose
Oligosaccharides – Sucrose, Fructose, Maltose
Polysaccharides – Classification as homo and heteropolysaccharides,
Homopolysaccharides - storage polysaccharides (starch and glycogen), structural polysaccharides (cellulose and chitin-structure,properties),
Heteropolysaccharides – glycoproteins
Metabolism: Glycolysis and gluconeogenesis, Kreb's cycle, oxidative phosphorylation.

b)Amino Acids, Peptides and Proteins

Introduction, classification and structure of amino acids.
Essential and nonessential amino acids.
Classification of proteins based on structure and function,
Structural organization of proteins[primary, secondary , tertiary and quaternary].
Fibrous and globular proteins,
Denaturation and renaturation of proteins.

UNIT-II	15 Hours

a)Lipids

Properties, Classification and function of lipids,
Hydrogenation of fats and oils, Saturated and unsaturated fatty acids.
General structure and biological functions of - phospholipids, sphingolipids, glycolipids, lipoproteins, prostaglandins, cholesterol, Lipid metabolism.

b) **Enzymes**

Introduction, nomenclature and classification, enzyme kinetics, factors influencing enzyme activity, metalloenzymes. Coenzymes and their functions. Enzyme inhibition- Irreversible and reversible (competitive, non-competitive and uncompetitiveinhibition with an example each) Zymogens (trypsinogen, chymotrypsinogen and pepsinogen),clinical importance of enzymes.
Isozymes (LDH, Creatine kinase, Alkaline phosphatase and their clinical significance).

UNIT-III:	15 Hours

a) **Vitamins**

Water and fat soluble vitamins, dietary source and biological role of vitamins Deficiency manifestation of vitamin A, B, C, D, E and K

b) Nucleic acids

Types of Nucleic acid, DNA and RNA, DNA double helical model, Biological significance of DNA. RNA types and clover leaf model of t-RNA.

c) Hormones

Classification of hormones based on chemical nature and mechanism of action. Chemical structure and functions of the following hormones: Glucagon, Cortisone, Epinephrine, Testosterone.

UNIT-IV: **Bioanalytical tools :**

a) Chromatography :

Principle, procedure and applications of - Gel filtration chromatography, affinity chromatography, gas liquid chromatography and HPLC.

b) Electrophoresis:

Principle, procedure and applications of - paper electrophoresis, Agarose gel electrophoresis , SDS- PAGE .

a) Spectroscopy:

UV-Vis spectrophotometry; mass spectroscopy, atomic absorption spectroscopy.

References

1. An Introduction to Practical Biochemistry, 3rd Edition, (2001), David Plummer; Tata McGraw HillEdu.Pvt.Ltd. New Delhi, India
2. Biochemical Methods,1st Edition, (1995), S.Sadashivam, A.Manickam; New Age International Publishers, India
3. Introductory Practical biochemistry, S. K. Sawhney&Randhir Singh (eds) Narosa Publishing. House,New Delhi, ISBN 81-7319-302-9
4. Experimental Biochemistry: A Student Companion, BeeduSasidharRao& Vijay Despande(ed).I.KInternational Pvt. LTD, NewDelhi. ISBN 81-88237-41-8
5. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, LudhianaISBN 81-7663-067

Third Semester B.Sc. Biotechnology Practicals

Paper Title: Biomolecules	Marks:Th-40+IA-10
Paper Code :	Total hours:60
Teaching Hours:4 Hours/Week	Credits:02

Practicals: Biomolecules

1. Definitions and calculations: Molarity, Molality, Normality, Mass percent % (w/w), Percent by volume (% v/v), parts per million (ppm), parts per billion (ppb), Dilution of concentrated solutions. Standard solutions, stock solution, solution of acids. Reagent bottle label reading and precautions.
2. Preparation of standard buffers– Acetate, phosphate, Tris and determination of pH of solution using pH meter.
3. Qualitative analysis of Carbohydrates
4. Qualitative analysis of Proteins
5. Estimation of maltose by DNS method
6. Determination of α-amylase activity by DNS method
7. Estimation of proteins by Lowry's method
8. Estimation of amino acid by Ninhydrin method
9. Extraction of protein from soaked/sprouted green gram by salting out method
10. Separation of plant pigments by circular paper chromatography
11. Separation of amino acids by thin layer chromatography
12. Agarose gel electrophoresis.
13. Determination of iodine number of lipids

Examination

In the practical examination, in a batch at least 15 (Fifteen) students may be made.Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:

Major Question	15 Marks
Minor Question	10 Marks
Comment and Identify	05 Marks
Journal	05 Marks
Viva Voce	05 Marks
Total	40 Marks

Fourth Semester B.Sc. Biotechnology Theory

Paper Title: **Molecular Biology**	Marks: Th-80+IA-20
Paper Code:	Total hours:60
Teaching Hours: 4 Hours/Week	Credits:03

Unit–I - Molecular basis of life and Nucleic Acids	15 Hours
An introduction to DNA and RNA, Experimental proof of DNA as genetic material(Griffith's transformation experiment, Avery, MacLeod and McCarty's Experiment, Hershey and Chase's Experiment) .Structure of DNA(Nucleosome model), Watson and Crick model of DNA, forms(types) of DNA, types of RNA, functions of DNA and RNA.	
Unit -II - DNA Replication and Repair	15Hours
Replication of DNA in prokaryotes and eukaryote– Enzymes and proteins involved in replication, Theta model, linear and rolling circle model. Polymerases and all enzyme components. The replication complex: Pre-primming proteins, primosome, replisome, unique aspects of eukaryotic chromosome replication, Fidelity of replication. DNA damage and Repair mechanism: photo reactivation, excision repair, mismatch repair and SOS repair.	
Unit -III - Transcription and RNA processing	15 Hours
Central dogma, RNA structure and types of RNA, Transcription in prokaryotes RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains. Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.	
Unit –IV - Regulation of gene expression and translation	15 Hours
Genetic code and its characteristics, Wobble hypothesisTranslation- in prokaryotes and eukaryotes-ribosome, enzymes and factors involved in translation. Mechanism of translation- activation of amino acid, aminoacyl tRNA synthesis, Mechanism- initiation, elongation and termination of polypeptide chain. Fidelity of translation, Inhibitors of translation. Protein folding and modifications, Post translational modifications of proteins.	

References

1. Glick, B.R and Pasternak J.J (1998) Molecular biotechnology, Principles and application of recombinant DNA, Washington D.C. ASM press
2. Howe. C. (1995) Gene cloning and manipulation, Cambridge University Press, USA
3. Lewin, B., Gene VI New York, Oxford University Press
4. Rigby, P.W.J. (1987) Genetic Engineering Academic Press Inc. Florida, USA
5. Sambrook et al (2000) Molecular cloning Volumes I, II & III, Cold spring Harbor Laboratory PressNew York, USA
6. Walker J. M. and Ging old, E.B. (1983) Molecular Biology & Biotechnology (Indian Edition) RoyalSociety of Chemistry U.K
7. Karp. G (2002) Cell & Molecular Biology, 3rdEdition, John Wiley & Sons;

Fourth Semester B.Sc.Biotechnology Practicals

Paper Title: **Molecular Biology**	Marks:Th-40+IA-10
Paper Code :	Total hours:60
Teaching Hours:4 Hours/Week	Credits:02

Practicals: Molecular Biology

1. Preparation of DNA model
2. Estimation of DNA by DPA method
3. Estimation of RNA by Orcinol method
4. Column chromatography – gel filtration (Demo)
5. Extraction and partial purification of protein from plant source by Ammoniumsulphate precipitation.
6. Extraction and partial purification of protein from animal source by organic solvents.
7. Protein separation by SDS-Polyacrylamide Gel Electrophoresis (PAGE)
8. Charts on- Conjugation, Transformation and Transduction, DNA replication,Types of RNA

Examination

In the practical examination, in a batch at least 15 (Fifteen) students may be made.V iva questions may be asked on any of the experiments prescribed in the practical sy llabus.

Distribution of Marks:

Major Question	15 Marks
Minor Question	10 Marks
Comment and Identify	05 Marks
Journal	05 Marks
Viva Voce	05 Marks
Total	**40 Marks**

Third Semester B.Sc. Biotechnology
Elective-1

Paper Title: Biotechnology for Human Welfare	Marks: Th-40+IA-10
Paper Code:	Total hours:30
Teaching Hours: 2 Hours/Week	Credits:02

UNIT-I:	15 Hours
Industry Application of biotechnology in industry: Industrial production of alcoholic beverage (wine), antibiotic (Penicillin), enzyme (lipase) Protein engineering applications in food, detergent and pharmaceutical industry, **Environment** Application of biotechnology in Environmental aspects Bioremediations and its types, waste water treatment, Bio Fuels, Phytoremediation	
UNIT-II	16 Hours
Forensic Science Application of biotechnology in forensic science: Solving crimes of murder and rape; solving claims of paternity and theft by using DNA finger printing techniques **Agriculture** Agricultural Biotechnology Concepts and scope of biotechnology in Agriculture. Planttissue culture, micro propagation, entreprencurship incommercial plant tissue culture. Banana tissue culture-primary and secondary commercial setups, Small scale bioenterprises:Mushroom cultivation.	

Fourth Semester B.Sc. Biotechnology Elective-2

Paper Title: Biotechnology for Human Welfare	Marks: Th-40+IA-10
Paper Code:	Total hours:30
Teaching Hours: 2 Hours/Week	Credits:02

UNIT-I:	15 Hours
Health Application of biotechnology in health: Genetically engineered insulin, recombinant vaccines, Edible vaccines, gene therapy, molecular diagnostics using ELISA,PCR; monoclonal antibodies and their use in cancer; human genome project Pharmacogenomics	
UNIT-II	15 Hours
Transgenic plants The GM crop debate -safety, ethics, perception and acceptance of GM crops GM crops case study: Bt cotton, Bt brinjal Plants as bio factories for molecular pharming : plantibodies, nutraceuticals. Post-harvest Protection: Antisense RNA technology for extending shelf life of fruits and shelf life of flowers.	

Textbooks/References

1. Prescott,Hariey,Klein's Microbiology,J.M.Willey,L.M.Sherwood,C.J.Woolverton,7th International, edition 2008,McGraw Hill.2. Foundations in Microbiology, K.P.Talaro,7th International edition 2009,MeGraw Hill.
2. A Textbook of Microbiology, R. C. Dubey and D. K. Maheshwari, Ist edition,1999,S.4.Brock Biology of Microorganisms, M.T.Madigan, J.M.Martinko, P. V. Dunlap, D.P.Chand & CompanyLtd.Clark-12th edition, Pearson International edition 2009 ,Pearson Benjamin Cummings.
3. Microbiology - An Introduction, G. J.Tortora, B. R.Funke, C. L. Case, 10th cd.6.General Microbiology, Stanier, Ingraham et al, 4th and 5th edition 1987,Macmillan 2008,Pearson Education.education limited.
4. Microbiology- Concepts and Applications, PelezarJr,Chan, Krieg, International ed, McGraw Hill.

Paper Title: Skill-1	Marks:Th-40+IA-10
Paper Code :	Total hours:30
Teaching Hours:4 Hours/Week	Credits:02

SKILL-1

Practicals

1. Mushroom cultivation
2. study of Hydroponics
3. Study of Organic farming
4. Synthesis and field study of Biofertiliser
5. Techniques of plant tissue culture
6. Estimation of Hemoglobin
7. Study of RBC, WBC, ELISA and RIA
8. Extraction of secondary metabolites from medicinal plants.

Examination

In the practical examination, in a batch at least 15 (Fifteen) students may be made.V iva questions may be asked on any of the experiments prescribed in the practical sy llabus.

Distribution of Marks:

Major Question	15 Marks
Minor Question	10 Marks
Comment and Identify	05 Marks
Journal	05 Marks
Viva Voce	05 Marks
Total	40 Marks

QUESTION PAPER PATTERN

Time: 3 Hours

Title of the paper: **Max. Marks: 80**

Q.I Answer any TEN of the following 10X2=20

1.
2.
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11.
12.

Q.II Answer any SIX of the following 5X6=30

13.
14.
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16.
17.
18.
19.
20.

.

Q.III Answer any THREE of the following 3X10=30

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22
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Instructions to the Question paper setting

Q.I Three questions from each Unit

Q.II Two questions from each Unit

Q.III Q.21 and 22 from Unit I
Q.23 from Unit II
Q.24 from Unit III
Q.25 from Unit IV

RANI CHANNAMNA UNIVERSITY

BELAGAVI

REVISED CURRICULUM FRAMEWORK FOR UNDER GRADUATE COURSE

STRUCTURE & SYLLABUS OF BACHELOR OF SCIENCE

BIOTECHNOLOGY

5th and 6th Semesters

w.e.f.
Academic Year 2026-27 Onwards

Submitted by

Chairman.
Board of Studies(UG).
Bachelor of Science.
Rani Channamma University Belagavi

RANI CHANNAMMAUNIVERSITY,BELGAVI

VIDYASANAGAMA

Accredited **with B+ Grade by NAAC**

FACULTY OF SCIENCE: DEPARTMENT OF BIOTECHNOLOGY

Board of Studies in Biotechnology

SL. No.	Name and Address	Designation
01	Prof. Vishwanath Awati Department of Mathematics Rani Channamma University Belagavi-591156	Chairman
02	Smt. Amruta Sane B.K.College,Belagavi	Member
03	Mrs. Jyoti Deshpande BLDEA's Degree College, Jamkhandi	Member

Appendix2:B.Sc.and B.A.with practical Programmes

COURSE PATTERNS,SCHEMES OF EXAMINATIONS AND CREDITS

(L:Lectures,P:Practical,T:Tutorial,L:Languages,C:Compulsory,E:Elective,O:Optional)

Semester	**Major1**		**Major2**		**Major3**		**Elective(E)/ Optional(O)**		**+Languages(L)**		**Compulsory(C)**		**Total Credits**
	Credits (L+P)	Teaching hrs/week	Credits (L+P)	Teaching hrs/week	Credits (L+P)	Teaching hrs/week	Credits (L)	Teaching hrs/week	Credits (L/P)	Teaching hrs/week	Credits (L)	Teaching hrs/week	
I	3+2	4+4	3+2	4+4	3+2	4+4	--	--	L-1=3 L-2=3	4 4	C-1=2	2	23
II	3+2	4+4	3+2	4+4	3+2	4+4	--	--	L-1=3 L-2=3	4 4	C-2=2	2	23
III	3+2	4+4	3+2	4+4	3+2	4+4	E-1=2	3	L-1=3 L-2=3	4 4	C-3=2	2	25
IV	3+2	4+4	3+2	4+4	3+2	4+4	E-2=2	3	L-1=3 L-2=3	4 4	#Skill-I-2	4	25
V	*S-3+3+2	4+4+4	*S-3+3+2	4+4+4	*S-3+3+2	4+4+4	--	--	--	--	#Skill-II-2	4	26
VI	*S-3+3+2	4+4+4	*S-3+3+2	4+4+4	*S-3+3+2	4+4+4	--	--	--	--	#Skill-III-2	4	26
	36		36		36		04		24		12		148

+Languages have three credits each, but 4hrs teaching/Week.

*There shall be specialization in 5th and 6thSemesters ; S indicates Specialization; each specializations hall have atleast two discipline/core elective papers (Courses).

Student shall study practical skill course of all the major courses at least one in each of the 4th, 5thand 6thsemester. # Ex:- Skill Major-1 in 4th, Skill Major-2 in 5thand Skill Major-3 in 6th semester.

Note:3-6 credit courses shall have max.100marks (20IA+80SEE) , Less than 03 credits shall have 50 marks (10IA+40SEE) for examination.

Fifth Semester B.Sc. Biotechnology Theory

Paper Title : Plant and Animal Biotechnology	Marks: Th-80+IA-20
Paper Code:	Total hours:60
Teaching Hours: 4 Hours/Week	Credits:03

UNIT-I**: Plant Tissue culture**	15 Hours

- Introduction and scope of Plant tissue culture
- Definition and concept of totipotency.
- Principles of plant tissue culture-cytodifferentiation and morphogenesis
- Media and laboratory organization.
- Techniques –
  - Organ culture (meristem and embryo)
  - callus culture
  - Haploid culture – Anther, Pollen and Ovule culture
  - Micropropogation of elite species.
- Somatic embryogenesis
- Synthetic seeds.
- Protoplast Isolation and culture
- Somatic hybridization
- Somaclonal variation.
- Secondary metabolites-In vitro secondary metabolite production, Scaling up of secondary metabolite production, limitations, and applications.
- Production of Shikonin and Ginseng.

UNIT-II **Transgenic Plants and Biofertilizers.**	15 Hours

- Overview of transgenic plants and their significance in agriculture.
- Techniques for introducing foreign genes into plants: Agrobacterium-mediated transformation, biolistic, microinjection, electroporation and chemical mediated transformation.
- Role of reporter genes in screening and selection.
- Plant Molecular markers.
- Applications of Transgenic Plants
- Improved crop traits through genetic engineering: pest resistance, herbicide tolerance, disease resistance, and abiotic stress tolerance.
- **Biofertilizers**- Rhizobium, Micorrhiza, Azolla

UNIT-III: **Animal Cell culture methods**	15 Hours

- Introduction and Scope of animal biotechnology
- Laboratory organization and Media preparation.
- Cell types and culture characterstics.
- Pluripotency, Multipotency, Differentiation, Trans differentiation and Reprogramming.
- Biology and characterization of cultured cells- cell adhesion, proliferation, differentiation,morphology of cells and identification.
- The basic technique of mammalian cell culture invitro.
- Measuring parameters of growth in cultured cells, cell viability, and cytotoxicity.
- Large-scale culture of cell lines- monolayer, suspension, and immobilized cultures.
- **Organ and histotypic culture**- Technique, advantages, limitations, applications.
- **Stem cells**: types (embryonic, adult, induced pluripotent), isolation, identification, expansion, differentiation and uses, stem cell engineering, ethical issues.

UNIT-IV: **Transgenic animals and cloning**.	15 Hours

- Gene constructs, promoter/ enhancer sequences for transgene expression in animals.
- Selectable markers for animal cells- thymidine kinase and CAT.
- Transfection of animal cells- calcium phosphate coprecipitation, electroporation, lipofection, peptides, direct DNA transfer, viral vectors, Retrovirus, microinjection.
- Transgene identification methods.
- **Transgenic and genome-edited animals**- Ethical issues in transgenesis.
- Manipulation of animal reproduction and characterization of animal genes, Embryo transfer in cattle and applications.
- Somatic cell cloning - cloning of Dolly. Ethical issues.

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Paper Title: Genetic Engineering	Marks: Th-80+IA-20
Paper Code:	Total hours:60
Teaching Hours: 4 Hours/Week	Credits:03

UNIT-I: **Tools of GeneticEngineering** — 15 Hours

- Definition, scope, and historical overview of genetic engineering. Importance and applications in various fields.
- **Isolation techniques of DNA and RNA**- Techniques for DNA isolation and purification methods (Plants, animals, microorganisms and plasmids) and RNA. Methods for quantification and characterization.
- **Recombinant DNA technology** –
  - Introduction to molecular cloning.
  - Prokaryotic and eukaryotic host cell.
  - Overview of cloning vectors-Plasmids, phage, cosmid, BAC, and YAC.
  - Expression vectors.
  - Features and applications of cloning vectors in genetic engineering.
  - Enzymes used in recombinant DNA technology: Restriction endonucleases, Polymerases, Ligase, kinases, and phosphatases.

UNIT-II **Techniques in Genetic Engineering** — 15 Hours

- **Gene introduction Techniques** /Methods of gene delivery- Physical, chemical, and biological methods.
- **Gene Manipulation Techniques**- Gene knockout techniques in bacterial and eukaryotic organisms.
- **Screenings of recombinants**- Replica plating, Blue-White selection, colony hybridization, FISH.
- **Protein Expression and Purification**- Techniques for expressing recombinant proteins using bacterial, animal, and plant expression systems.
- **Gene library:** Types and applications.

UNIT-III: **Genome Editing and Applications of Genetic Engineering** — 15 Hours

Genome Editing

- Introduction to genome editing techniques- Principles and applications of genome editing techniques
- CRISPR-Cas9

- Site-directedmutagenesis.

Applications of Genetic Engineering

- Overview of the diverse applications of genetic engineering.
- DNA fingerprinting and its applications in forensics.
- Production of biopharmaceuticals using recombinant DNA technology.
- The role of biotechnology in sustainable crops and livestock improvement.
- Industrial applications of genetic engineering- enzyme production, biofuel production, food industry and bioremediation

UNIT-IV: **Bioinformatics, Biosafety and Bioethics**	15 Hours

Bioinformatics and Computational Tools

- Introduction to bioinformatics.
- Genome sequencing techniques
- Genome projects: A brief account on Human Genome Project
- Biological databases.
- Tools for biological sequence analysis – Sequence comparison and phylogenetic analysis.
- Role of Bioinformatics in genetic engineering.

Biosafety

- **Biosafety assessment of transgenic plants**:
  - Biosafety guidelines
  - Potential risks and benefits of transgenic plants
  - International regulatory frameworks for releasing and commercializing genetically modified organisms (GMOs).

Bioethics

- Public perception and consumer acceptance of transgenic plants.
- Ethical considerations of GMOs.
- Socio-economic impacts of GMO
- **IPR –** Patent, procedure involved in patenting biotechnological inventions.

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Fifth Semester B.Sc. Biotechnology Practicals

Paper Title: Practicals	Marks:Th-40+IA-10
Paper Code :	Total hours:60
Teaching Hours:4 Hours/Week	Credits:02

Practicals:

1. Laboratory organization of basic and commercial plant tissue culture
2. Preparation of culture media (Plant and Animal)
3. Explant preparation- Leaf, bud, rhizome and meristem.
4. Anther culture
5. Plant protoplast isolation.
6. Preparation of synthetic seeds
7. Animal cell culture of trypsinised cells
8. Extraction of serum (chicken/mammalian)
9. Isolation / extraction of genomic DNA from plant/bacteria/animal
10. Quantification of extracted DNA by spectrophotometer.
11. Agarose gel electrophoresis of DNA.
12. Study of genetic engineering equipments –
    a) PCR machine
    b) Laminar air flow cabinet
    c) Refrigerated centrifuge
    d) CO2 incubator
    e) ELISA reader
    f) Incubator shaker
13. Introduction to bioinformatics database tools.
14. Sequence alignment (FASTA, BLAST)
15. Prediction of protein secondary structure and function.

Examination

In the practical examination, in a batch at least 15 (Fifteen) students may be made.Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:

Major Question	15 Marks
Minor Question	10 Marks
Comment and Identify	05 Marks
Journal	05 Marks
Viva Voce	05 Marks
Total	**40 Marks**

Sixth Semester B.Sc. Biotechnology Theory

Paper Title: **Immunology and Medical Biotechnology**	Marks: Th-80+IA-20
Paper Code:	Total hours:60
Teaching Hours: 4 Hours/Week	Credits:03

UNIT-I: **Cells and Organs of the ImmuneSystem**	15 Hours

- Introduction to the Immune System
- History and scope of Immunology
- Types of Immunity
  - First and second line of defense
  - Innate and acquired/adaptive immunity
  - specificity, diversity.
- Cells of the immune system
- Antigen-presenting cells (APCs)
- Role of B and T-lymphocytes in Humoral immunity and cell-mediated immunity
- Primary and secondary immune response
- Immunization, Memory
- Organs of the Immune system: Thymus, bone marrow, spleen, Lymph Node, peripheral lymphoid organs.

UNIT-II : **Molecules of the Immune System**	15 Hours

- Antigens - Structure and properties of antigens
- iso- and allo-antigens, antigen specificity, Cross-reactivity and Precipitation
- Haptens - Properties (foreignness, molecular size, heterogeneity).
- Adjuvants
- Antigenicity and Immunogenicity.
- Affinity and Avidity.
- B and T cell epitopes
- Superantigens
- **Immunoglobulins**- Classification, structure, and function.
- Antibody diversity- Monoclonal and polyclonal antibodies.
- **Major histocompatibility complexes**- Classification, structure, and function.
- **Cytokines**: Classification and function
- **Hypersensitivity: Reactions** – Types I, II, and III. Delayed Type Hypersensitive Response.

UNIT-III : **Immunotechniques and vaccines**	15 Hours

- **Immunodiffusion reactions**- Radial immunodiffusion, Ouchterlony double diffusion
- Immunoelectrophoresis
- Agglutination: Agglutination reactions.
- ELISA, RIA.
- Immunocytochemistry
- Fluorescent Techniques.
- Flow Cytometry

Vaccines

- Conventional vaccines (Live attenuated, heat killed and toxoid)
- Recombinant vaccines- subunit (Peptide, Protein and DNA)
- Attenuated recombinant vaccine
- Vector recombinant vaccine
- CoVID19 vaccines
- Edible vaccines
- Plantibodies
- Cancer vaccines.

UNIT-IV: **Microbial disease of human and therapy**	15 Hours

- Microbial diseases in humans- Mode of infection, symptoms, epidemiology and control measures of diseases caused by
  - Viruses - Hepatitis-B
  - Bacteria -Typhoid
  - Fungi -Aspergillosis
  - Protozoa -Malaria
- Autoimmune disorders with examples.
- Immunodeficiencies- Primary and secondary immunodeficiencies
- Acquired immunodeficiency syndrome
- Cancer immunotherapy.
- Role of biotechnology in diagnosis and therapy
- Gene therapy- Types, examples

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Paper Title: **Bioprocess and Environmental Biotechnology**	Marks: Th-80+IA-20
Paper Code:	Total hours:60
Teaching Hours: 4 Hours/Week	Credits:03

UNIT-I: **Introduction to bioprocess technology**	15 Hours

- Introduction and scope of industrial biotechnology
- Basic principle of fermentation technology.
- Basic components of fermentation technology.
- Strain improvement of industrially important microorganisms.
- Types of microbial culture and its growth kinetics– Batch, Fed-batch, and Continuous culture.
- Principles of upstream processing – Media preparation, Inocula development, and sterilization .
- **Bioreactors**- Design and components - Impeller, Baffles, Sparger;
- **Specialized bioreactors**- design and their functions: airlift bioreactor, tubular bioreactors, membrane bioreactors, tower bioreactors, fluidized bed reactor, packed bed reactors.

UNIT-II : **Downstream processing**	15 Hours

- **Downstream processing**- cell disruption, precipitation methods, solid-liquid separation, liquid-liquid extraction, filtration, centrifugation, chromatography, drying devices (Lyophilization and spray dry technology), crystallization,
- Biosensors-construction and applications
- Microbial production of Lactic acid, ethanol, amylase, Penicillin, Vinegar and Single Cell Proteins.
- Plant suspension culture for the production of food additives: saffron, capsaicin and shikonin.
- Technique of mass culture of algae: spirulina
- Production of xanthan gum and Polyhydroxy alkanoids (PHA).

UNIT-III : **Fundamentals of Environmental Biotechnology**	15 Hours

- Introduction and scope of Environmental Biotechnology.
- Principles of Environmental Science.
- Role of Biotechnology in Environmental Conservation.
- Microbial Processes in Environmental Biotechnology.
- Pollution and Biotechnology – Major issues in environmental pollution and the role of biotechnology in addressing them.
- Use of biosensors in pollution monitoring.
- Biotechnological Methods in Pollution Abatement-Reduction of CO2 emission.
- Addressing eutrophication through biotechnological interventions.
- Application of cell immobilization techniques in pollution abatement

UNIT-IV: Bioremediation and Waste Management	15 Hours

- **Bioremediation:**

- Importance of bioremediation in environmental cleanup.
- Types of contaminants suitable for bioremediation.
- Microorganisms used in bioremediation.
- *In-situ* Bioremediation Methods –
  Bioaugmentation, Biostimulation, Bioventing, Phytoremediation.
- *Ex-situ* Bioremediation Methods –
  Composting, Land farming, Biopile and bioslurry systems.

- **Bio metallurgy and bio-mining.**
- **Waste Management:**

- Waste water Management-
  Waste water Characterization and Composition.
  Biological Processes in Waste water Treatment.
  Activated Sludge Process
  Biological Nutrient Removal
- Anaerobic Digestion and Biogas Production
- Solid Waste Management
- Xenobiotics – Characterstics, types and their bidegradation.

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23. Roseline,A.2011.Pharmacognosy.MJPPublishers,Chennai.
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Sixth Semester B.Sc.Biotechnology Practicals

Paper Title: Practicals	Marks:Th-40+IA-10
Paper Code :	Total hours:60
Teaching Hours:4 Hours/Week	Credits:02

Practicals:

1. Hemagglutination of ABO blood groups and determination of Rh factor.
2. Whole count of WBC using Hemocytometer.
3. Haemoglobin estimation using Haemometer.
4. ELISA – Demonstration
5. Western Blotting – Demonstration
6. Demonstration of PCR for diagnosis
7. Serum Immuno electrophoresis
8. Identification of industrially important microorganisms: E.coli, Saccharomyces cereviceae, Spirulina
9. Production of wine from grapes/ banana
10. Study of fermentor- Demonstration
11. Study of Biogas plant.
12. Estimation of lactic acid.
13. Estimation of solids in sewage.
14. Analysis of water samples for BOD, DO and toxic chemicals.
15. Visit to research centres/ institutions/industries.

NOTE: A report on the visit should be submitted along with practical record.

Examination

In the practical examination, in a batch at least 15 (Fifteen) students may be made.Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks

Major Question	15 Marks
Minor Question	10 Marks
Comment and Identify	05 Marks
Journal	05 Marks
Viva Voce	05 Marks
Total	**40 Marks**

QUESTION PAPER PATTERN

Time: 3 Hours

Title of the paper: **Max. Marks: 80**

Q.I Answer any TEN of the following 10X2=20

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

Q.II Answer any SIX of the following 5X6=30

13.
14.
15.
16.
17.
18.
19.
20.
.

Q.III Answer any THREE of the following 3X10=30

21
22
23
24
25

Instructions to the Question paper setting
Q.I Three questions from each Unit
Q.II Two questions from each Unit
Q.III Q.21 and 22 from Unit I
Q.23 from Unit II
Q.24 from Unit III
Q.25 from Unit IV

Fifth semester Skill Enhancement Course

Paper Title: Pharmaceutical Biotechnology Practical	Marks:Th-40+IA-10
Paper Code :	Total hours:56 hrs
Teaching Hours:4 Hours/Week	Credits:02

Practicals-

1. Preparation of aqueous Iodine solution used as antibiotics.
2. Preparation of Magnesium Hydroxide used as antacid.
3. Preparation of Sodium Chloride Injections.
4. Preparation of antibiotic soap.
5. Demonstration of production of Insulin.
6. Observation of blood cells.
7. Examination of sputum for tuberculosis
8. Antibiotic sensitivity test- paper disk method.
9. Study of vaccines and its types (charts & models)
10. Estimation of blood glucose by calorimetric method.
11. Photographic demonstration of genetically modified animals & applications.
12. Study of nanotechnology based drug delivery system for biopharmaceuticals.
13. Visit to research center/ Pharmaceutical industry.

NOTE: A report on the visit should be submitted along with practical record.

Examination

In the practical examination, in a batch at least 15 (Fifteen) students may be made.Viva ques tions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks

Major Question	15 Marks
Minor Question	10 Marks
Comment and Identify	05 Marks
Journal	05 Marks
Viva Voce	05 Marks
Total	**40 Marks**

Sixth semester Skill Enhancement Course

Paper Title: Food and Agricultural Biotechnology Practical	Marks:Th-40+IA-10
Paper Code :	Total hours:56 hrs
Teaching Hours:4 Hours/Week	Credits:02

Practicals-

1. Determination of quality of a milk sample by methylene blue reduction test.
2. Role of yeast in bread making.
3. Production of Sauerkraut by microorganisms.
4. Estimation of protein, oil and starch content in grain crops.
5. Food preservation techniques- osmotic(sugar/salt); physical(drying, freezing, radiation) and chemicals.
6. Production of starch from grains.
7. Production of pathogen- free plants through meristem culture.
8. Soil pH and texture analysis.
9. Estimation of soil Organic matter.
10. Isolation of rhizobium from root nodules.
11. Staining of Vesicular-arbuscular Mycorrhizal (VAM) fungi.
12. Effect of bio-pesticides on the growth of microorganisms.
13. Photographic demonstration of transgenic crop plants.
14. Visit to food industry / agricultural research center/ soil testing center/Organic farming nursery.

NOTE: A report on the visit should be submitted along with practical record.

Examination

In the practical examination, in a batch at least 15 (Fifteen) students may be made.Viva ques tions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks

Major Question	15 Marks
Minor Question	10 Marks
Comment and Identify	05 Marks
Journal	05 Marks
Viva Voce	05 Marks
Total	**40 Marks**