

2009

**MICROBIOLOGY**

PAPER—IX

*Full Marks : 50**Time : 2 hours*Answer any **two** questions from each Group*The figures in the right-hand margin indicate marks**Candidates are required to give their answers in their own words as far as practicable**Illustrate the answers wherever necessary***Write the answers questions of each Group  
in separate books**

GROUP—A

[Marks : 20]

1. Answer any *four* questions : $2\frac{1}{2} \times 4$ 

(a) Evaluate :

$$\lim_{x \rightarrow 0} \frac{\sin(x)^2}{x}$$

(Turn Over)

(b) Evaluate :

$$\lim_{x \rightarrow 0} \left( \frac{1}{\sin x} - \frac{1}{\tan x} \right).$$

(c) A function is defined as follows :

$$\begin{aligned} f(x) &= x \quad \text{when } 0 < x < 1 \\ &= 2 - x \quad \text{when } 1 \leq x \leq 2 \\ &= x - \frac{1}{2} x^2 \quad \text{when } x > 2. \end{aligned}$$

Show that  $f(x)$  is continuous at  $x = 2$ .

(d) If

$$y = \log \left( x + \sqrt{x^2 + a^2} \right) \quad \text{find } \frac{dy}{dx}.$$

(e) If

$$y = e^{ax^2 + bx + c} \quad \text{find } \frac{dy}{dx} \quad \text{at } x = 0.$$

(f) Discuss the geometrical significance of  $\frac{dy}{dx}$  of a curve  $y = f(x)$ .

(g) Evaluate :

$$\int \sqrt{1 + \sin 2x} \, dx .$$

2. Answer any five questions :

2x5

(a) Find :

$$\lim_{x \rightarrow 3} \frac{x-3}{\sqrt{x-2} - \sqrt{4-x}} .$$

(b) Find :

$$\lim_{h \rightarrow 0} \frac{1}{h} \left\{ \frac{1}{x+h} - \frac{1}{x} \right\} .$$

(c) Show that :

$$\left. \begin{aligned} f(x) &= x, \quad x > 0 \\ &= 0, \quad x = 0 \\ &= -x, \quad x < 0 \end{aligned} \right\} \text{ is}$$

continuous at  $x = 0$ .

(d) If

$$y = \frac{\sin x - \cos x}{\sin x + \cos x},$$

find  $\frac{dy}{dx}$ .

(e) If

$$s = ut + \frac{1}{2} ft^2,$$

find  $\frac{ds}{dt}$  when  $t=2$ .

(f) Find

$$\int \frac{dx}{e^x + e^{-x}}.$$

(g) Find

$$\int \frac{\sin 2x \, dx}{(a + b \cos x)^2}.$$

(h) Evaluate

$$\int_{-2}^{-1} \frac{dx}{(11 + 5x)^3}$$

3. (a) When does the function  $\sin 3x - 3 \sin x$  attain its maximum or minimum values in  $(0, 2\pi)$ ?

(b) Let the growth of a microorganism satisfy the differential equation :

$$\frac{dp}{dt} = KP - \beta P^2$$

where  $P(t)$  be the population of microorganism at time  $t$  and  $K, \beta > 0$ . Show that rate of growth

will be zero when  $P=0$  and  $P = \frac{K}{\beta}$ . What is the maximum level of population?

4 + 6

## GROUP—B

[Marks: 20]

4. The following frequency distribution shows the Protein Intake of 400 families :

Table : Protein Intake of 400 families :

Protein Intake unit/day (gram)	No. of families
15—25	30
25—35	40
35—45	100
45—55	110
55—65	80
65—75	30
75—85	10
Total	400

Calculate the mean, median, mode, and standard deviation of the protein intake for those 400 families.

10

5. (a) Gestational Age, GA (weeks) and Crown Heel Length, CHL (cm) of 10 new borns are given below :

Serial No.	GA (weeks)	CHL (cm)
1	34	46.8
2	30	47.0
3	32	47.0
4	28	46.2
5	35	47.0
6	37	47.0
7	40	47.4
8	29	46.6
9	38	47.8
10	32	46.6

Calculate the simple correlation coefficient between GA and CHL for newborns.

- (b) In a feeding trial, 17 children were given high protein food supplement to their normal diet and 15 comparable children were kept under normal diet. They were kept on this feeding trial for a

period of seven months. At the end of the study the changes (initial-final) in the haemoglobin (g%) level of the two groups are assessed. Extract of the study is as follows :

	High protein diet group	Control group
Sample size	$n_1 = 17$	$n_2 = 15$
Mean (calculated)	$\bar{x}_1 = -0.69\%$	$\bar{x}_2 = 0.9487\%$
Standard deviation (calculated)	$(n_1 - 1) s_1^2 = 41.2704$	$(n_2 - 1) s_2^2 = 33.8646$

Does the provide any evidence to say that the change in the haemoglobin level of the children who received high protein food is different from the control group ? State the null hypothesis and alternative hypothesis clearly.

Given that  $t_{0.05(30)} = 2.042$ .

4 + 6



6. (a) Twelve pre-school children were given a supplement of multipurpose food for a period of four months. Their skin fold thickness (in mm) was measured before the commencement of the programme and also at the end. The values obtained are given in the following table.

Table : Skin-Fold thickness of the children who Received Multi-purpose Food :

Serial No.	Skin-fold thickness (mm)	
	At the beginning	At the end
1	6	8
2	8	8
3	8	10
4	6	7
5	5	6
6	9	10
7	6	9
8	7	8
9	6	5
10	6	7
11	4	4
12	8	6

Test if there is any change in their skin-fold thickness. (Take 5% level of significance)

Given that  $t_{0.05(11)} = 2.201$ .

(b) In a health survey it is found that the mean haemoglobin level of 55 individuals is 10.2 per 100 ml with a standard deviation of 2.1. Can we consider this group as taken from a population with mean of 11.0 g/100 ml ?

Given  $Z$  value at 5% level is 1.96.

(Notations have their usual meaning) 7 + 3

[ *Internal Assessment* : 10 Marks ]

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