DAVANGERE UNIVERSITY
DAVANGERE-577007

CURRICULUM CONTENTS

IN

BIOTECHNOLOGY

NEW SYLLABUS (2024-25)

Undergraduate Course B.Sc.

3rd and 4th Semester

DAVANGERE UNIVERSITY

SHIVAGANGOTRI

DAVANGERE-577007

Chairman
Board of Studies
Department of Studies in Biotechnology
Davangere University
Shivagangotri, Davangere - 577 007.

Curriculum Structure for Undergraduate Programme Biotechnology for 2024-25

Sl. No.	Course/PaperCode	Title of the Paper	Subject Category	Teaching Hours/ week	Semester End Exam.	Internal Assessment	Total Marks	Credits	Examinationn Duration
1	2	3	4	5	6	7	8	9	10
			Semester-III						
3	**24- MCBT –III – FUNDAMENTALS OF BIOMOLECULES**		**MCBT -T**	04	80	20	**100**	03	3 Hrs.
	Practical – III FUNDAMENTALS OF BIOMOLECULES		**MCBT -P**	04	40	10	**50**	02	3 Hrs.
	Elective– IA BIOCHEMICAL TECHNIQUES or IB ENZYMOLOGY AND METABOLISM		**ELBT-IA or ELBT-IB**	02	40	10	**50**	02	2 Hrs.
	Total			**10**	**160**	**40**	**200**	**07**	---
			Semester-IV						
4	**24-MCBT-IV - MOLECULAR BIOLOGY**		**MCBT-T**	04	80	20	**100**	03	3 Hrs.
	Practical – IV MOLECULAR BIOLOGY		**MCBT-P**	04	40	10	**50**	02	3 Hrs.
	Elective IIA*BIOINFORMATICS or IIB APPLICATIONS OF BIOTECHNOLOGY IN HEALTH		**ELBT-IIA or ELBT-IIB**	02	40	10	**50**	02	2 Hrs.
	Total			**10**	**160**	**40**	**200**	**07**	---

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Continuous Assessment Programme/Internal Assessment/Formative Assessment
Major Courses

Sl. No.	Continuous Assessment Programme/Internal Assessment	Maximum Marks
(1)	(2)	(3)
01	Two Session Tests with proper record for assessment (5+5 = 10)	**10**
02	Assessment of Skill Development activities/Seminars/Group Discussion/ Assignment etc., with proper record	**05**
03	• Attendance with proper record	**05**
	TOTAL MARKS	**20**

- **Attendance Marks-breakup**

<75%	-	00 Marks
75-80%	-	01 Mark
80-85%	-	02 Marks
85-90%	-	03 Marks
90-95%	-	04 Marks
>95%	-	05 Marks

Continuous Assessment Programme/Internal Assessment/Formative Assessment
Elective/Optional Papers

Sl. No.	Continuous Assessment Programme/Internal Assessment	Maximum Marks
(1)	(2)	(3)
01	Two Session Tests with proper record for assessment (2+2 = 4)	**04**
02	Assessment of Skill Development activities/Seminars/Group Discussion/ Assignment etc., with proper record	**03**
03	• Attendance with proper record	**03**
	TOTAL MARKS	**10**

- **Attendance Marks-breakup**

<75%	-	00 Marks
75-80%	-	01 Mark
85-90%	-	02 Marks
90-100%	-	03 Marks

SEMESTER-III

24-MCBT-III: FUNDAMENTALS OF BIOMOLECULES

TOTAL HOURS-56

Course Learning Objective:

a) To understand the basics of biomolecules and its significance
b) To study about the water properties, carbohydrates properties, classification, importance and metabolism
c) To learn about amino acids, proteins and enzyme properties and its significance.
d) To acquire knowledge about lipids, nucleic acids and hormones
e) To study the concept of vitamins and bioanalytical tools

Course Outcome: On successful completion of the course, the student will able to:

a) Understand the basic concepts of water, carbohydrates and metabolism.
b) Understand the amino acids, proteins, enzymes and their scope and importance
c) Understand the lipids, nucleic acids and hormones and their role and importance
d) Understand the nutritional chemistry of vitamins and working principles and applications of analytical instrumentation.

Unit-I Carbohydrates and Metabolism **14hr**

Water: Structure of water molecule, physical properties of water, role of water in life. pH and Buffers, Henderson and Hassel Balch equation, biological buffer system.

Carbohydrates: Definition, classification, Fischer and Haworth structure of Monosaccharides – ribose, glucose, galactose and fructose. Reducing and non-reducing sugars. Stereochemistry – Definition with examples. Epimers, enantiomers, anomers, isomers concept. Fischer and Haworth structure of Disaccharides – sucrose, maltose, lactose. Polysaccharides classification: homo and heteropolysaccharides, Structure of starch and glycogen. Derivatives of carbohydrates.

Metabolism: Definition of metabolism, Glycolysis and Gluconeogenesis, Krebs cycle and Electron Transport system.

Unit-II Amino acids, Proteins and Enzymes **14hr**

Amino acids: Generalized structure, essential and non-essential amino acids, nonprotein amino acids, classification based on polarity, zwitter ionic structure, pKa value. D-and L-amino acids, optical activity.

Proteins: Classification of proteins with example. Organization of proteins - Primary, secondary, tertiary and quaternary structures. Stability of proteins. Structural importance of collagen, myoglobin and haemoglobin. Biological roles of proteins.

Enzymes: Properties, Nomenclature and Classification, factors influencing enzyme catalysed reactions, coenzymes, co factors, Induced fit theory and lock and key enzyme mechanism, Enzyme inhibition – irreversible and reversible (competitive, non-competitive, and uncompetitive inhibition with an example each). Industrial applications of enzymes.

Unit-III Lipids, Nucleic acids and Hormones **14hr**

Lipids: Definition, sources, general structure, fatty acids, Saturated and unsaturated fatty acids, classification of lipids, properties (saponification value, acid value, iodine number, rancidity). Functions of lipids, hydrogenation of fats and oils. General structure and biological functions of Glycolipids, Phospholipids. Sphingolipids, Lipoproteins.

Nucleic Acids: Definition, types, three components (Phosphoric acid, Pentose sugar, Nitrogenous bases) Nucleosides and Nucleotides – structure and nomenclature. DNA-Types, secondary structure of DNA (Watson and Crick model), RNA- Types (rRNA, mRNA, tRNA and Heterogeneous nuclear RNA), Informosome.

Hormones: Definition, general functions, outline of vertebrate hormones classification (steroid hormones, peptide hormones, amino acid derivatives), Insulin and Glucagon-structure and functions.

Unit-IV Nutritional chemistry and Bioanalytical techniques **14hr**

Vitamins: Definition, classification and biological role of vitamins. Fat-soluble vitamins-general characteristics, storage, daily requirement, occurrence, deficiency diseases of Vitamin A,D, E and K

Water soluble vitamins: general characteristics, storage, daily requirement, and occurrence, deficiency diseases of VitaminB1, VitaminB2, VitaminB3, VitaminB5, VitaminB6, VitaminB7, VitaminB9, VitaminB12, and vitamin C.

Bioanalytical techniques: Spectroscopy – Colorimeter, UV- visible spectroscopy -Principle, procedure and applications. Centrifugation – Principle, Types and applications. Chromatography – Principle, procedure and application of (Paper, TLC, GC, HPLC and Ion Exchange). Electrophoresis – Principle, procedure and Applications (Agarose and SDS-PAGE)

TEXT AND REFERENCE BOOKS:

1. Boyer, R. (2002). Concepts in Biochemistry (2nd ed.). Brooks/Cole, Australia.

2. Campbell, M. K., Farrell, S. O., & McDouggal, O. M. (2016). Biochemistry. Cengage Learning.

3. Chatterjee, B., & Shinde, R (2024 edition). Textbook of Medical Biochemistry. Jaypee Publications.

4. Devlin, T. M. (1997). Textbook of Biochemistry with Clinical Correlations. Wiley and Sons, Inc., New York.

5. Elliott, W. H., & Elliott, D. C. (2001). Biochemistry and Molecular Biology (3rd ed.). Oxford Publication.

6. Garrett, R., & Grisham, C. M. (1999). Biochemistry. Saunders College Publishers.

7. Horton, R., et al. (1996). Principles of Biochemistry. Prentice Hall, International, Inc., New Jersey.

8. Jain, J.L. and Jain, S. and Jain, N.(2005) Fundamentals of Biochemistry, S. Chand Limited

9. Knowler, J. T., & Leader, D. P. (Eds.). The Biochemistry of the Nucleic Acids (11th ed.). Chapman and Hall.

10. Metzler, D. E. (2002). Biochemistry (Vols. 1 & 2). Elsevier Publication.

11. Montgonary, R. M., Conway, T. W., & Spectator, A. A. (1996). Biochemistry: A Case-Oriented Approach (6th ed.). Mosby Inc., Missouri.

12. Nelson, D. L., & Cox, M. M. (2001). Biochemistry. Macmillan Worth Publishers, Hampshire.

13. Roa, C. N. R. (1999). Understanding Chemistry. University Press Hyderabad.

14. Satya Narayana, U. (2021). Biochemistry (6th ed.). Elsevier Health Sciences.

15. Strayer, L. (2000). Biochemistry (5th ed.). W. H. Freeman and Company.

16. Voet, D., Voet, J. G., & Pratt, C. W. (2004). Biochemistry (5th ed.). John Wiley & Sons.

17. Walker, J. M. (2000). Principles and Techniques of Practical Biochemistry. Cambridge University Press.

18. Wilson, K., & Walker, J. M. (2009). Practical Biochemistry: Principles and Techniques. Cambridge University Press, Cambridge, U.K.

19. Zubcy, G. L., Pason, W. W., & Vance, D. E. (1995). Principles of Biochemistry. WMC Brown Publishers, Oxford.

24-MCBT-P-III: PRACTICAL PAPER-III FUNDAMENTALS OF BIOMOLECULES

1. Qualitative analysis of carbohydrates.
2. Estimation of reducing sugar/maltose by DNS method.
3. Qualitative analysis of amino acids.
4. Estimation of proteins by Biuret method.
5. Assay of amylase activity.
6. Study of acid phosphatase and alkaline phosphatase activity.
7. Determination of Iodine number of lipids
8. Determination of acid number of an edible oil
9. Separation of amino acids by circular paper chromatography.
10. Study of analytical instruments – Colorimeter, Centrifugation, Chromatography, Electrophoresis.

TEXT AND REFERENCE BOOKS:

1. Jayaraman, J. (1981). *Laboratory manual in biochemistry*. New Age International.

2. Kumar, Suresh & Praveen, Shelly & Tyagi, Aruna. (2019). Biochemistry: A Practical Manual.

3. Plummer, D.T. (2019). Practical Biochemistry Plummer.

4. Sadasivam, S. and Manickam, A. (2007). Biochemical Methods. New Age International (P) Limited.

5. Thimmaiah S. K. (1999) Standard Methods of Biochemical Analysis, Kalyani Pub.,

Practical Proper Examination III semester

Duration: 3Hrs

• Experimentation (Major 10 Minor 8 Spotters 12)	-	30 Marks
• Viva Voice	-	10 Marks
	Total	**40 Marks**

Internal Assessment for Practical Paper I semester

• Attendance	-	05 Marks
• Record/Journal	-	05 Marks
	Total	**10 Marks**

SEMESTER III

ELECTIVE 1A-BIOCHEMICAL TECHNIQUES

TOTAL HOURS-32

Course Learning Objective:

To learn the principle and working of biochemical tools.

Course Outcome: On successful completion of the course, the student will able to:

a) Understand and handle Microscopes.
b) Understand Centrifugation methods and applications
c) Describe and operate with chromatographic methods.
d) Perform electrophoresis and describe applications

Unit-I Microscopy **8 hr**

Introduction, resolving power, numerical aperture, Principle and applications of Light microscopes –Bright field, Dark field, Phase contrast, Fluorescence and confocal microscopes. Electron microscopes – TEM, SEM.

Unit-II Centrifugation **8 hr**

Principle of centrifugation, Principle, working and applications of-analytical, density gradient (rate zonal and isopycnic centrifugation), ultracentrifugation, differential centrifugation.

Unit-III Chromatography: **8 hr**

Principle, types-paper chromatography, thin layer chromatography,
Column chromatography- gel permeation, ion exchange chromatography, gas chromatography, FPLC, high performance (Pressure) liquid chromatography principle and its applications.

Unit-IV Electrophoresis: **8 hr**

Principles and application of electrophoretic techniques- polyacrylamide gel electrophoresis, agarose gel electrophoresis, two-dimensional electrophoresis,

TEXT AND REFERENCE BOOKS:

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006) Biochemistry. VI Edition. W.H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R.(2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists.
3. David Frifielder, (1983) Physical Biochemistry: 2nd Edition.
4. Nelson, D.L., Cox, M.M. Lehninger (2004) Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
5. R Reed, D. Holmes, J. Weyers, and A. Jones, (1998) Practical Skills in Bimolecular Sciences,
6. Rodney Boyer, Modern Experimental Biochemistry: (2000) 3rd Edn. Benjamin Cummings,
7. Upadya and Upadya, (2016) Biophysical Chemistry

SEMESTER III

ELECTIVE IB- ENZYMOLOGY AND METABOLISM

TOTAL HOURS-32

Course Learning Objective: To learn the enzyme properties, applications and metabolism.

Course Outcome: On successful completion of the course, the student will able to:

a) Describe properties, naming, classification and mechanism of action of enzymes.
b) Understand factors influencing enzyme activity and applications of enzymes.
c) Understand how anabolic and catabolic reactions occur and their regulation.
d) Describe carbohydrate metabolism.

Unit-I Enzymes Nomenclature and classification **8 hr**

History, chemical nature and characteristics of enzymes. Nomenclature and classification of enzymes, ribozymes, abzymes. Interaction between enzyme and substrate- lock and key model, induced fit model. Features of active site, activation energy. Measurement and expression of enzyme activity, enzyme assays. Definition of IU, katal, enzyme turnover number and specific activity, Coenzymes and their functions.

Unit-II Enzyme kinetics and applications **8 hr**

Definition, factors affecting the velocity of enzyme catalyzed reaction-enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators (explanation with graphical representation). Michaelis Menten equation and Km value and its significance, Definition of Vmax value of enzyme and its significance.

Applications of enzymes: Industrial and Clinical applications.

Unit-III Metabolic concepts **8 hr**

Definition of metabolism, terminology of metabolism, metabolic pathways-catabolic pathways, anabolic pathways, central pathways, anaplerotic pathways, secondary pathways. Regulation of metabolic pathways.

Bioenergetics- Thermodynamic principles, chemical equilibrium, free energy, enthalpy, entropy ATP as universal currency of free energy in biological system.

Unit-IV Metabolism of Carbohydrates **8 hr**

Cellular respiration, glycolysis (pathway, its regulation and inhibitors)
Glyconeogenesis (bypass reaction)
TCA cycle and its regulation
Electron transport chain-ATP synthesis, oxidative phosphorylation
Photophosphorylation, Hill reaction, CO_2 fixation. Glycogenesis and glycogenolysis

TEXT AND REFERENCE BOOKS:

1. Aehle W (2007), Enzymes in Industry: Production And Application, John Wiley and Sons Inc.
2. Alejandro G. Marangoni, (2003) Enzyme Kinetics: A modern Approach, Wiley-Interscience
3. Donald Voet, Judith G. Voet, (2002) 4th edition. Biochemistry, John Wiley and Sons Inc.
4. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
5. Nicholas C. Price, Lewis Stevens, and Lewis stevens. (2009) 3rd edition. Fundamentals of Enzymology: The cell and molecular Biology of Catalytic Proteins , Oxford University Press, USA
6. P.K Sivaraj Kumar,(2007). Enzyme Mechanism, RBSA Publishers
7. Trevor Palmer, Philip Bonner, (20008) Enzymes: Biotechnology, Clinical Chemistry (second Edition) Horwood Publishing Limited.

SEMESTER-IV

24-MCBT-IV: MOLECULAR BIOLOGY

TOTAL HOURS-56

Course Learning Objective:

f) To understand the basics Molecular biology and significance and central dogma of molecular biology.
g) To learn the process of DNA replication, DNA damage and Repair.
h) To understand the events of RNA transcription and modification.
i) To understand the mechanism of protein synthesis.
j) To learn the process of gene regulation

Course Outcome: On successful completion of the course, the student will able to:

a) Study the basics of DNA evolution, special emphasis to historical perspective, components and process of DNA replication in prokaryotes and eukaryotes
b) Acquire the knowledge of RNA synthesis and its regulation both in prokaryotes and eukaryotes.
c) Understand the process of genetic code derivation, its decoding process to form proteins, modification of proteins and trafficking.
d) Aware about the gene regulation of both prokaryotes and eukaryotes system, and special emphasis to deregulation process leading to cancer as well as molecular basis of cancer.

Unit-I DNA **14hr**

DNA as genetic material: Mendelian concepts, Griffith's Transformation experiment, Avery-Mcleod-McCarty, Hershey and Chase experiment.

DNA Replication: Central dogma, Replication of DNA in prokaryotes and eukaryotes– semi conservative mode: Messelson and Stahl experiment. Enzymes and proteins involved in replication-DNA polymerases I. II, III, helicases, gyrases, ligase, SSB proteins, primase, topoisomerases. Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

DNA damage and Repair mechanism: types of damage, photo reactivation, excision repair, mismatch repair and SOS repair

Unit-II RNA Transcription **14hr**

Prokaryotic RNA Transcription: RNA polymerase, sigma factor, promoter, initiation, elongation and termination.

Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance, elongation and termination.

RNA processing: Post transcriptional modification of pre-mRNA: 5' cap formation, polyadenylation, splicing.

Unit-III Protein Translation **14hr**

Genetic Code: Genetic code and its characteristics, deciphering genetic code, Wobble hypothesis.

Translation in prokaryotes: Ribosome's, enzymes and factors involved in translation. Activation of amino acids, aminoacyl tRNA synthetases. Mechanism of translation-initiation, elongation and termination of polypeptide chain. Fidelity of translation, Inhibitors of translation.

Translation in Eukaryotes: Overview of Eukaryotic translation: Post translational modifications of proteins: Protein folding and targeting- to mitochondria and lysosomes.

Unit-IV Gene Regulation: **14hr**

Prokaryotic gene regulation- Operon concept- regulation of lac operon and Trp operon, attenuation control.

Eukaryotic gene regulation- Activators, repressors binding to enhancers, coordinated control (tissue specific gene expression), DNA methylation, chromatin remodelling,

Cancer Biology: Introduction to cancer cells morphology and its characteristic features, Molecular basis of Cancer, Mutation and mutagens, Proto-oncogenes. Ontogenesis, Tumor suppressor genes.

TEXT AND REFERENCE BOOKS:

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 Press New York, USA

6. Walker J. M. and Ging old, E.B. (1983) Molecular Biology & Biotechnology (Indian Edition) Royal Society of Chemistry U.K 7 Karp. G (2002) Cell & Molecular Biology, 3rdEdition, John Wiley & Sons; I

MCBT-P-IV: PRACTICAL PAPER-IV Molecular Biology

1. Quantitative estimation of DNA by DPA method
2. Quantitative estimation of RNA by Orcinol method
3. DNA isolation from plant source – Onion/tender coconut
4. DNA isolation from animal source – Chick/Sheep Liver
5. DNA isolation from microbial source
6. Agarose gel electrophoresis of DNA
7. Charts on – DNA replication, transcription, Translation, forms of DNA and Types of RNA. Gene regulation(lac Operon and trp operon)

Practical Proper Examination IV semester

Duration: 3Hrs

• Experimentation (Major 10 Minor 8 Spotters 12)	-	30 Marks
• Viva Voice	-	10 Marks
	Total	**40 Marks**

Internal Assessment for Practical Paper I semester

• Attendance	-	05 Marks
• Record/Journal	-	05 Marks
	Total	**10 Marks**

SEMESTER-IV

ELECTIVE IIA: BIOINFORMATICS

TOTAL HOURS-32

Course Learning Objective:

To learn the basics of Bioinformatics and its applications in current science

Course Outcome: On successful completion of the course, the student will able to:

a) Uunderstand the overview of Bioinformatics and its applications.

b) Understand sequence alignment and database searching tools.

c) Knows about Nucleic acids sequence alignment methods

d) Understand tools for protein sequence alignments.

Unit-I Introduction to Bioinformatics **8 hr**

Definition and scope; Genomics; Proteomics; Structural Genomics; Pharmacogenomics: Population genomics; Biodiversity; Systems Biology. Chronology of events in history and development of Bioinformatics.

Overview of Human Genome Project. Collecting and Storing Sequence Data: Genomic Sequencing; Sequence assembly, Use of molecular markers in sequence assembly,

Unit-II Sequence alignments and applications **8 hr**

Definition and applications; Choice to be made for alignment; Scoring Matrices; Homology and related concepts; Dot matrix methods; Dynamic Programming methods for global and local alignments; Database searching – FASTA, BLAST; Statistical and biological significance

Unit-III Nucleic acids sequence alignments **8 hr**

Identification of open Reading frames by different methods; Codon usage method, codon preference method, Fickett's statistical analysis, Neural network method, Hidden Markov Models in gene finding. Identification of Translational and transcriptional signals- identification of promoter using frequency table method, Splice site identification.

SEMESTER-IV

ELECTIVE II B: APPLICATIONS OF BIOTECHNOLOGY IN HEALTH

TOTAL HOURS-32

Course Learning Objective:

To understand the role of biotechnology in maintenance of human health in current scenario with target specific action.

Course Outcome: On successful completion of the course, the student will able to:

a) Understand the concepts of biotechnology in human health
b) Understand the concepts of human genetics, and gene therapy
c) Understand the role of hormones, enzymes, vaccines and monoclonal antibodies in the treatment of human diseases.
d) Understand the role of Cancer biology and treatment with regenerative medicine.

Unit-I Human Genetics and gene therapy — 8hr

Human Genetics: Overview of mutations. Autosome and allosome related disorders, Human Chromosome abnormalities – Chromosome karyotyping, Down's syndrome, Tuners syndrome, Klinefelter's syndrome, Sex determination - Amniocentesis and Ultra-sound. Genetic counselling.

Gene Therapy: Definition and salient features. Approaches for gene delivery; Ex vivo in Humans. Cystic Fibrosis (CF); Gene therapeutic strategies.

Unit –II Vaccine and Monoclonal antibodies — 8hr

DNA-based Vaccines : Introduction. Attenuated vaccines, Subunit vaccines, newer vaccines; Peptide vaccines, Recombinant DNA (rDNA) vaccines, Edible vaccines.

Monoclonal Antibodies: Targets in Therapy, Generation of MAbs, Recombinant MAbs, Immunotherapy using MAbs.

Unit-III Therapeutic proteins — 8hr

Enzyme: Introduction. Enzymes as Therapeutics. Therapeutics Enzymes; DNase I, Alginate Lyase, Adenosine Deaminase,

Hormone Therapy: Insulin (Humulin), Human growth hormone. Somatostatin.

Unit-IV Cancer biology and Stem cell technology — 8hr

Tumor Biology: Introduction, properties of tumor cell, causes of tumors, tumor antigens. Proto-oncogenes, oncogenes , tumour suppressor genes .

Regenerative Medicine: Introduction to stem cell: Definition, scope, characteristics, properties, types and applications of stem cells.

THEORY EXAMINATION QUESTION PAPER PATTERN FOR MAJOR SUBJECTS

(Semesters I –VI)

B.Sc. Semester-I Degree Examination; 2024-25

(Semester Scheme; New Syllabus: 2024-25)

SUBJECT: Biotechnology

Paper –_____: _____

Paper Code: _____

Time: 3 Hours **Max. Marks: 80**

Instructions to candidates:

1) All sections are compulsory
2) Draw neat and labelled diagrams wherever necessary.

SECTION-A

1. Answer **all** the following questions: **(2×10=20)**

a)

b)

c)

d)

e)

f)

g)

h)

i)

j)

SECTION-B

Answer any **SIX** of the following: **(5×6=30)**

2. From Unit I

3. From Unit I

4. From Unit II

5. From Unit II

6. From Unit III

7. From Unit III

8. From Unit IV

9. From Unit IV

SECTION -C

Answer **Any Three** of the following: **(10×3=30)**

10. From Unit I

11. From Unit II

12. From Unit III

13. From Unit IV

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THEORY EXAMINATION QUESTION PAPER PATTERN FOR ELECTIVE/OPTIONAL PAPERS

(Semesters III & IV)

B.Sc. Semester-I/II/III/IV/V Degree Examination; 2024-25

(Semester Scheme; New Syllabus: 2024-25)

SUBJECT: Biotechnology

Paper – OPEN ELECTIVE III & IV _____: _____

Paper Code: _____

Time: 2 Hours **Max. Marks: 40**

Instructions to candidates:

1) All sections are compulsory
2) Draw neat and labelled diagrams wherever necessary.

SECTION-A

Answer **all** the following questions: **(2×5=10)**

1.
2.
3.
4.
5.

SECTION-B

Answer any **SIX** of the following: **(5×6=30)**

6. From Unit I
7. From Unit I
8. From Unit II
9. From Unit II
10. From Unit III
11. From Unit III
12. From Unit IV
13. From Unit IV

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