



**106**

**Bio-Medical Engineering**

TIME : 3 HOURS

MAXIMUM MARKS : 300

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**INSTRUCTIONS :**

1. *All questions are compulsory.*
  2. *Question Paper may be divided into 4 (four) Sections from Section-A to Section-D and carry marks as under :*
    - a. *Section - A - Total 3 Questions having two parts, i.e. (a) and (b) each questions carries 12 marks × 3 Questions = Total 36 Marks.*
    - b. *Section - B - Total 3 Questions having two parts, i.e. (a) and (b) each questions carries 20 marks × 3 Questions = Total 60 Marks.*
    - c. *Section - C - Total 3 Questions having two parts, i.e. (a) and (b) each questions carries 28 marks × 3 Questions = Total 84 Marks.*
    - d. *Section - D - Total 3 Questions having two parts, i.e. (a) and (b) each questions carries 40 marks × 3 Questions = Total 120 Marks.*
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**SECTION - A**

(Each question is of 12 marks and each sub part (a) and (b) are of 6 marks each)

- 1 (a) Give examples of three biomaterials (Metals or alloys).  
(b) Explain biocompatibility and bioresorbability with two materials each.
- 2 (a) What are the three types of joints in human body ?  
(b) What is a pacemaker ? What is the typical estimated life cycle of a pacemaker ?
- 3 (a) If  $E$  is the energy and  $P$  is the power of any continuous time signal  $x(t)$ , then, what is the condition for  $x(t)$  to be
  - (i) an energy signal,
  - (ii) a power signal  
(b) Differentiate between stationary and non-stationary signals.

## SECTION - B

(Each question is of 20 marks and each sub part (a) and (b) are of 10 marks each)

- 4 (a) Draw internal architecture of 8279 keypad and display controller.  
(b) Find the Fourier transform,  $F(s)$  of functions
- (i)  $f(t) = te^{-at}$  for  $t \geq 0$  and 0 otherwise.  
(ii)  $f(t) = |t|$ .

$$\left[ \text{Note : } F(s) = \int_{-\infty}^{\infty} f(t)e^{-i\omega t} dt \right]$$

- 5 (a) Define different types of muscles based on structure and function.  
(b) Calculate Reynold's number for the blood vessel having following  
 $\rho = 1060 \text{ kg/m}^3$ ;  $\mu = 3 \times 10^{-3} \text{ Pa.s}$ ;  $v = 3000 \text{ cm/min}$ ;  $D = 30 \text{ mm}$
- 6 (a) Define Coquette and Poiseuille flow with simple diagrams.  
(b) Explain isometric, concentric and eccentric contraction.

## SECTION - C

(Each question is of 28 marks and each sub part (a) and (b) are of 14 marks each)

- 7 (a) If  $e(n)$  is error sequence of stationary white noise, prove  
$$E[e(n-m)e(n-1)] = \sigma_e^2 \delta(l-m).$$
- (b) Determine the autocorrelation  $y_{xx}(l)$  of the random sequence  
 $x(n) = A \cos(\omega_0 n + \phi)$  where the amplitude  $A$  and the frequency  $\omega_0$  are constants and  $\phi$  is a uniformly distributed random phase over the interval  $(0, 2\pi)$ .

- 8 (a) Draw a cross-section of heart and mark the sections of heart and indicate the blood flow path. (Start with Number 1 indicating the blood flow to heart from superior and inferior vena cava and do sequential numbering)
- (b) Explain the action of sarcomere during muscle contraction with diagram.
- 9 (a) Define artifacts. What are the sources of artifacts in ECG ?
- (b) What is a biopolymer ? Explain in detail about collagen.

### SECTION - D

(Each question is of **40** marks and each sub part **(a)** and **(b)** are of **20** marks each)

- 10 (a) What does the following program do : Explain each line of the program.

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org 00h
mov r0; #20h
mov r1; #30h
mov r3; #5
back : mov a, @r0
xch a, @r1
mov @r0, a
inc r0
inc r1
djnz r3, back;
sjmp $
end

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- (b) Draw a knee joint and identify the six ligaments.

- 11 (a) Explain hemodialysis machine in detail with diagram showing important components of it.
- (b) Explain Oscillometric method for blood pressure measurement with diagram.
- 12 (a) A 22 cm long tube with a diameter of 3.25 mm is filled with blood. Use property values for blood  $\mu = 3.5 \text{ cP}$ ,  $\rho = 1.06 \text{ g/cm}^3$ . What is Q when applied pressure ( $\Delta p$ ) = 20 Pa, calculate the flow resistance, power developed by the heart, velocity and shear stress. For the same tell the flow nature of the blood.
- (b) Describe natural sutures and artificial sutures with their advantages and disadvantages.
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