CS/B.Tech (BME)/SEM-7/BME-702/2009-10
2009
ARTIFICIAL ORGANS & REHABILITATION ENGINEERING

Time Allotted : 3 Hours   Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1.   Choose the correct alternatives for the following : $10 \times 1 = 10$

   i)   The roller pump, centrifugal pump, oxygenator are components of an

   a)   artificial heart lung device

   b)   artificial kidney

   c)   artificial pancreas

   d)   artificial liver.

   ii)   Skin autografting is done using healthy skin from

   a)   same individual   b)   different individuals

   c)   cadaver skin   d)   artificial skin.

77524   [Turn over

iii) The acceptance of an implant by a surrounding tissue is called

    a) bioacceptance   b) biocompatibility

    c) biodiversity   d) biosensitivity.

iv) Juvenile diabetes is an

    a) auto immune disease

    b) age related disorder

    c) infectious disease

    d) none of these.

v) In artificial blood PFC stands for

    a) phosphours, flourine, chlorine

    b) polytetra fluoro carbon

    c) per fluoro carbon solution

    d) none of these.

vi) In blood rheology haematocrit is

    a) the volume of RBC percentage of the volume of whole blood

    b) the time taken for RBC to settle down in a tube of anti-coagulated blood sample

    c) the volume of WBC percentage of the volume of whole blood

    d) the volume of platelet percentage of the volume of whole blood.

vii) The term orthotics is associated with

    a)   devices those replace a body part

    b)   devices those augment the function of an extremity

    c)   devices those mimic the function of a heart

    d)   devices those mimic the function of a lung.

viii) The middle molecule of haemodialysis is

    a)   prothrombin

    b)   gloubulin

    c)   inulin

    d)   insulin.

ix) Which bone is used in bone-conduction audiometry ?

    a)   Incus   b)   Humerous

    c)   Radius   d)   Mastoid.

x) The structural and functional unit of kidney is

    a)   filtering membrane   b)   uterus

    c)   nephron   d)   renal artery.

GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. What do you mean by Rehabilitation engineering ? Explain the terms orthotics and prosthetics. 3 + 1 + 1

3. With the help of a suitable block diagram explain the functioning of an artificial kidney. A patient weighing 70 kg, has a dialyzer clearance of 300 ml/min and the dialysis session lasted for 3 hrs. Assuming that the body is about 60% water by weight find the Kt/V ratio. Do you think the patient had optimum dialyzer clearance ? Express your views. 2 + 3

4. Explain the process of regeneration of artificial skin. Why do you think immuno-suppressives are necessary for the above mentioned process ? 3 + 2

5. a) Calculate the blood flow velocity through ascending aorta and its Reynolds number. [inner dia. of aorta 2·0 cm, cardiac output 70 ml/beat working at normal rate, blood viscosity 3·5 c.p. & sp. gr. of blood 1·056]
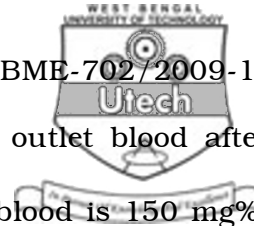
b) Calculate the urea concentration in outlet blood after single dialysis. [Urea conc. in inlet blood is 150 mg%, mass transfer coefficient 1/60 min/cm, membrane area 1 m^2 and blood flow rate 200 ml/min.]   (2 + 1) + 2

6. How can you improve the function of partially inactive hand or upper extremities by using electrical/electronic circuitry ?

7. What are the different types of Biomaterials used for artificial implants ? What are their limitations ?   3 + 2

GROUP – C
(Long Answer Type Questions)
Answer any *three* of the following.   3 × 15 = 45

8. a) What do you mean by blood rheology ? Mention different factors which affect rheological properties of blood.

   b) Briefly explain the problems associated with ECD.   8 + 7

9. In artificial pancreas what are the different insulin administration systems ? What are glucose sensors ? What is the role of glucose oxidase in a glucose sensor ? What are liver assist devices (LAD) ? How do they function ?

      6 + 3 + 2 + 4

10. What are hearing aids ? Differentiate between Air conduction and Bone conduction hearing. Give the functional diagram of an audiometer. What is masking in an audiometer ?

3 + 3 + 5 + 4

11. What do you understand by cardiac valve prosthesis ? What are different types of mechanical heart valves used now-a-days ? What are bioengineered heart valves ? Explain with example. 5 + 5 + 5

12. a) Why is an artificial lung needed during bypass heart surgery ? What is a myoelectric arm ? How does it function ?

b) Silicone rubber is designed as an extracorporeal membrane oxygenator for heart-lung bypass surgery. Calculate the area of membrane, which is fed with 100% pure O_2 (water saturated) at 37° C. [Cardiac output 4 L/min, gas flow rate 10 L/min, O_2 and CO_2 transfer rate 5·7 and 4·5 ml/100 ml of blood, membrane permeability of O_2 and CO_2 0·51 and 2·72 c.c./min-mm Hg at STP, partial pr. of water vapour is 47 mm of Hg at 37° C]. (3 + 2 + 3) + 7

13. a) Explain hemodialysis machine with a neat sketch. Deduce the equation for artificial kidney or overall mass-transfer in dialyzers. What are the criteria for an ideal hemodialysis machine ?

b) Write short notes on artificial blood.   (5 + 3 + 3) + 4