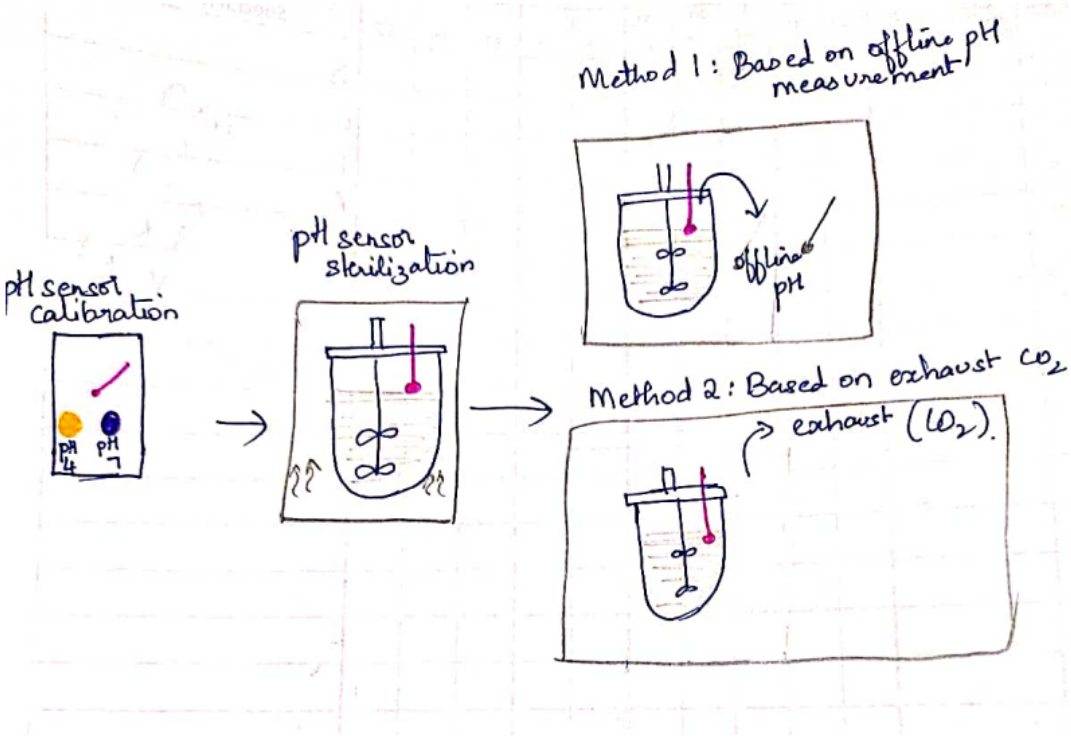
1. Show pictorial view of the pH balance in a bioreactor. Also show how you will maintain necessary air supply.
   Ans : In a bioreactor, temperature, pH, substrate, salts, vitamins, and oxygen are maintained. Aeration is provided by gas sparging via a sample sparger near the fermenter base.

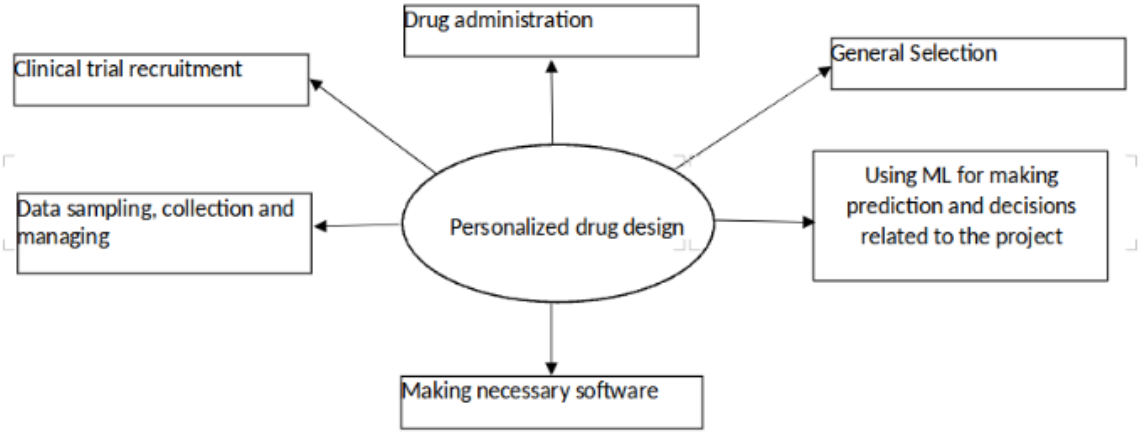


2. Mention the enzymes needed to prepare a DNA sample before pushing it through gel electrophoresis.
   Ans :
   - Lysozyme – to break bacterial cell wall.
   - Cellulase – to break plant cell wall.
   - Chitinase – to break fungal cell wall.
   - Ribonuclease – removes RNA.
   - Protease – removes proteins (such as histones that are associated with DNA).
3. Name the goods you would like to protect against biopiracy that is native to Bangladesh (Naming 5 would be sufficient).
   Ans : When any biological material is sold in the market without taking any permission of the actual author or without giving any kind of credit to the actual author is called biopiracy. The five goods thats need to protect against biopiracy are:

- Dhaka muslin.
- Jamdani Saree.
- Nokshi Katha Saree
- Hilsha Fish
- Royal Bengal Tiger

4. Do you think you have scope to give your input as a computer engineer in personalized drug design?

   Ans : Drug design is the inventive process of finding new medications based on the knowledge of a biological target. As a Computer engineer i can be can be helpful to scientists in minimizing the synthetic and biological testing efforts by focussing only on the most promising compounds.These drugs are known as computer aided drug design.It can be applied during various stages in drug discovery: targeted identification, validation, molecular design, and interactions of drug candidates with targets of interest.



5. Show the pictorial view of the PCR chain including polarities for DNA.

   Ans : PCR or Polymerase Chain Reaction is a technique used in molecular biology to create several copies of a certain DNA segment. A PCR reaction needs the following components:

   DNA Template : The DNA of interest from the sample.

   Primers : Short, chemically synthesized, single-stranded pieces of DNA that are complementary to the DNA fragment of interest.

DNA Polymerase : The enzyme that elongates the primers by adding nucleotides to it, using the desired DNA fragment as a template. This enzyme needs to be able to withstand high temperatures used in the PCR reaction. Therefore, scientists isolated a thermostable DNA polymerase from the bacterium Thermus aquaticus. It is known as Taq polymerase.

Nucleotides : Single bases A, T, C, and G are the building blocks of DNA synthesis in a PCR reaction.

Buffer system: The buffer contains potassium and magnesium that are essential for the DNA denaturation and renaturation steps. It also contains other factors important for enzyme activity, fidelity and stability.

Steps in a PCR Reaction :

- Denaturation.
- Annealing.
- Elongation/Extension.

6. Mention the name of the characteristics of a competent host. How you would apply a complete rDNA to a plant (mention only the names of the means you are going to use).
   Ans : Host cells are bacterial cells which take up the recombinant DNA. Since DNA is hydrophilic, it cannot pass through the cell membrane of bacteria easily. Therefore, the bacterial cells have to be made 'competent' to take up the DNA. There are several other methods to introduce foreign DNA into host cells.
   - Microinjection
   - Bolistics or gene gun.
7. Suppose you have a restriction enzyme that has a recognition sequence GCCG. How you would complete the rDNA for a given sequence of one strand as below shown in a pictorial view (You need to complete the DNA with a complementary strand before starting the process).
   ATAACGATAGCCGTATTATGCAATGCATTACGAGCCGTATAAT
   Ans : Sequence **GCCG**

   ATAACGATA|**GCCG**TATTATGCAATGCATTACGA|**GCCG**TATAAT

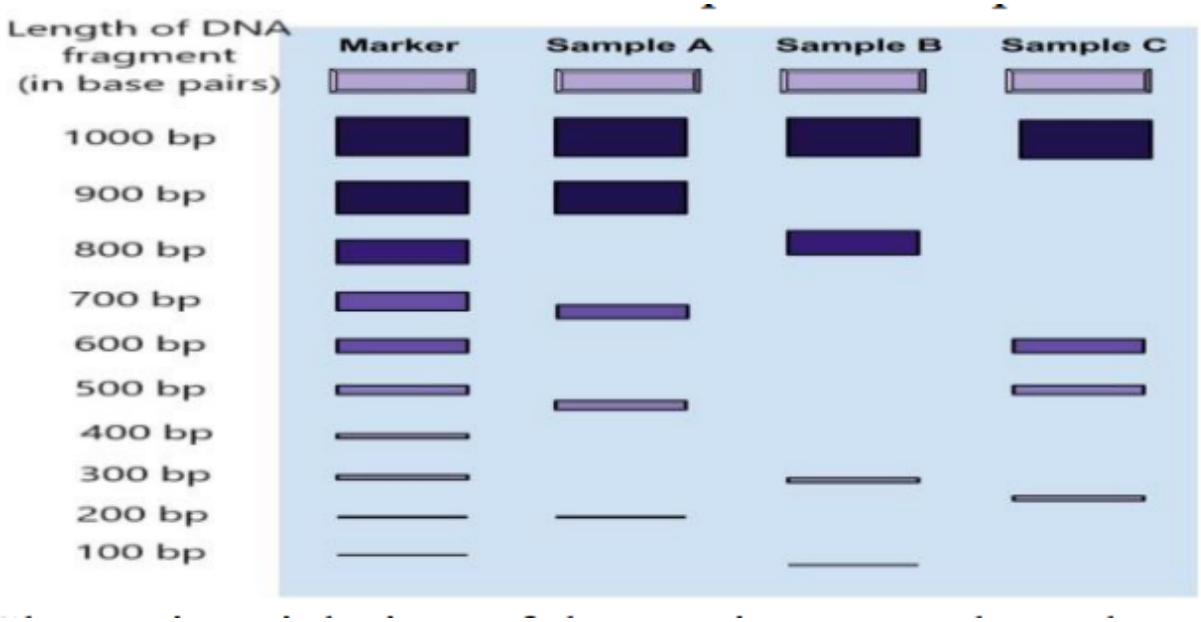
TATTGCTATCGGC|ATAATACGTTACGTAATGCTCGGC|ATATTA

GCCGTATTATGCAATGCATTACGA

ATAATACGTTACGTAATGCTCGGC

ATC**GCCGTATTATGCAATGCATTACGA**GCCGTAC
TAGCGGCT**ATAATACGTTACGTAATGCTCGGC**ATG

8. Find the total number of base pairs of sample “A” and “C” from below.



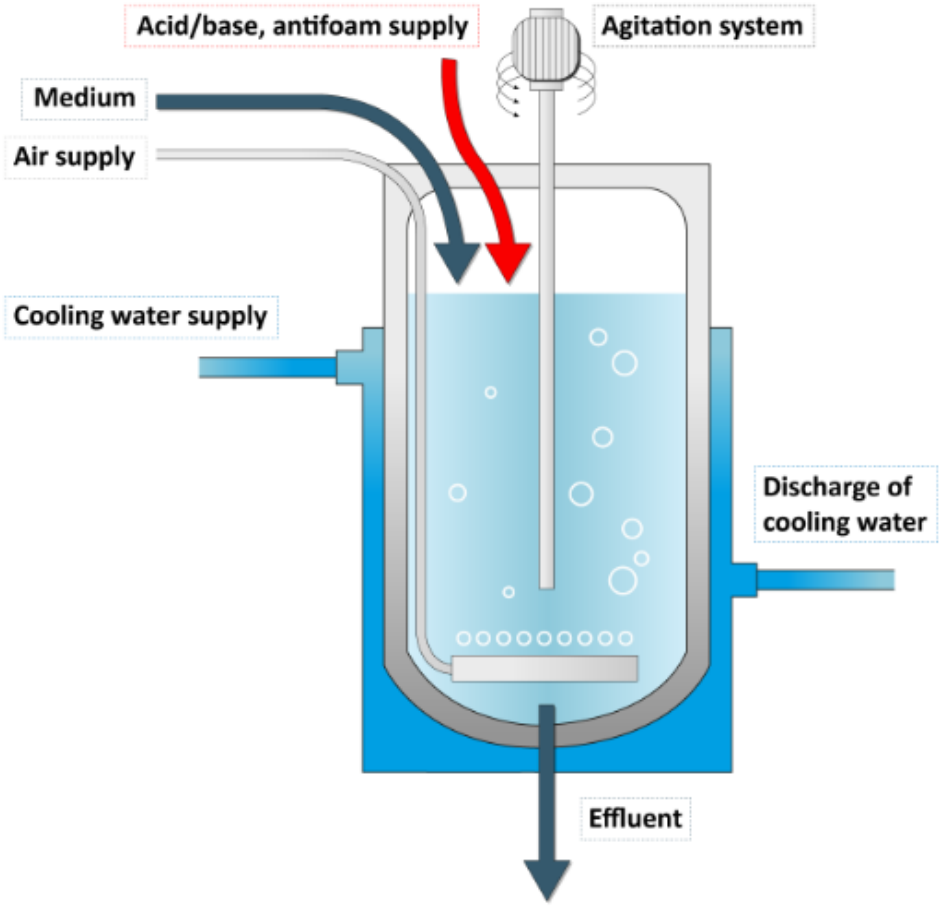
Ans : Total number of base pairs of sample “A” and “C” is given below

Sample **A**	Sample **C**
1000	1000
900	600
680	500
450	280
200	000
Total = 3230	Total= 2380

9. Show pictorial view of the nutrients supply and temperature control in a bioreactor.

   Ans :

Bioreactor



10. Do you think we need a protocol to monitor transgenic animal issues? Propose some basic points that you think we should include in the protocol (it should be very brief).

    Ans :

    Yes, I think we need a protocol to monitor transgenic animal issues.

    Protocols to monitor transgenic animal issue:

    - Justifying why the particular transgenic animal is being created involves weighing the benefits of the experiment versus the consideration of the ethical cost of the experiment in terms of the potential suffering of the animal.

- Ensure that the well being of the animal and the environment is protected.
- Evaluate the standard operating procedures for laboratory management, animal welfare and human health.
- Regular government framework to ensure animal safety.
- Predicating the risk before initialization.
- Making awareness among people
- Making sure the implementation of those rules and that they're followed as well.

11. Do you think you have scope to give your input as a computer engineer in gene therapy for a project? Give details.

    Ans : Genes are the segments of DNA that produce protein to perform a vast area of function in the body. If the gene is muted or disabled then it produces damaged protein or no protein as a result it can cause diseases to the human body.

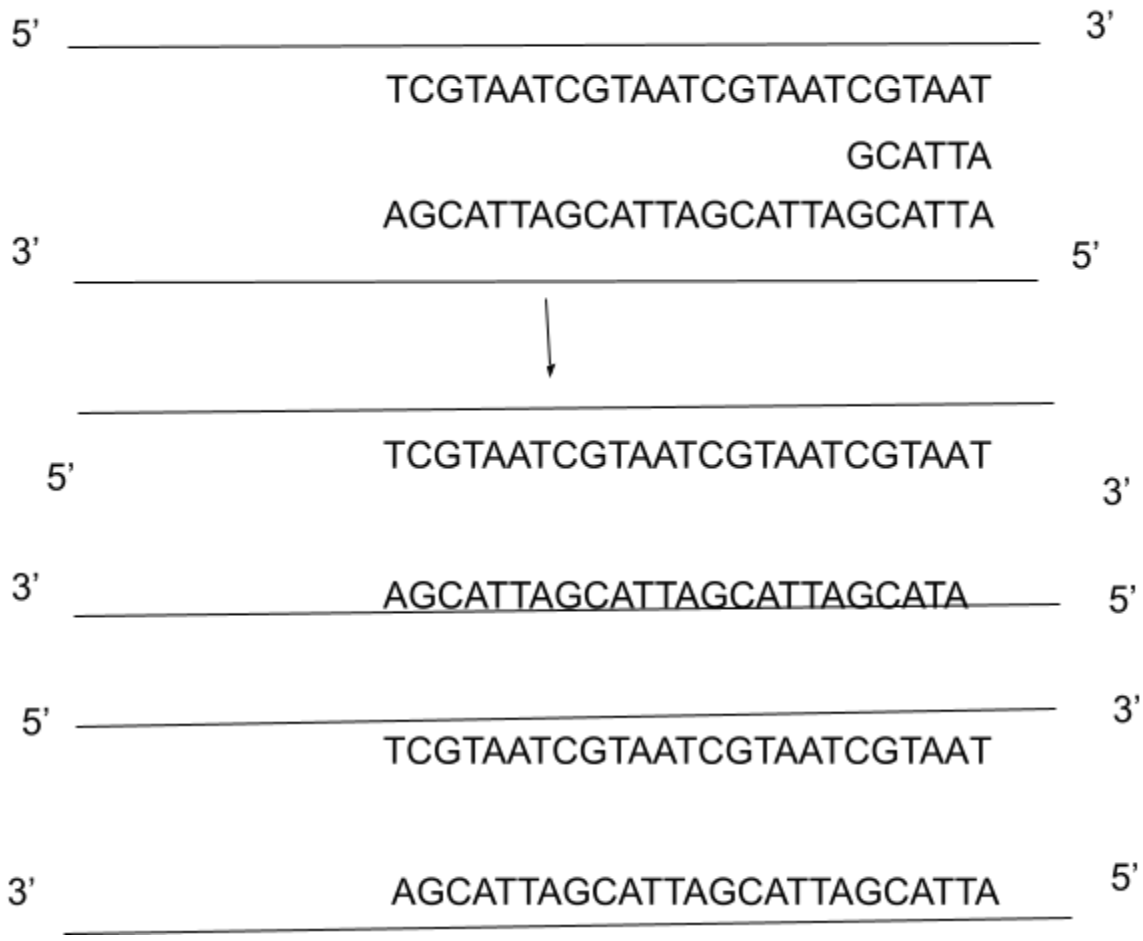
    In gene therapy functional copy of a gene is delivered into a patient's own cell. Normal protein that has been produced from functional genes has the ability to correct the underlying cause of the diseases.
    As a computer engineer I can introduce AI and Machine learning in the field of gene therapy. ML can be used in several sectors like:
    - Genome sequencing
    - Gene editing(CRISPR editing tool)
    - Genetic testing and so on.

12. Name the specific fields where you can give your input as a computer engineer.

    Ans :
    - Gene Therapy
    - Pharmacogenomics
    - Synthetic Biology
    - Molecular Diagnosis
    - Drug Design

13. Suppose you have a primer sequence GCATTA. In PCR you have a fragment of DNA with 25 spaces for bases which will repeat itself after every six sequences. If the above mentioned primer fits on the right hand side of your desired DNA strand, show the whole DNA strand before and show the whole picture after the elongation process.

Ans: Sequence: GCATTA



14. Why do you put DNA samples in the negative terminal of the device for gel electrophoresis?

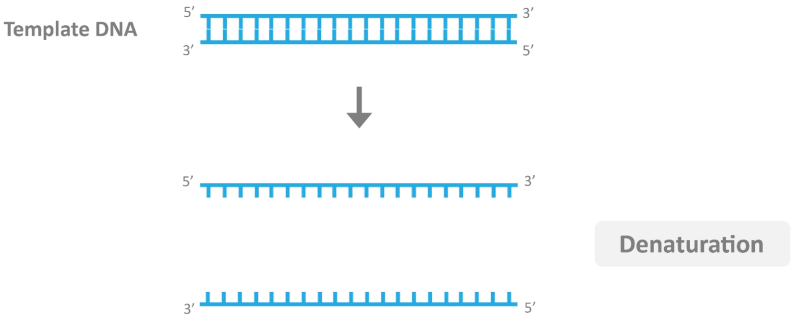
Ans : DNA is a negatively charged particle. In gel electrophoresis the well is negatively charged and the opposite is positively charged. As we know, negative charged particles are attracted by the positive electrode so DNA fragments will travel towards the positive side from the negative well. DNA fragments travel at different speeds of their size. For traveling the DNA fragments we put DNA samples on the negative side.

CT-03

1. Give a pictorial view of differences and /or similarities between denaturation and annealing in PCR.

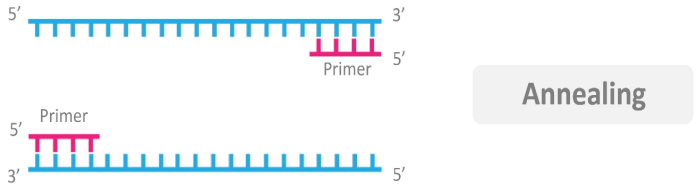
   Ans : Denaturation:

   - Temparature : 92-94C.
   - Double stranded DNA melts into single stranded DNA.
   - Breaking the weak hydrogen bonds between the two DNA strands.



   Annealing :

   - Temperature : 54- 60°C
   - The primers bind (anneal) to their complementary sequence in the template DNA.



2. Name the criteria of a component host for rDNA.

   Ans : See q6.

3. Name the applications of rDNA in the medical field.

   Ans : rDNA technology refers to the process of joining DNA molecules from two different sources and inserting them into a host organism, to generate products for human use.

   The applications of rDNA in the medical field are given below :

   - Insulin:
   - Vaccines
   - Human Growth Hormones
   - Monoclonal Antibodies
   - Interferon

- Antibiotics

4. Do you think you have scope to give your input as a computer engineer in molecular diagnosis for a project?Give details.
5. Suppose you have a restriction enzyme that has a recognition sequence TGCCGA. How you would complete the rDNA for a given sequence of one strand as below shown in a pictorial view (You need to complete the DNA with a complementary strand before starting the process).
   ATATCGCCGAACTTGCATCTGACGATCGTTATCGATCGACCGGT
   CGCCGAATTGCATCG