

MASTER OF BIO-MEDICAL ENGINEERING FIRST YEAR SECOND SEMESTER – 2025

DESIGN OF IMPLANTS AND ARTIFICIAL ORGANS

Time :3h

Full Marks: 100

A. Answer any ten questions. (Write T/F)

10X1=10

1. 1/3 of blood supply to Liver is through portal vein.
2. One mg of international standard of insulin equals to 16 units.
3. In 1st° burn loss of epidermis takes place.
4. 20% deficit in blood volume can lead to irreversible shock.
5. Even on 50% loss of hematocrit O₂ delivery is not comprised.
6. Free hemoglobin can lead to kidney toxicity.
7. Biotransformation is one of the main functions of lung.
8. Hydrophobic membranes of dialysis unit trigger complement activation.
9. Dextran is an oxygen carrying colloid.
10. Contact area of knee joint doesn't changes during flexion.
11. Activated charcoal is an excellent sorbent,
12. In hemodialysis exchange of water don't take place due to absence of convective transport.

B. Answer any six questions.

6X15=90

- i. What are the main functions of human (normal) kidney? What do you mean by dwell time? If concentration of urea in blood of a person is 200mg/100mL, then find the concentration of urea in blood after hemodialysis when $K = (1/60) \text{ min/cm}$, $A = 10^5 \text{ cm}^2$, $Q_B = 200 \text{ mL/min}$ of a patient and explain the health condition of that person. Write the drawbacks of kidney transplantation. Write about membrane modules present for hemodialysis? 2+2+5+2+4 **CO1, 5**
- ii. Name different liver assist devices. Write a short note on facilitated transport for liver failure. 5+10 **CO3, 5**

- iii. What are the main functions of skin? What options are present for artificial skin? Write design parameters of permanent skin replacement. What membrane materials are used to fabricate artificial lung and what are their advantage and disadvantage? 2+3+6+4 **CO1, 2**
- iv. Write short note on Novalung. Write how CO₂ removal rate plays an important role in design of artificial lung. Write a strategy to improve the CO₂ removal in hollow fiber membrane oxygenator. Name types of total joint replacement and bones involved in normal joint for (ii & iii) of the following joints, i. Wrist, ii. Elbow, iii. Ankle, iv. Finger. 2+2+2+4+5 **CO4, 5**
- v. Write the steps of systemic approach for design of artificial heart including the general parameters one should consider during design of an artificial organ. Also indicate the steps. Write a short note on natural insulin structure and also write who has invented it. 8+2+2+3 **CO2, 5**
- vi. Which of the following joints: i) hip, ii) knee; is more stable and explain why? Describe shoulder joint with special reference to its high range of motion. Write the advantages and disadvantages of different ceramic and polymer materials when used in hip implant. 6+6+3 **CO4**
- vii. Write a short note on insulin administration system. 15 **CO3, 5**
- viii. Write a short note on peritoneal membrane. Write the indications of insulin lack. Write the causes of liver failure. What is parabolic dialysis? Name different parts of hemodialysis machine. Name one housing and potting material of hemodialysis machine. **CO1,5**
3+4+2+2+2+2