RAFFLES UNIVERSITY

TEACHING PLAN: Fundamental of Plant Biochemistry and Biotechnology

SCHOOL: (SOAS) SCHOOL OF AGRICULTURAL SCIENCES		**ACADEMIC SESSION: 2023-2024**	**FOR STUDENTS' BATCH: 2023-2027**	
1	**Course No.**	ABB-T-101		
2	**Course Title**	**Fundamental of Plant Biochemistry and Biotechnology**		
3	**Credits**	**2**		
4	**Learning Hours**	**Contact Hours: 54** **Assessment: 20** **Guided Study: 26** **Total hours: 100**		
5	**Course Objective**	1. Role of cell organelles and their functions 2. Functions of biomolecules and their utility in cell 3. Identify the deficiency symptoms of biomolecules 4. Synthesis pathways of biomolecules and regulations 5. Identification of biomolecules in given sample 6. Application of plant tissue culture in crop improvement 7. Application of recombinant DNA methods in crop improvement 8. Application of PCR techniques and its applications and marker assisted selection in plant breeding		
6	**Course Outcomes**	1. Educate the outlines of bio-molecules, metabolic pathways morphology and anatomy of living cells 2. Develop the understanding of energy synthesis, hereditary mechanisms, enzymatic reactions, cellular function and growth, molecular tests, etc. 3. Develop the skills for applying principles and methods biochemistry and biotechnology to understand plant growth and metabolisms 4. Develop the ability to apply advance techniques for standardization of biochemical processes in plants, optimize cell and tissue growth and culture plant cell and tissue in the laboratory 5. Develop the ability to apply advance techniques of PCR and its application recombinant DNA technology and marker assisted selection in crop improvement		
7	**Outline syllabus:**			
7.01	**Paper Code**	**Unit**	**Introduction**	**Page Numbers[1]**	**Lectures**
7.02	**ABB-T-101**	Unit I	Unit-1: Importance of Biochemistry. Properties of Water, pH and Buffer. Carbohydrate: Importance and classification Unit-2: Structures of Mono-saccharides, Reducing	2-36	1 to 8

			and oxidizing properties of Monosaccharides Mutarotation; Structure of Disaccharides and Polysaccharides Unit-3: Lipid: Importance and classification; Structures and properties of fatty acids; storage lipids and membrane lipids Unit-4: Proteins: Importance of proteins and classification; Structures, titration and zwitterions nature of amino acids		
7.03		Unit II	Unit-1: Structural organization of proteins. Enzymes: General properties; Classification; Mechanism of action; Michaelis & Menten and Line Weaver Burk equation & plots Unit 2: Introduction to allosteric enzymes. Nucleic acids: Importance and classification Unit-3: Structure of nucleotides, A, B & Z DNA; RNA: Types and Secondary & Tertiary structure Unit-4: Metabolism of carbohydrates: Glycolysis, TCA cycle, Glyoxylate cycle, Electron transport chain Unit-5: Metabolism of lipids: Beta oxidation, Biosynthesis of fatty acids	37-110	8 to 17
7.04		Unit III	Unit-1: Concepts and applications of agriculture biotechnology: Scope, organ culture, embryo culture, cell suspension culture, anther, callus culture, anther culture, pollen culture and ovule culture and their application Unit-2: Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance Unit-3: Embryo rescue and its significance; somatic hybridization and cybrids Unit-4: Somaclonal variation and its use in crop improvement; cryo-preservation	111-145	17 to 23

7.05		Unit IV	Unit-1: Introduction to recombinant DNA methods Unit-2: Physical (Gene gun method), chemical (PEG mediated) and agrobacterium mediated gene transfer methods Unit-3: Transgenics and its importance in crop improvement Unit-4: PCR techniques and its applications; RFLP, RAPD, SSR Unit-5: Marker Assisted Breeding in crop improvement; Biotechnology regulations	146-215	23 to 28

8	**Course Evaluation**	
8.1	**CA: 10%**	
8.11	**Attendance**	25%
8.12	**Homework**	2 Assignments-50%
8.13	**Quizzes**	2 Quizzes, 25%
8.14	**Projects**	
8.15	**Presentation**	
8.16	**Any other**	Practical examination-30%
8.2	**MTE**	10%
8.3	**End-term examination: 50%**	
9	**Text Books & References**	
9.1	**Text book**	1. Fundamental of Plant Biochemistry and Biotechnolgy by Rajan Katoch 2. Fundamental of Plant Biochemistry and Biotechnolgy by Dr Bishun Deo Prasad and Dr Vinod Kumar
9.2	**References**	1. Biochemistry by David Hames and Nigel Hooper. 2. Principles of Biochemistry by Lehninger. 3. Plant biotechnology by Slater · 4. Plant biotechnology by B.D.Singh 5. Jain, J.L. (2000) Fundamentals of Biochemistry Chand & Co., New Delhi
9.3	**Video References**	1. https://youtu.be/IoJS774v5qs 2. https://youtu.be/zReRlJfMjsE 3. https://youtu.be/bfON4l_5DPE 4. https://youtu.be/mPpKWPEMi_8 5. https://youtu.be/MPOVbil8cgs 6. https://youtu.be/rrs_VDys47A 7. https://youtu.be/-m6jTbRA_0c 8. https://youtu.be/hanlkPC-TIc 9. https://youtu.be/QZ9S5HvfpmA 10. https://youtu.be/uGmWfdhIr3c

Mapping of Outcomes v. Topics

Outcome no. → Syllabus topic↓	1	2	3	4	5
Paper Code.Unit I (1)	✓				
Paper Code. Unit I (2)	✓				
Paper Code. Unit I (3)	✓				
Paper Code. Unit I (4)	✓				
Paper Code.Unit II (1)		✓			
Paper Code. Unit II(2)		✓			
Paper Code. Unit II(3)	✓	✓			
Paper Code.Unit II (4)		✓			
Paper Code.Unit II (5)	✓	✓			
Paper Code. Unit III(1)			✓	✓	
Paper Code. Unit III(2)			✓	✓	
Paper Code.Unit III (3)			✓	✓	
Paper Code. Unit III(4)			✓	✓	
Paper Code. Unit IV(1)					✓
Paper Code.Unit IV (2)					✓
Paper Code. Unit IV(3)					✓
Paper Code. Unit IV(4)					✓
Paper Code. Unit IV(5)					✓

Question Bank

Unit-I

A). Chose the correct answer:

1) Which of the following Biomolecules simply refers to as “Staff of life”?

(a) Lipids

(b) Proteins

(c) Vitamins

(d) Carbohydrates

2) Which of the following is the simplest form of carbohydrates?

(a) Carboxyl groups

(b) Aldehyde and Ketone groups

(c) Alcohol and Carboxyl groups

(d) Hydroxyl groups and Hydrogen groups

3) Which of the following monosaccharides is the majority found in the human body?

(a) D-type

(b) L-type

(c) LD-types

(d) None of the above

4). Which of these is not a lipid**?**

(a) Fats

(b) Oils

(c) Proteins

(d) Waxes

5). The abundantly distributed enzyme in germinating seeds and adipocytes is

(a) Lipase

(b) Proteases

(c) Cellulase

(d) Nuclease

B) Define the following term

i) pH scale
ii) Protein
iii) Mono saccharides
iv) Fatty acid
v) Biochemistry

C) Write short note on the following heads

1) Define Carbohydrate and write down its occurrence and importance
2) Classify the Carbohydrate with suitable example
3) Discuss the classification of Mono saccharides with suitable example
4) Discuss the properties of water with suitable example
5) Explained the role of protein in living organism
6) Discuss structure and classification of fatty acid with suitable example

D) Descriptive question

1) What is lipid? Classify lipids with examples and its importance
2) Define Amino acid with suitable example, Structure and its properties
3) Classify the amino acids with suitable example
4) Sketch the structure of Di(Maltose, Lactose, Sucrose and Poly saccharides(Starch an cellulose)
5) Sketch the structure of Fischer, Hawarth's projection, D,L form of Glucose and Fructose

Unit-II

A) Chose the correct answer

1) DNA fingerprinting recognizes the differences in

(a) satellite DNA

(b) bulk DNA

(c) Repetitive DNA

(d) both (a) and (c)

2) The process of DNA replication is affected by an enzyme known as

(a) Mutase

(b) Ligase

(c) Polymerase I

(d) Ribonuclease

3) If the DNA strand has nitrogenous base sequence ATTGCC, the mRNA will have?

(a) ATTGCA

(b) UGGACC

(c) UAACGG

(d) ATCGCC

4) Which of the following enzymes separates the two strands of DNA during replication?

(a) Gyrase

(b) Topoisomerase

(c) Helicase

(d) DNA polymerase

5). DNA replication is

(a) conservative

(b) conservative and discontinuous

(c) semi-conservative and discontinuous

(d) semi-conservative and semi-discontinuous

6) Which of the following is used in DNA replication studies?

(a) *Neurospora crassa*

(b) *Drosophila melanogaster*

(c) *Escherichia coli*

(d) *Pneumococcus*

7). Which of the following helps in opening of DNA double helix in front of replication fork?

(a) topoisomerase

(b) DNA polymerase-I

(c) DNA gyrase

(d) DNA ligase

8). DNA polymerase synthesizes

(a) DNA in 5'-3' direction

(b) DNA in 3'-5' direction

(c) mRNA in 3'-5' direction

(d) mRNA in 5'-3' direction

B) Define the following term

i) Axon
ii) intron
iii) DNA replication
iv) SSR
v) VNTR

C) Write short note on the following heads

1) Explain Holoenzyme with suitable example
2) Sketch the pathway of Biosynthesis of fatty acids
3) Define Bita-Oxidation of fatty acids and its different stages
4) Differentiate between A, B and Z DNA
5) Differentiate between DNA and RNA
6) Give a brief account of Watson and Crick's model of DNA

D) Descriptive question

1) Define enzyme, its characteristics and classification with suitable example
2) Define and classify RNA enumerating their properties
3) Explain Glyoxylate cycle and its significance
4) Explain Kreb's cycle and its significance
5) Elaborate different factors effecting enzyme activity

Unit-III

A) Chose the correct answer

1). what is plant tissue culture?
a) The technique of in vitro maintaining and growing cells
b) The technique of in vivo growing cells
c) The technique of growing plants in gardens
d) The technique of cutting plants
2). Tissue culture technique was first practised by _____
a) White
b) Haberlandt
c) Halperin
d) Skoog
3). Which of the following scientist was not responsible for developing somatic hybrids?
a) Steward
b) Halperin
c) Wetherell
d) Skoog

4). What is an explant?
a) A part of plant grown under soil
b) Any part of a plant taken out and grown in a test tube
c) A specific part of a plant grown in a test tube
d) Leaves grew under test tube
6. Essential requirement of an artificial medium in which explant is being regenerated is

a) the medium should have a sulphur source
b) the medium should have very low carbon concentration
c) the medium must provide a carbon source
d) the medium must provide a nitrogen donor
B) Define the following term
i) Totipotency
ii) Differentiation
iii) Dedifferentiation
iv) Redifferentiation.
v) Organogenesis

C) Explained in brief
1) Give an account of evolution and different stages of biotechnology development
2) Embryo rescue and its significance
3) Explain culture and its types based on growth media
4) Define media and explain its types
5). Briefly explain embryo culture and its application

D) Descriptive question

1) Explain Anther and pollen culture and its principle, methods, advantages and disadvantages
with application in crop improvement
2) Explain different types of culture in plant tissue culture
3) What is Somaclonal variation? Explain its achievement, advantages, disadvantages and
application in crop improvement.
4) Explain in detailed embryo culture and its application
5) What are synthetic seeds? How are they prepared?
6) Explain in detail cryopreservation with it technique and application in crop improvement

7) Explain in details cybrids and somatic hybridization with its advantages and disadvantages

41. Explain micro propagation and the stages, advantages and disadvantages of micro
Propagation

Unit-IV

A) Chose the correct answer

1) The set of DNAs generated by using random primers in a PCR reaction is called

a) RAPD

b) RFLP

c) AFLP

d) in situ hybridization

2) All the statements are true regarding RFLP and RAPD except

a) RAPD is a quick method compared to RFLP

b) RFLP is more reliable than RAPD

c) Species specific primers are required for RAPD

d) Radioactive probes are not required in RAPD

3) Molecular markers are used to construct
a) chromosome maps

b) cytogenetic maps
c) physical maps
d) all of these

4) The variation in the restriction DNA fragment lengths between individuals of a species is called
a) restriction Fragment Length Polymorphism (RFLP)
b) Random amplified Polymorphic DNA (RAPD)
c) Amplified Fragment Length Polymorphism (AFLP)
d) Simple Sequence repeats (SSR)

5) Locations of quantitative genes on chromosomes are called
a) Qualitative trait loci
b) Quantitative trait loci
c) both a and b
d) none of these

6) The set of DNAs generated by using random primers in a PCR reaction is called
a) RAPD
b) RFLP
c) AFLP
d) in situ hybridization

B) Define the following term
i) Ligase
ii) Restriction enzyme
iii) Transgenic plant
iv) VNTR
v) Recombinant DNA

C) Explained in brief
1) Write the short notes about biotechnology regulations
2) Briefly explain AFLP and SSR with its application
3) Briefly explain RFLP and RAPD with its application
4) Briefly explain DNA marker and its application
5) Briefly explained SSR marker and its application

D) Descriptive question
1) What is marker and explain different type of marker with suitable example
2) Explain in detail about Transgenic and its importance in crop improvement
3) Explain in detail about recombinant DNA technology
4) Explain PCR technique and its applications
5) Analyze in details different methods of gene delivery in the plant