FACULTY	AGRICULTURE, ENGINEERING, AND NATURAL SCIENCES		
SCHOOL	AGRICULTURE AND FISHERIES SCIENCES		
DEPARTMENT	FOOD SCIENCE AND SYSTEMS		
SUBJECT	FOOD BIOTECHNOLOGY		
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DURATION	2 HOURS	**MARKS**	100

FIRST OPPORTUNITY EXAMINATION

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This question paper consists of **three (3)** pages excluding this front page.

Instructions:

- **Answer any five (5) out of six (6) questions.**

QUESTION 1

a) Describe the nomenclature and basic structural features of plasmids pUC18 and pUC19. Include a labeled diagram illustrating the key components, similarities, and differences. **[10]**

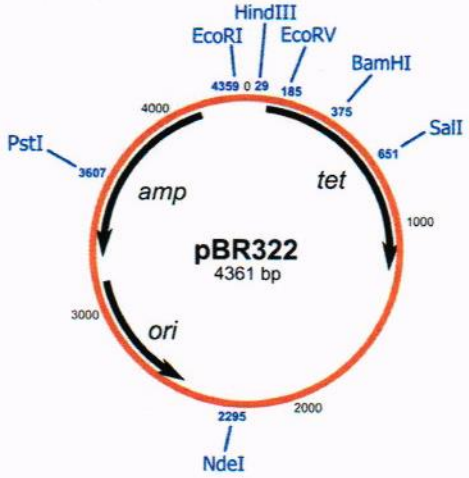
b) Briefly discuss why the sticky ends generated by restriction enzymes are more suitable for constructing recombinant DNA. **[4]**

c) Given a sketch of the pBR322 cloning vector and *E. coli* strains deficient in the α-subunit of a β-galactosidase gene, explain how you would differentiate the following *E. coli* strains when the BamHI enzyme was used to isolate the gene of interest from foreign DNA.

i) Non-transformed (wild type) *E. coli* strain. **[2]**

ii) Transformants carrying a non-recombinant pBR322. **[2]**

iii) Transformants carrying a gene of interest inserted. **[2]**



QUESTION 2

a) Briefly discuss how the following factors influence a fermentation process:

i) Temperature. **[5]**

ii) Rheology. **[5]**

b) Select five (5) hydrolytic enzymes that you deem most applicable in the food industry and discuss the reasons for your selections. **[10]**

i) α-Amylase

ii) Amyloglucosidase

iii) β-Galactosidase (lactase)

iv) Chymosin (rennin)

v) Glucose isomerase

vi) Glucose oxidase

vii) Invertase

viii) Lipases

ix) Papain

x) Pectinases

xi) Proteases (various)

xii) Cellulases

QUESTION 3

a) Briefly discuss the following methods applied in downstream processing:

- **i)** Flocculation **[4]**
- **ii)** Centrifugation **[4]**
- **iii)** Gel-filtration chromatography **[4]**

b) Briefly describe the reason for the following stages used in downstream processing:

- **i)** Product recovery process. **[4]**
- **ii)** Product formulation **[4]**

QUESTION 4

a) Briefly describe three (3) advantages of bacteriophages over plasmid-based cloning vectors. **[6]**

b) Briefly outline two (2) types of cloning vectors derived from bacteriophage lambda (λ). **[4]**

c) State the difference between the genomes of bacteriophage lambda (λ) and M12 bacteriophages. **[4]**

d) Choose one answer and give one (1) example of such an enzyme: **[4]**

i) Restriction enzymes that have restriction sites lying within the same recognition sequence are called:

Isoschizomers

Endonucleases

Neoschizomers

Exonucleases

ii) Restriction enzymes that recognize the same sequence but cut it differently (one cuts sticky ends and another cuts blunt ends) are called:

Isoschizomers

Endonucleases

Neoschizomers

Exonucleases

e) Using different restriction enzymes, state two (2) factors that determine the restriction patterns of an organism's DNA. **[2]**

QUESTION 5

a) Describe five (5) ways in which biotechnology has improved life quality through advancements in food production and processing. **[5]**

b) State any five (5) disadvantages of modern biotechnology practices in general. **[5]**

c) Indicate the use of the following biotechnology products in food processing: **[10]**

	Product	**Use**	**Organism**
1	Tryptophan		*Corynebacterium*
2	Riboflavin (Vit B)		*Ashbya gossypii*
3	Nisin		*Streptococcus lactis*
4	Methionine		*Ashbya gossypii*
5	Acetic acid		*Acetobacter aceti*
6	Malic acid		*Aspergillus spp.*
7	Inosinic acid		*Corynebacterium*
8	Citric acid		*Aspergillus niger*
9	β-carotene		*Blakeslea trispora*
10	Ascorbic acid (Vit C)		*Gluconobacter oxydans*

QUESTION 6

a) Define the term 'probiotics' and state three (3) of their health benefits to humans. **[4]**

b) Excluding probiotics, briefly explain four (4) additional health benefits associated with fermented food consumption. **[4]**

c) Briefly state the rationale of the following stages used in downstream processing:

i) Purification. **[2]**

ii) Release of intracellular products. **[2]**

d) Briefly discuss the following techniques used in downstream processing, mentioning The specific stage where each technique is applied:

i) Ion exchange chromatography. **[4]**

ii) Freeze-drying. **[4]**

END OF EXAMINATION