 **ST. JOSEPH’S COLLEGE (AUTONOMOUS), BENGALURU - 27**

Register Number:

Date: **28-07-2022**

**M.Sc. BIOTECHNOLOGY - II SEMESTER**

**SEMESTER EXAMINATION: APRIL 2022**

**(Examination conducted in July 2022)**

**BT DE 8521: Stem Cell Biology and Next Gen Therapeutics**

**Time- 2 ½ hrs Max Marks-70**

**This question paper contains TWO printed pages and THREE parts.**

**Part A (Answer *ANY TEN* questions) 2mx10=20marks**

1. You have some frozen sperm from the wooly mammoth. How would you generate pluripotent stem cells from them to revive the mammoths?
2. How can artificial blood be *efficiently* generated in the future?
3. What is the relationship between stem cells and tumors?
4. What is the dock and block mechanism mediated by therapeutic antibodies?
5. List four drug delivery systems used to deliver small molecules, RNA or proteins.
6. What are the major types of hematopoietic progenitors?
7. A scientist, while trying to derive ESCs, made a mistake and isolated cells from the gastrula stage instead of the blastula stage. What cells will they obtain in their culture?
8. How will you decellularize a piece of bone and how will you test that its completely devoid of cells?
9. How does functionalization and 3D printing improve the quality of scaffolds?
10. Scientists are trying to generate ESCs without destroying the embryo. Suggest a method that you would like to try.
11. What are the advantages and disadvantages of using pancreatic beta cell progenitors instead of using fully differentiated beta cells?
12. Why do scientists make and store hundreds of lines of ESCs derived from different embryos?

**Part B (Answer *ANY FIVE* questions) 6mx5=30marks**

1. Patient X is suffering from Type I diabetes and glucagon deficiency. What regenerative therapy will you suggest for them, describe in detail.
2. Antibody-conjugates have diverse applications and are likely to be in clinical use in the future. Describe any antibody-drug-conjugate, its synthesis and potential use.
3. What are acellular engineered tissues and what are their disadvantages compared to hybrid engineered tissues? How would you improve their function with respect to engraftment and stem cell differentiation?
4. Liver cirrhosis can be a fatal disease if left untreated. The main challenges for regenerative therapy are immune rejection, complete vascularization and the risk of tumorigenesis. Based on your knowledge of tissue engineering, design a liver tissue that will take care of all these challenges.
5. Adult stem cells have various markers that can be used to enrich them. How will you use negative magnetic selection for this purpose and why is it preferred over positive selection?
6. Illustrate the siRNA pathway in detail. How will you ensure the siRNA molecules are not degraded quickly and have low off-target effects?
7. Many cell-based therapies incorporate a suicide switch as an insurance policy. Describe their molecular basis and under what conditions would you trigger them?

**Part C (Answer *ANY TWO* questions) 10mx2=20marks**

1. Gullu is a fully grown stem cell (G1-phase), waiting to divide. What can be the fate of Gullu’s daughters, Goli and Gilli, and what factors does it depend on? Gullu seems to be unaware that he has made an error during replication in the S-phase, and thus, developed a nonsense mutation in the newly synthesized DNA Polymerase gene. How will it impact Goli and Gilli, explain.
2. Describe the various phases of a clinical trial, highlighting their importance. A drug which passed all the pre-clinical phases, using standard cancer cell lines in vitro, failed in the first stage of the clinical trials. Enumerate the possible reasons for its failure. What changes will you, as the new lead scientist, make to the pre-clinical testing?
3. PROTACS are one of the most promising technologies to come out of the last decade. Describe their molecular mechanism using a diagram. What are their advantages and disadvantages over conventional siRNA knockdown. Suggest an alternative to the standard effector protein used with PROTACS, along with your reasoning.