BRAINWARE UNIVERSITY

Ph.D. Course Work Examinations, September - 2026

Programme –Ph.D. in Science (Biotechnology)

Course Name – Instrumentation, techniques and related ethical principles in Biotechnology

Course Code – PHD – BTG01A

(Semester – 1)

Full Marks: 100 **Time: 4 hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group –A

(Multiple Choice Type Questions) 1 x 10 = 10

1. Choose the correct alternative from the following :

i) Which fluorescent protein is most commonly used in FRET experiments

a Hemoglobin b Rhodopsin

c Green Fluorescent Protein (GFP) d Myosin

ii) The primary advantage of confocal microscopy is:

a A. Low magnification b Observation without lenses

c Optical sectioning and 3D image reconstruction d Imaging only dead cells

iii) MIC stands for:

a Minimum Infection Concentration b Maximum Inhibitory Concentration

c Minimum Inhibitory Concentration d Minimum Incubation Count

iv) A researcher wants to determine the lowest concentration of a new antimicrobial nanoparticle that prevents visible bacterial growth. Which test should be performed?

a Disk diffusion test b Gram staining

c MIC assay d ELISA

v) To detect protein–protein interaction inside a living cell, the most suitable technique is:

a FRAP b FRET

c SEM d TEM

vi) After determining the MIC, a microbiologist wants to know whether the antimicrobial agent actually kills bacteria rather than only inhibiting growth. Which test should be performed?

a Catalase test b Kirby-Bauer test

c MBC determination d Coagulase test

vii) A laboratory aims to detect rare mutant alleles present at a frequency below 0.1% without relying on standard curves. Which method would you recommend after evaluating the available techniques?

a Real-Time PCR b Microarray

c Droplet Digital PCR d Northern blotting

viii) A clinician must select the most suitable sequencing method to identify a novel disease-causing mutation across the entire exome. Which option should be selected?

a Sanger sequencing
b Restriction mapping
c Southern blotting
d Next Generation Sequencing (NGS)

ix) A pharmaceutical company requires absolute quantification of a therapeutic biomarker protein with high analytical accuracy. Which method would you recommend?

a. Relative quantification by Western blot
b. ELISA only
c. Absolute quantification using isotope-labeled standards and MS
d. Coomassie staining

x) A DNA microarray experiment shows simultaneous upregulation of hundreds of genes involved in inflammation. Analyze is the most appropriate interpretation of this result?

a The genes have identical DNA sequences.
b The proteins encoded are structurally identical.
c The genes are likely co-regulated under inflammatory conditions.
d All genes are mutated.

Group – B

(Short Answer Type Questions) 5 x 6 = 30

Answer the following questions :

2. Differentiate between primary cell culture and established cell lines.
3. Explain the working principle of confocal microscopy.
4. Explain the principle of Fluorescence-Activated Cell Sorting (FACS).
5. Discuss the applications of nanoparticles as antimicrobial agents.
6. Assess the role of tandem mass spectrometry (MS/MS) in the identification of post-translational modifications (PTMs). Discuss the major analytical challenges encountered during PTM characterization and suggest strategies to overcome them.
7. Discuss the ethical issues associated with plant and animal tissue culture.

Group – C

(Long Answer Type Questions) $10 \times 6 = 60$

Answer the following questions :

8. A pharmaceutical company has developed a new antibacterial nanoparticle. Design an experimental protocol to evaluate its antimicrobial efficacy using disk diffusion, MIC, and MBC assays. Explain how the results would be interpreted.

9. Analyze the various methods used for isolation and purification of DNA, RNA, and proteins from complex biological mixtures.

10. A stem cell research laboratory proposes the establishment of a human stem cell bank for regenerative medicine. Discuss the ethical, legal, and biosafety issues associated with cell and tissue culture, along with measures to ensure responsible research practices.

11. A clinician suspects that inappropriate antibiotic use has contributed to the development of antimicrobial resistance in a patient. Explain the mechanisms of AMR and discuss how antimicrobial susceptibility testing can guide appropriate treatment.

12. A tissue culture laboratory repeatedly experiences contamination in animal cell cultures. Identify the possible sources of contamination and propose a strategy to prevent and control contamination while maintaining healthy cell lines.

13. A cell biology laboratory aims to study mitochondrial morphology and protein localization simultaneously in living cells. Propose an appropriate microscopy strategy using fluorescence and confocal microscopy. Justify your choice

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