Year- April 2024

TYBSC-

Mathematics

SEM- VI

No. of pages - 9

Paper / Subject Code: 88679 / Mathematics: Topology of Metric Spaces and Real Analysis(R-2023)

TYBSc - Sem - VI

Duration 2 ½Hrs Marks: 75

N B (1) All questions are compulsory
(2) Figures to the right indicate marks.

1. (a) Attempt ANY ONE from the following: (8)
   (i) Let $f : (X, d) \longrightarrow (Y, d')$ be a function. Show that f is continuous at $p \in X$ if and only if for each sequence (x_n) in X converging to p, the sequence $(f(x_n))$ converges to $f(p)$ in Y.
   (ii) Let $f : (X, d) \longrightarrow (Y, d')$ be a function. Prove that f is continuous on X if and only if for each open subset G of Y, $f^{-1}(G)$ is an open subset of X.

   (b) Attempt ANY TWO from the following: (12)
   (i) Let (X, d) be a metric space and let $A \subset X$ be any non empty subset of X. Define a function $d_A : X \to \mathbb{R}$ as $d_A(x) = d(x, A)$, $\forall x \in X$. Show that d_A is a uniformly continuous function.
   (ii) Let $f : \mathbb{R}^2 \longrightarrow \mathbb{R}$ be a continuous map. Show that $g : \mathbb{R}^2 \longrightarrow \mathbb{R}$ defined by $g(x, y) = f(x + y, x - y)$ is continuous on $\mathbb{R}^2$.(Under usual metric of $\mathbb{R}$ and Euclidean metric of $\mathbb{R}^2$)
   (iii) Prove every function $f : (X, d_1) \longrightarrow (Y, d')$ where (X, d_1) is a finite metric space and (Y, d') is any metric space is continuous.

2. (a) Attempt ANY ONE from the following: (8)
   (i) Let (X, d) be a metric space and A, B be conncected subsets of X such that $A \cap B \neq \emptyset$. Prove that $A \cup B$ is a connected set.
   (ii) Prove that a metric space is connected if and only if every continuous function from X to $\{1, -1\}$ is a constant function.

   (b) Attempt ANY TWO from the following: (12)
   (i) If $f : (X, d) \longrightarrow (Y, d_1)$ is a continuous function where X is a connected metric space and Y is a finite metric space then show that f is a constant function.
   (ii) Which of the following subsets of $\mathbb{R}^2$ (distance being Euclidean) are connected and which are disconnected? Justify your answer.
   (I) $E = \{(x, y) \in \mathbb{R}^2 : xy = 1\}$ (II) $F = \{(x, y) \in \mathbb{R}^2 : xy = 0\}$
   (iii) Prove that in a normed linear space, an open ball $B(x, r)$ is a convex set.

3. (a) Attempt ANY ONE from the following: (8)
   (i) $\{f_n\}$ is a sequence of real valued functions defined on $S \subseteq \mathbb{R}$ such that $f_n \longrightarrow f$ uniformly on S. If each f_n is bounded on S, then prove that f is bounded on S and there exists $\alpha \in \mathbb{R}^+$ such that $|f_n(x)| \leq \alpha \ \forall \ n \in \mathbb{N}$ and $\forall \ x \in S$.
   (ii) (I) If $\{f_n\}$ is a sequence if real valued continuous functions on $S, S \subseteq \mathbb{R}$ such that $\sum_{n=1}^{\infty} f_n$ converges uniformly to f on S, then prove that f is continuous on S, and for $p \in S$, $\sum_{n=1}^{\infty} \lim_{x \to p} f_n(x) = \lim_{x \to p} \sum_{n=1}^{\infty} f_n(x)$.

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(ii) Let $\sum_{n=1}^{\infty} f_n$ be a series of R integrable functions on $[a,b]$, converging uniformly to f on $[a,b]$, then prove that f is $R-$integrable on $[a,b]$ and $\int_a^b f(x)\,dx = \sum_{n=1}^{\infty} \int_a^b f_n(x)\,dx$.

(b) Attempt ANY TWO from the following: (12)

(i) $f_n : [0,1] \longrightarrow [0,1]$ is defined by $f_n(x) = x * \chi_n(x)$ where $\chi_n(x) = \begin{cases} 0 & \text{if } x \notin \left[0, \frac{1}{n}\right] \\ 1 & \text{if } x \in \left[0, \frac{1}{n}\right] \end{cases}$

Show that $\{f_n\}$ converges uniformly to 0 on $[0,1]$.

(ii) $f_n : [0,1] \longrightarrow \mathbb{R}$, $f_n(x) = \frac{x}{n}$. Show that $\{f_n\}$ is uniformly convergent on $[0,1]$. Also show that $\{f_n\}$ does not converge uniformly on $[0,\infty)$.

(iii) Show that the series $\sum_{n=1}^{\infty} \frac{x^n}{n!}$ is uniformly convergent on $[-A,A], A > 0$ but not uniformly convergent on $\mathbb{R}$.

4. Attempt ANY THREE from the following: (15)

(a) Let $f : [a,b] \to [a,b]$ is continuous on $[a,b]$ and differentiable on (a,b). If $\exists\ c \in \mathbb{R}$ with $0 < c < 1$ such that $|f'(x)| \leq c,\ \forall x \in (a,b)$ then prove that f is a contraction of $[a,b]$.

(b) Let (X,d) be a metric space and $f : X \longrightarrow \mathbb{R}$, ($\mathbb{R}$ with usual metric) is continuous on X. If $f(x_0) > 0$ for some $x_0 \in X$ then show that $\exists\ \delta > 0$ such that $f(x) > 0\ \ \forall x \in B(x_0,\delta)$.

(c) Show that $E = \{(x,y) \in \mathbb{R}^2 : x > 0, x^2 - y^2 = 1\}$ is path connected.

(d) Prove or disprove: If A and B are connected subsets of $(\mathbb{R},d)$ where d is the usual distance, then $A \setminus B$ is also connected.

(e) $f_n : [0,1] \longrightarrow \mathbb{R}$ is defined as $f_n(x) = \begin{cases} n & \text{if } 0 < x < \frac{1}{n} \\ 0 & \text{otherwise} \end{cases}$.

(i) Find the pointwise limit f of $\{f_n\}$.

(ii) Is $\lim_{n\to\infty} \int_0^1 f_n(x) = \int_0^1 f(x)dx$?

(iii) Does $\{f_n\}$ converge uniformly to f on $[0,1]$? State clearly the result used.

(f) If R is the radius of convergence of the power series $\sum_{n=0}^{\infty} c_n x^n$, then find the radius of convergence of the series $\sum_{n=0}^{\infty} \frac{(-1)^n}{n^2} c_n x^n$.

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Total Marks: 75 **Time: 2.5 Hours**

N.B. 1) All questions are compulsory
2) Use of a simple calculator is allowed
3) Figures to the right indicate marks

Q.1 A) Attempt any one from the following (8)

i) If z_0 and w_0 are points in z and w plans respectively then show that

(a) $\lim_{z\to z_0} f(z) = \infty$ if and only if $\lim_{z\to z_0} \frac{1}{f(z)} = 0$.
(b) $\lim_{z\to\infty} f(z) = \omega_0$ if and only if $\lim_{z\to 0} f\left(\frac{1}{z}\right) = \omega_0$
(c) $\lim_{z\to\infty} f(z) = \infty$ if and only if $\lim_{z\to 0} \frac{1}{f\left(\frac{1}{z}\right)} = 0$.

ii) Let $f(z) = u(x,y) + iv(x,y)$. $f'(z)$ exists at a point $z_0 = x_0 + iy_0$. Then prove that the first order partial derivatives of u & v exist at (x_0, y_0) and they satisfy Cauchy- Riemann equations $u_x = v_y$, $u_y = -v_x$. Also show that $f'(z) = (u_x)_{z=z_0} + i(v_x)_{z=z_0}$. Show that the converse is not true.

B Attempt any two from the following. (12)

i) If a function $f: \Omega \to \mathbb{C}$ is continuous and nonzero at $z_0 \in \Omega$ then show that $f(z) \neq 0$ throughout some neighbourhood of z_0.

ii) Prove that $u = e^x \sin y$ is harmonic. Also find corresponding analytic function $f(z) = u(x,y) + i\,v(x,y)$

iii) Let $f(z) = u(x,y) + iv(x,y)$ be analytic in a domain D and consider the family of level curves $u(x,y) = c_1$ and $v(x,y) = c_2$ where $c_1, c_2 \in \mathbb{R}$. Prove that these families are orthogonal.

Q.2 A) Attempt any one from the following. (8)

i) State and prove the Taylor's theorem.

ii) Let A be an open connected subset of $\mathbb{C}$ and $f: A \to \mathbb{C}$ be an analytic function in A. Let $z_0 \in A$ and $r > 0$ such that $B(z_0, r) \subset A$. Then for any $\omega \in B(z_0, r)$ prove that $f(\omega) = \frac{1}{2\pi i}\int_{\partial B(z_0,r)} \frac{f(z)}{z-\omega}\,dz$.

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B Attempt any two from the following. (12)

i) Let A be an open connected subset of $\mathbb{C}$ and $f: A \to \mathbb{C}$ be an analytic function such that $f'(z)$ is continuous in A. Prove that $\int_C f(z)dz = 0$ for any simple closed curve C in A.

ii) Construal a linear fractional transformation that maps the points $i, \infty, 3$ to $\frac{1}{2}, -1, 3$ respectively.

iii) Evaluate $\int_C \frac{e^z}{z^2-2z} dz$, $C: |z| = 1$

Q.3 A) Attempt any one from the following. (8)

i) Prove that, a power series $\sum_{n=0}^{\infty} a_n (z - z_0)^n$ represents a continuous function $S(z)$ at each point inside its circle of convergence $|z - z_0| = R$.

ii) If a series $\sum a_n (z - z_0)^n$ converges to $f(z)$ at all points within the disc of convergence $|z - z_0| < R$ then prove that it is the Taylor series expansion for f centered at z_0.

B Attempt any two from the following. (12)

i) Define

(a) An isolated singular point (b) A pole

(c) An essential singularity.

ii) Find Laurent series expansion of $f(z) = \frac{1}{z(4-z)^2}$ in the domains

$|z| < 4$ and $|z| > 4$.

iii) Evaluate $\int_C \frac{dz}{(z^2+1)(z^2-4)}$ where C is the circle $|z| = 1.5$.

Q. 4 A Attempt any three questions from the following. (15)

i) Use $\epsilon - \delta$ definition of limit to show that $\lim_{z \to 0} \frac{\bar{z}^2}{z} = 0$

ii) Test differentiability of the function $f(z) = z\,Re\,z$ at 0.

iii) Find all z that satisfy $\overline{\cos(\iota z)} = \cos(i\bar{z}) \forall z \in \mathbb{C}$.

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iv) Determine whether the set of points $-1, -i, i, 2-i$ lies on a circle.

v) With the help of a suitable power series, show that

$f(z) = \begin{cases} \frac{e^z-1}{z} & z \neq 0 \\ 1 & z = 0 \end{cases}$ is entire, use it to show that $\lim_{z\to 0} \frac{e^z-1}{z} = 1$.

vi) Compute residues of following complex valued function $f(z) = \frac{z^3}{(z-1)^4(z-2)(z-3)}$ at its simple poles.

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TYBSC-sem VI

Time: 2.5 Hours **Total Marks: 75**

N. B. 1) All questions are compulsory.
2) Use of a simple calculator is allowed.
3) Figures to the right indicate marks.

Q. 1 A) Attempt **any one** from the following. (8)

i) Let $\Omega \subset \mathbb{C}$ is a domain in $\mathbb{C}$. If $u, v : \Omega \to \mathbb{R}$ are such that
i) u_x, u_y, v_x, v_y exist and satisfy Cauchy Riemann equations
ii) u_x, u_y, v_x, v_y are continuous on Ω,
then prove that $f(z) = u(x, y) + iv(x, y)$ is analytic in Ω.

ii) If z_0 and w_0 are points in z and w plane respectively then show that
(a) $\lim_{z\to z_0} f(z) = \infty$ if and only if $\lim_{z\to z_0} \frac{1}{f(z)} = 0$.
(b) $\lim_{z\to\infty} f(z) = \omega_0$ if and only if $\lim_{z\to 0} f\left(\frac{1}{z}\right) = \omega_0$
(c) $\lim_{z\to\infty} f(z) = \infty$ if and only if $\lim_{z\to 0} \frac{1}{f\left(\frac{1}{z}\right)} = 0$.

B) Attempt **any two** from the following. (12)

i) If a function $f(z) = u(x, y) + iv(x, y)$ is analytic in a domain D. then show that its component function u and v are harmonic in D.

ii) Use $\epsilon - \delta$ definition of limit to show that

$\lim_{z\to 1-i}[x + i(x + y)] = 1$

iii) Does there exist a complex differentiable function $f = u + iv$ with real part $u(x, y) = xe^y$? Justify your answer.

Q.2 A) Attempt **any one** from the following. (8)

i) Suppose that a function f is analytic throughout a disk $|z - z_0| < R_0$, centred at z_0 and with radius R_0. Then prove that $f(z)$ has the power series representation $f(z) = \sum_{n=0}^{\infty} a_n(z - z_0)^n, |z - z_0| < R_0$, where $a_n = \frac{f^n(z_0)}{n!}$.

ii) Let A be an open, connected subset of $\mathbb{C}$ and $f: A \to \mathbb{C}$ be an analytic function in A. Let $z_0 \in A$ and $r > 0$ be such that $B(z_0, r) \subset A$. Then state and prove Cauchy Integral Formula for any $\omega \in B(z_0, r)$.

B) Attempt **any two** from the following. (12)

i) Let D be a simply connected domain in $\mathbb{C}$ and $f: D \to \mathbb{C}$ be an analytic function defined on D such that $f'(z)$ is continuous on D. If C is a simple closed curve in D then show that $\int_C f(z)\, dz = 0$.

ii) Give definition of $\sinh z$ and $\cosh z$ and prove that

$$\cosh^2 z - \sinh^2 z = 1.$$

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iii) Evaluate $\int_C \frac{2z+3}{z}dz$, where C is the
   a) Upper half of the circle $|z| = 2$
   b) Lower half of the circle $|z| = 2$
   c) The whole circle $|z| = 2$ in anti-clockwise direction.

Q 3 A) Attempt **any one** from the following. (8)

i) If z_1 is a point inside the circle of convergence $|z - z_0| = R$ of a power series $\sum_{n=0}^{\infty} a_n(z - z_0)^n$ then show that the series must be uniformly convergent in the closed disk $|z - z_0| \leq R_1$, where $R_1 = |z_1 - z_0|$.

ii) Let C be a simple closed curve in the interior of the disc of convergence of the power series $S(z) = \sum_{n=0}^{\infty} a_n (z - z_0)^n$ and let $g(z)$ be any function which is continuous on C. Then prove that, the series $\sum_{n=0}^{\infty} g(z)a_n(z - z_0)^n$ can be integrated term by term over C and $\int_C g(z)S(z)dz = \sum_{n=0}^{\infty} \int_C g(z)a_n(z - z_0)^n dz$.

B) Attempt **any two** from the following. (12)

i) State Cauchy's Residue Theorem and using it evaluate $\int_C \frac{dz}{(z^2+1)(z^2+4)}$ where C is the circle $|z| = 1.5$

ii) Expand $f(z) = \frac{1}{z(z-1)}$ as a Laurent series for the annular domains:

(i) $0 < |z| < 1$ (ii) $1 < |z|$ (iii) $0 < |z - 1| < 1$

iii) Let $\sum a_n z^n$ has radius of convergence R. Find the radius of convergence of

a) $\sum_{n=0}^{\infty} n^3 a_n z^n$ b) $\sum_{n=0}^{\infty} a_n z^{3n}$ c) $\sum_{n=0}^{\infty} a_n{}^3 z^n$

Q. 4 Attempt **any three** questions from the following. (15)

i) Represent the $|z + 1| = |z - i|$ subset of $\mathbb{C}$ in the plane.

ii) Show that $z(t) = z_0 + t\bar{v}$ and $Re\big((z - z_0)i\,\bar{v}\big) = 0$ represents the same line in $\mathbb{C}$

iii) Find the image of $\frac{1}{5} \leq |z| \leq 2$ under the reciprocal map $w = \frac{1}{z}$ on extended plane.

iv) Determine whether the set of points $\{-1, -i, i, 2 - i\}$ lies on a circle.

v) Find $\underset{z=0}{Res} f(z)$ where $f(z) = \frac{\cot z}{z^4}$ (using the idea of power series division).

vi) With the help of a suitable power series, show that

$$f(z) = \begin{cases} \frac{\sin z}{z} & z \neq 0 \\ 1 & z = 0 \end{cases}$$

is entire. Use it to show $\lim_{z\to 0} \frac{\sin z}{z} = 1$.

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(8)

TY BSC - Sem VI - mathematics.

Duration: 2 ½ Hrs. Marks: 75

N.B. (1) All questions are compulsory.
(2) Figures to the right indicate marks.

1. (a) Attempt ANY ONE from the following: (8)
   (i) Let $f : (X, d) \longrightarrow (Y, d')$ be a function. Show that f is continuous at $p \in X$ if and only if for each sequence (x_n) in X converging to p, the sequence $(f(x_n))$ converges to $f(p)$ in Y.
   (ii) State and prove Fixed point theorem for a contraction.

   (b) Attempt ANY TWO from the following: (12)
   (i) Let (X, d) be a metric space and let $A \subseteq X$. If $d_A : X \longrightarrow \mathbb{R}$ is defined by $d_A(x) = d(x, A)$, then show that d_A is continuous on X (distance in $\mathbb{R}$ being usual).
   (ii) Let (X, d) and (Y, d') be metric spaces and $f : (X, d) \longrightarrow (Y, d')$ be any function. Prove that f is continuous on X if and only if for every $B \subseteq Y, f^{-1}(B) \subseteq f^{-1}(\overline{B})$.
   (iii) Let (X, d) and (Y, d') be metric spaces and $f, g : X \longrightarrow Y$ be continuous on X. Show that $E = \{x \in X : f(x) = g(x)\}$ is a closed subset of X.

2. (a) Attempt ANY ONE from the following: (8)
   (i) Prove that a subset E of $\mathbb{R}$ is connected if and only if it is an interval. (Distance in $\mathbb{R}$ being usual)
   (ii) Define path, path connected set in a metric space. Let A and B be path connected subsets of a metric space (X, d) such that $A \cap B \neq \emptyset$. Show that $A \cup B$ is path connected.

   (b) Attempt ANY TWO from the following: (12)
   (i) Let (X, d) be a metric space and A, B are subsets of X such that A is connected and $A \subseteq B \subseteq \overline{A}$. Prove that B is connected.
   (ii) Let (X, d) be a connected metric space and (Y, d') be a metric space. If $f : (X, d) \longrightarrow (Y, d')$ is a continuous function then prove that $f(X)$ is connected.
   (iii) Prove or disprove: If A° and ∂A are connected then A is connected.

3. (a) Attempt ANY ONE from the following: (8)
   (i) Prove that the power series $\sum_{n=1}^{\infty} c_n x^n$ is either absolutely convergent for all $x \in \mathbb{R}$ or there is a unique real number $r \geq 0$ such that the series is absolutely convergent for each $x \in \mathbb{R}$ with $|x| < r$ and is divergent for each $x \in \mathbb{R}$ with $|x| > r$.
   (ii) Prove that a sequence $\{f_n\}$ of real valued functions defined on S ($S \subseteq \mathbb{R}$) converges uniformly to a function $f : S \longrightarrow \mathbb{R}$ if and only if $\lim_{n \longrightarrow \infty} M_n = 0$, where $M_n = \sup\{|f_n(x) - f(x)| : x \in S\}$. Hence show that, if there is a sequence (t_n) in $\mathbb{R}$ such that $|f_n(x) - f(x)| \leq t_n$ for all $n \geq n_0$ for some $n_0 \in \mathbb{N}$ and for all $x \in S$ such that $t_n \longrightarrow 0$ then $f_n \longrightarrow f$ uniformly on S.

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(b) Attempt ANY TWO from the following:

(i) If $\{f_n\}$ is a sequence of real valued R - integrable functions defined on $[a,b]$ converging uniformly to f on $[a,b]$ and $F_n(x) = \int_a^x f_n(t)\,dt$ then prove that $\{F_n\}$ converges uniformly to F on $[a,b]$ where $F(x) = \int_a^x f(t)dt$.

(ii) State and prove Cauchy Criterion for Uniform Convergence of a Series $\sum_{n=0}^{\infty} f_n$ of real valued functions defined on a subset S of $\mathbb{R}$.

(iii) Give an example of a power series with radius of convergence = 5 and interval of convergence = $(3,13)$.

4. Attempt ANY THREE from the following:

(a) Let $f:\mathbb{R}^2 \longrightarrow \mathbb{R}$ be a continuous map. Show that $g:\mathbb{R}^2 \longrightarrow \mathbb{R}$ defined by $g(x,y) = f(x+y, x-y)$ is continuous on $\mathbb{R}^2$ (under usual metric of $\mathbb{R}$ and Euclidean metric of $\mathbb{R}^2$).

(b) Consider $f:[1,\infty) \longrightarrow \mathbb{R}, f(x) = 1/x$. Show that f is uniformly continuous on $[1,\infty)$.

(c) Prove or disprove: If A and B are connected subsets of $(\mathbb{R}, d)$ where d is the usual distance, then $A \setminus B$ is also connected.

(d) Show that $A = \{(x,y) \in \mathbb{R}^2 : xy = 0\}$ is a connected subset of $\mathbb{R}^2$ (distance being Euclidean).

(e) Show that $\dfrac{1}{1-x} = \sum_{n=0}^{\infty} x^n$ for $|x| < 1$.

(f) Examine the sequence $\{nxe^{-nx^2}\}$ of functions for pointwise and uniform convergence on $[0,1]$.

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Year - April 2024

TYBSC-

physics

SEM - VI

No. of pages - 4

TYBSc - Sem - VI

(1)

Time: 3 hrs. M. M.: 100

N.B.:

1. **All** questions are **compulsory**.
2. **Figures** to the **right** indicate **full** marks.
3. Draw **neat** diagrams wherever **necessary**.
4. Symbols have usual meaning unless otherwise stated.
5. Use of **non-programmable** calculator is allowed.

Q1 Attempt any **two**

(i) State Kepler's three laws of planetary motion and prove second and third laws. **10**

(ii) Show that when body moves in a central force field its motion is confined to a plane. **10**

(iii) Obtain the equation of motion of a particle of mass m as related to the rotating earth. **10**

(iv) A starred system rotates with a variable angular velocity ω with respect to inertial system fixed in space. Show that $\frac{d\mathbf{r}}{dt} = \frac{d'\mathbf{r}}{dt} + \boldsymbol{\omega} \times \mathbf{r}$ **10**

Hence obtain the Coriolis theorem.

Q2 Attempt any **two**

(i) a) What is virtual displacement? **10**

b) State and derive an expression for the principle of virtual work.

(ii) a) Define the generalized force Q_k. Using that definition, show that, **10**

$$Q_k = -\frac{\partial V}{\partial q_k}$$

Where V is potential and q_k are generalized coordinates.

b) Show that, for Cartesian coordinates x_i and general coordinates q_k,

$$\frac{\partial \dot{x}_i}{\partial \dot{q}_k} = \frac{\partial x_i}{\partial q_k}$$

(iii) Consider a particle constrained to move on the inner surface of the cone with half angle α. Set up the Lagrangian and get the equations of motion. **10**

(iv) a. What is canonical momentum? For a Lagrangian given by **10**

$$L = \frac{1}{2}m(\dot{x}^2 + \dot{y}^2 + \dot{z}^2) - q\phi(x, y, z) + q(\vec{A} \cdot \vec{v})$$

b. Calculate all the components of canonical momentum.

c. Is this canonical momentum a conserved quantity? Give reason to your answer.

Q3 Attempt any **two**

(i) Derive Euler's equation of motion for a rigid body .Discuss its cases for spin, moment of inertia and angular velocity is at constant ,zero and nonzero **10**

(ii) Obtain an equation of continuity in kinematics of moving fluid .Write the equation if the fluid is incompressible **10**

(iii) Derive Bernoulli's theorem from conservation of linear momentum and energy. Write the meaning of every term in its equation **10**

(iv) What is an Ideal fluid. Obtain the Eulers equation equation of motion for an ideal fluid. state the assumptions **10**

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Q4 Attempt any **two**

(i) What is an Anharmonic oscillator? Write down the general expression for restoring force indicating harmonic and anharmonic terms.Draw potential energy curves for (i) $\alpha < 0, K > 0$ (ii) $\alpha < 0, K < 0$. Infer on the confined motion in each case, If potential energy of Anharmonic oscillator is $V(x) = K(\frac{x^2}{2} + \frac{\alpha x^4}{2})$. Where K→ *spring constant*, α → *anharmonic coefficient*. **10**

(ii) What is logistic map? Find its fixed points, showthat the fixed point x=0 is an attractor for $\delta < 1$ and a repeller for $\delta > 1$. **10**

(iii) Obtain reduced Duffing's equation by suitable rescalling. Discuss numerical solutions of Duffing's equation for γ =0.1, f = 0.5 graphically showing odd and even harmonics. Explain the mechanical hysteresis. **10**

(iv) Show that the undamped duffing's equation $\ddot{x} + x + x^3 = f\cos wt$ can have the exact solution $x(t) = A_0 \cos\frac{wt}{3}$. find the conditions under which such simple subharmonic solution occurs. **10**

Q5. Attempt any **four**

(i) Define central force. Explain types of central forces. **05**

(ii) Interpret the various terms involved in the Coriolis's theorem **05**

(iii) Set up the Lagrangian for a simple pendulum. Using that derive the equation of motion. **05**

(iv) Define constraints. Give three examples **05**

(v) Consider a liquid flowing through horizontal tube of non-uniform cross-section. The pressure is 1600 N/m^2 at a point where the velocity of flow is 0.5 N/m^2 what is the Velocity of flow at a point where pressure is 1000 N/m^2 .Density of liquid is uniform and is equal to 1000 kg/m^3 . **05**

(vi) A rigid body consists of three particles of masses 2, 1 and 4 units located at (1, −1,1), (2,0,2) and (−1,1,0) respectively. Determine the elements of the moment of inertia matrix for the rigid body. **05**

(vii) Write down three properties of deterministic chaos **05**

(viii) What is phase space diagram? Plot phase space diagram for one - dimentional damped oscillator and driven oscillator. **05**

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Paper / Subject Code: 886 ...ysics: Electronics

TYBSC - Sem VI

Time: 3 hrs. M. M.: 100

N.B.:

1. **All** questions are **compulsory**.
2. **Figures** to the **right** indicate **full** marks.
3. Draw **neat** diagrams wherever **necessary**.
4. Symbols have usual meaning unless otherwise stated.
5. Use of **non-programmable** calculator is allowed.

Q1 Attempt any **two**

(i) Describe the construction of SCR. With the help of equivalent circuit and I-V characteristics, explain the working of SCR. **10**

(ii) Explain the voltage divider bias of a JFET. State and explain the condition under which the drain current in voltage divider bias is approximately constant for any JFET. **10**

(iii) Explain the construction and working principle of a Unijunction Transistor (UJT). Draw and Explain I-V characteristics of UJT. Explain peak point and valley point. **10**

(iv) Explain the construction and working of n-channel D-MOSFET. Draw and discuss its drain and trans-conductance curves. **10**

Q2 Attempt any **two**

(i) Explain with the help of neat circuit diagram, the DC analysis of an emitter coupled differential amplifier with double ended input Configuration and single ended output. Derive the necessary expressions. **10**

(ii) With the help of a neat circuit diagram and relevant waveforms, explain the working of triangular wave generator using Schmitt trigger and integrator. What is the expression for frequency and peak to peak voltage of the triangular wave? **10**

(iii) Explain with neat circuit diagram the working of the emitter coupled differential amplifier with double ended input and double ended output. **10**

(iv) Explain in detail the construction and working of logarithmic amplifier. Obtain an expression for its output voltage varies as the logarithmic of the input. **10**

Q3 Attempt any **two**

(i) Explain with the help neat circuit diagram and relevant waveforms transistorized Astable multivibrator. **10**

(ii) Explain with the help of neat circuit diagram and relevant waveforms Monostable multivibrator using IC 555 timer. Derive an expression for output pulse width. **10**

(iii) Explain with the help of neat circuit diagram and relevant waveforms ramp generator using IC 555 timer. Derive an expression for the slope of the ramp. **10**

(iv) Explain with the help neat circuit diagram working of a transistor series voltage feedback regulator. Derive an expression for its output voltage and power dissipation. **10**

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Q4 Attempt any **two**

(i) With the help of a neat circuit diagram explain the working of two input TTL NOR gate. Draw its truth table. **10**

(ii) Explain the working of a tri state inverter. **10**

(iii) Explain parallel transmission of data. Explain a technique that converts parallel transfer of data to serial transfer of data and vice versa. **10**

(iv) Explain Pulse Modulation. Explain in detail companding process used to overcome problems of distortion and noise in the transmission of audio signals. **10**

Q5. Attempt any **four**

(i) For a certain D-MOSFET, I_{DSS} = 10 mA, $V_{GS(OFF)}$ = -8 V. is this an n-channel or p-channel?. Calculate (i) I_D at V_{GS} = -3V and (ii) I_D at V_{GS} = +3V **05**

(ii) The parameters of UJT are R_{BB} = 5 $k\Omega$ and $\eta = 0.6$ (i) Determine R_{B1} and R_{B2} at I_E = 0 (ii) Calculate the voltage V_P necessary to turn on the UJT if supply voltage is 12 V. **05**

(iii) In differential amplifier circuit of double ended input and single output, V_{CC} = + 12 V, V_{EE} = - 12 V, R_C = 10 KΩ and $V_1 = V_2$ = 0V. What is the dc emitter current in each silicon transistor? What is the tail current? What is the dc voltage at output? **05**

(iv) First order active low pass filter has C = 0.1 μF and R= 1kΩ . Calculate cut-off frequency. If R_F is 1kΩ and R_i is 1kΩ, Calculate pass band gain. **05**

(v) A pulse of 2 μs duration is used to trigger the transistorized monostable circuit, If $R_{L1} = R_{L2}$ = 3 kΩ , R_1 = 80 kΩ and C_1 = 0.001 μF. calculate the length of the output pulse **05**

(vi) Calculate the frequency of oscillation and duty cycle for 555 timer as astable multivibrator with resistance $R_A = R_B$ = 10 kΩ and capacitance 0.01 μ F. **05**

(vii) Data sheets for 74COO series devices give the following output currents for CMOS driving CMOS: I_{OLmax} = 10 μA I_{OHmax} = -10 μA. If the worst case input current of a CMOS device is 1 μA, calculate its fanout. **05**

(viii) Explain pulse width modulation (PWM) in brief. **05**

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Year - April 2024

TYBSC - Chemistry

SEM - VI

No. of pages - 17

Paper / Subject Code: 88609 / Chemistry: Physical Chemistry (6 Units)

TYBSc Sem VI

[Time : 3Hours] [Total marks :100]

N.B. : (1) All questions are compulsory.

(2) Figures to the right indicate full marks.

(3) Use of logarithmic table/non-programmable calculator is allowed.

Physical Constants:

$N = 6.022 \times 10^{23}$ $c = 3.0 \times 10^{8}$ m/s

$R = 8.314$ J/K mol $h = 6.626 \times 10^{-34}$ Js

$\frac{2.303\,RT}{nF} = \frac{0.0592}{n}$ at 298 K

1. Attempt **any four** of the following:

A. Define activity and activity coefficient of an electrolyte. Give the expression for activity of the following electrolytes 5
i) $AlCl_3$ ii) $CuSO_4$ iii) Na_2SO_4

B. Explain the function of the salt bridge. Why is a saturated solution of KCl generally used in preparation of salt bridge? 5

C. Derive an expression for the e.m.f of an electrode concentration cell of the following cell 5
$Cd(Hg)a_1 / CdSO_{4\,(aq)} / Cd(Hg)a_2$

D. Derive an expression for the e.m.f of an electrolyte concentration cell with transference reversible with anion 5

E. Calculate the mean activity coefficient of NaCl in a solution containing 0.02mol/dm^3 of NaCl and 0.05mol/cm^3 of $CaCl_2$ (A=0.509 at 298K for water) 5

F. Define hydrogen overvoltage. In the electrolysis of 2N sulphuric acid the hydrogen overvoltage at lead cathode was found to be 0.352V at 298 K for a given current density what will be the hydrogen overvoltage if the current density is increased six times its present value for the same cathode under the same conditions. (Given: b = 0.12 V at 298 K) 5

2. Attempt **any four** of the following.

A. Explain the terms 5
i) Monomer
ii) Polydispersity Index
iii) Degree of polymerization

B. In a polymer sample 30% molecules have a molecular weight 20,000, 40% have molecular weight 30,000 and 30 % have 60,000. Calculate number average and weight average molecular weights for given polymer. 5

C. Explain the classification of polymers on the basis of the structure. 5

D. Explain the viscosity method for determination of molecular weight of polymers. 5

E. Explain number average molecular weight and weight average molecular weight 5

F. Describe advantages and applications of light emitting polymers. 5

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3. Attempt **any four** of the following:

A. Explain the Compton effect using Quantum mechanics and also give limitations of Classical mechanics in explaining it. 5

B. Find the eigen value and state whether the function is an Eigenfunction for then operator $\frac{d^2}{dx^2}$ for the following funct on. 5

i) 6cos4x ii) $3e^{5x}$

C. Write a note on: 5

i) Wave matter duality of matter ii) Heisenberg Uncertainty Principle

D. What is a commutative operator? Explain and prove it with an example. 5

E. Discuss the classification of conductor, semiconductor and insulator on the basis of band gap. 5

F. Explain production of hydrogen gas using electrolysis of water and mention advantages of hydrogen gas as fuel. 5

4. Attempt **any four** of the following:

A. Explain the working of NMR Spectrometer with the help of a neat labelled diagram 5

B. Derive the fundamental equation of NMR spectroscopy 5

C. Explain the relaxation processes in NMR spectroscopy. 5

D. Explain the principle of ESR spectroscopy 5

E. Draw diagram of ESR spectrometer and explain functions of following in ESR spectrometer i) Klystron oscillator ii) Sample cavity iii) Crystal detector 5

F. Explain fine splitting and hyperfine splitting of hydrogen ESR spectrum. 5

5. **Answer the following:**

A. Select whether the following statements are **true** or **false (Any five)** 5

a. For a concentration cell, the standard emf of the cell is unity

b. Reduction involves the decrease in the oxidation state of the metal ion

c. The deviation of an electrolyte solution from its ideal behaviour is called as activity

d. A plot of log of mean activity coefficient versus square root of ionic strength gives a positive slope

e. The value of liquid junction potential depends on the volume of the electrolyte in a galvanic cell

f. The minimum external potential that must be applied between electrodes in an electrolytic solution to bring continuous electrolysis is called as decomposition potential

g. The cause of polarization phenomenon in an electrolytic cell is due to back emf

h. Overvoltage is dependant on temperature

B. Fill in the blank with appropriate words **(Any five)** 5

a. ------ is an example of natural polymer (nucleic acid, PVC, Rayon, polyester)

b. Thermoplast are the polymers which soften when heated and_____ when cooled. (brittle, harden, blackned, colourless)

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c. Weight average molecular weight is defined by symbol _____
($\overline{M}_n$, $\overline{M}_w$, $\overline{M}_z$, $\overline{M}_v$)

d. Heating rubber with sulphur is called_____
(Galvanization, Vulcanization, Sulphonation, Bessmerisation)

e. Which is a naturally occurring polymer _____
(polythene, protein, PVC, Polypropylene)

f. In linear polymers monomeric units are ------- together (break up, branched,cross linked, linked)

g. PVC is an example of-------- polymer
(inorganic, organic, bio-organic, natural)

C. Select and write the appropriate answer. **(Any five)** 5

a. According to Quantum mechanics, ejection of electrons from metal in Photoelectric effect is dependant on_____ of the radiation
a) Intensity b) Frequency c) temperature

b. In Black body radiation as temperature of the body increases, _____of the emitted radiation
a) wavelength and intensity increase
b) wavelength and intensity decrease
c) wavelength decreases, intensity increases

c. The wave function defined for a system has to be -------
a) single valued b) infinite c) discontinuous

d. Which of the following is not correct about standing waves?
a) amplitude vary with time b) confined in a space c) Do not propagate

e. If operator satisfies, $\hat{A}\,[f(x) + g(x)] = \hat{A}\,f(x) + \hat{A}\,g(x)$, operator is said to be —
a) commutative b) linear c) harmonic

f. Which of the following is a nonrenewable source of energy?
a) Tidal b) CNC c) Solar

g. A solar cell works on the principle of
a) Photovoltaic effect b) Photoelectric effect c) Thermoelectric effect

h. Which of the following is an advantage in using hydrogen as a future fuel?
a) transportation b) high calorific value c) storage

D. **Match the column: (Any five)** 5

Column A	Column B
a. C_{12}^{6}	i. 2.0023
b. Precessional angular frequency	ii. $I = ½$
c. Degenerate energy level	iii. Tetramethylsilane(TMS)
d. D^2	vi. ω_o
e. N^{15}	v. $I = 1$
f. g value of free electron in ESR	vi. Absence of magnetic field
g. Reference compound in NMR	vii. 2.2003
	viii. I=0
	ix. Presence of magnetic field
	x. $I = \frac{3}{2}$

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T.Y.B.Sc - Sem VI 200424M02

Chemistry: Drugs and Dyes (6 units)

Time: 03 Hours **Marks 100**

N.B.

1. All questions are compulsory
2. Figures to the right indicates full marks

Q1 **Attempt any FOUR of the following** 20

A. What is structure activity relationship (SAR)? Explain SAR in sulphonamides.
B. Explain the Anti-infective property of Turmeric.
C. What is drug metabolism? What are the factors affecting drug metabolism?
D. Give the structure and chemical class of following,
   i) Fluconazole ii) Albendazole
E. Give the synthesis ,side effects of Levofloxacin.
F. What are Antimalarials? What are symptoms of malaria?

Q2 **Attempt any FOUR of the following** 20

A. Explain briefly the different forms of carbon nanoparticles.
B. Give the synthesis and uses of Anastrozole.
C. Give the structure, chemical class and uses of following,
   i) PAS ii) Isoniazide
D. Write a short note on immunostimulants.
E. Give the synthesis of i) Epichlorohydrin from propene
   ii) p-acetyl amino benzene sulphonyl chloride from aniline
F. Explain the antibacterial activity of silver nanoparticles.

Q3 **Attempt any FOUR of the following** 20

A. Explain nitro and nitroso dyes with one example of each.
B. How will you convert napthol to Eriochrome Black T.Give its uses.
C. Draw the structure of following compound and classified according to constitution.
   i) Acid Magenta ii) Safranine-T
D. Write the synthesis of Indanthrene blue.Give its uses.
E. Give the synthesis of Direct Deep Black EW.
F. Explain the oxidation process in affluent treatment.

Q4 **Attempt any FOUR of the following** 20

A. Write a note on Hair dye.
B. Explain the types of security Inks.
C. What are duties and responsibilities of FDA and FASSAI?
D. Draw the structures and uses of the following as colour markers
   i) Bromophenol blue ii) Cresol red
E. What are requirements of dyes used in cosmetics?
F. Give the important uses of pigments.

Q5 **Attempt any FOUR of the following**

A. Fill in the blank with appropriate words given below (any five) 05
   (Tuberculosis, WMA, positive, thiazine, copper, non-ionic, ionic, E.histolytica)
   a) Mycobacterium bacilli is Gram……..
   b) Amoebiasis is caused by protozoan……
   c) The Declaration of Helsinki has been developed by ……
   d) …… is a disease of respiratory transmission.
   e) Methylene blue is a …….. dye.
   f) The ……complex of phthalocyanine is called Monastral Fast Blue B.
   g) Lakes are also called …….pigments.

B. Match the following (any five)

Group A	Group B
a) Melanin	i) Nematodes
b) AIDS	ii) TiO_2
c) Roundworm	iii) Biazo dye
d) Gold nanoparticles	iv) Used as sorbents
e) White pigment	v) HIV virus
f) Activated charcoal	vi) Anticancerous activity
g) Congo red	vii) Cestodes
	viii) Hair colouring pigments

C. **State whether the following statements are True or False.(any five)**

a) Rhodamine 6G is used as laser dye.
b) All tumors are cancerous.
c) Acronym BCG stands for Bacillus Calmette Gauerin.
d) Diamond is a good conductor of electricity.
e) Camouflagecolours can be used to detect objects by infrared photography.
f) Pigments are water soluble substances.
g) DNA markers are useful in study of crop evolution.

D. **Draw the structure of following drugs/dyes. (any five)**

a) Clotrimazole
b) Tinidazole
c) Rosolic acid
d) Indigo
e) Acriflavine
f) Orange IV
g) Cisplatin

(Time: 3 hours) Total Marks: 100

N.B.: (1) All questions are compulsory.
(2) Figures to the right indicate full marks.
(3) Use of log table/ non-programmable calculator is allowed.

Q.1 **Attempt any four of the following.** 20

A) (a) What is a polarogram? Draw a polarogram and label all the different regions.
(b) Explain- half wave potential and its significance.

B) Explain the construction and working of dropping mercury electrode with a neat labelled diagram.

C) Explain the term polarographic maxima with a neat diagram. How is it eliminated?

D) A 5×10^{-4} M solution of Ba^{2+} ion in 0.1 M KCl as a supporting electrolyte gave a diffusion current of 4.1 μA. If the rate of flow of mercury drops and the drop time is 1.5 mgs^{-1} and 3 second respectively. Calculate diffusion coefficient of Ba^{2+} ion.

E) Explain the nature of amperometric titration curves when,
i) titrant is reducible but other species are not.
ii) both titrant and titrand are reducible

F) Draw a labelled diagram of rotating platinum electrode. Give the advantages and limitations of amperometric titrations.

Q.2 **Attempt any four of the following.** 20

A) Explain the following terms: i) retention time ii) retention volume

B) Draw a neat and labelled schematic diagram of gas-liquid chromatography. Give any three requirements of carrier gas.

C) Name the detectors used in gas chromatography. Explain any one detector with the help of a labelled diagram.

D) What are ion exchange resins? What are the requirements of a good ion exchange resin?

E) If the two separated components A and B have retention times 4.45 min. and 6.36 min. respectively. If the peak widths at half peak heights of A and B are 0.22 min. and 0.33 min. respectively. Calculate the number of theoretical plates for each peak.

F) With reference to ion exchange chromatography explain the following applications-
1) Demineralisation of water
2) Separation of Amino acids

Q.3 **Attempt any four of the following.** 20

A) Explain the physical method of food preservation with reference to
(i) Pasteurisation
(ii) Irradiation

B) Give the composition of milk. Discuss the nutritive value of milk.

C) Explain the Lowenthal's method to estimate tannin in tea.

D) Give the composition of Coffee. What is the role of chicory in Coffee?

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E) Give the constituents of Face Powder. What are the characteristics of Face Powder?

F) What are cosmetics? Give the differences between deodorant and antiperspirant.

Q.4 **Attempt any four of the following.**

A) Give the applications of thermogravimetry.

B) Draw a neat and labelled diagram of thermobalance. Discuss any three components of it.

C) Explain the principle of DTA. Discuss DTA curve of $CaC_2O_4.H_2O$ with respect to curve, reactions and decomposition temperature.

D) Give the characteristics of reference material used in DTA. Mentioned name of any four reference materials used in DTA.

E) Define thermometric titration. Discuss the thermometric titration for Complexometric titration in determination of Calcium and Magnesium

F) Discuss any five parameters used in method validation process.

Q.5 A) **Select the correct option and complete the following statements: (any five)**

a) The electrode which has its own potential and cannot take up potential applied on it is called _____.
i) dropping mercury electrode ii) non-polarizable electrode iii) rotating platinum electrode

b) In polarography, KCl is used to _____. migration current.
i) Eliminat ii) increases iii) maintain

c) The potential at the point on the polarography wave where $i = i_d/2$, is termed as_____.
i) Half wave current ii) Half wave potential
iii) decomposition potential

d) _____ is directly proportional to the concentration of metal ion.
i) Diffusion current ii) Residual current
iii) limiting current

e) _____. is used as maxima suppressor in polarography.
i) KCl ii) Gelatin iii) Pool of mercury

f) Rotating platinum is used in amperometric titration as _____. electrode
i) reference ii) working iii) combined

g) In amperometric titration of Zn^{2+} determined by titrating with_____.
i) dimethyl glyoxime ii) silver nitrate iii) EDTA

h) When titrand is reducible but titrant and product are not in amperometric titration shows _____.
i) constant current till the equivalence point, then increases.
ii) decrease in current till the equivalence point, then constant
iii) increase in current till the equivalence point, then decreases

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Q.5 B) State whether true or false: (any five) **05**

a) Separation of components in gas-liquid chromatography occurs by differential adsorption.
b) The choice of the detector does not depend on the carrier gas.
c) The smaller the magnitude of plate height, the higher is the efficiency of the column.
d) The response of the detector in gas chromatography should be linear.
e) An anion exchanger contains a carboxylic functional group.
f) Styrene on polymerization produces linear polymers.
g) The unit of ion exchange capacity is milliequivalent/gm

Q.5 C) Fill in the blanks with correct alternatives given in the bracket: (any five) **05**

(glucose oxidase, 63°C and 72°C, Lipstick, magnesium silicate, quality, deodorant, methylene blue, irradiation)

a) Food processing improves the _____ value of food.
b) Raw honey contains the enzyme _____
c) _____ prevents/controls body odour.
d) _____ is a physical method of food preservation.
e) Pasteurization of milk is carried out at _____
f) For determination of reducing sugars in honey, by Cole's ferricyanide method _____ is used as an internal indicator.
g) _____ mainly consists of an oily base material and colouring agent
h) Chemically talc is _____.

Q.5 D) Match the columns: (any five) **05**

	A		B
i)	Thermometric titration	(a)	ΔT plotted against sample temperature
ii)	Thermogravimetric analysis	(b)	Closeness of obtained value to true value
iii)	Double pan used	(c)	Reference standard
iv)	Accuracy	(d)	Exotherm
v)	DTA curve	(e)	Weight change measurements
vi)	MgO	(f)	Adiabatic condition
vii)	Air oxidation	(g)	DTA

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3 Hours Total Marks: 100

1. Attempt all questions.
2. All questions carry equal marks.
3. Draw neat labeled diagrams wherever necessary.
4. Use of log tables and non-programmable calculator is allowed.

Q.1 a. Do as directed : (Any six) 06

1. What are fibrous proteins?
2. Define protein motifs.
3. State true or false:
   Myosin protein is present in the M-band of the sarcomere.
4. Fill in the blank:
   The binding curve of hemoglobin to oxygen is -------- in nature.
5. What is protein renaturation?
6. Name the chromatography that uses the charge on the protein to separate it from the mixture.
7. Enlist the types of rotational symmetry in protein.
8. Fill in the blank:
   Oxygen binding to hemoglobin is regulated by ---------- molecules.
9. What is Bohr effect?

Q.1 b. Answer the following questions: (Any Two) 14

1. Describe molecular chaperons assisted protein folding.
2. Give salient features of tertiary structure of myoglobin.
3. Elaborate on chemical energy modulated mechanisms of muscle contraction.

Q.2 a. Do as instructed: (Any six) 06

1. Excess carbohydrate is converted to sucrose and transported to other plants to be
   a. Used as fuel b. Stored
   c. Both (a) and (b) d.Neither of these
2. The phosphorylated form of glycogen synthase is inactive.
   (True / False)

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3. The enzyme that catalyzes the conversion of Starch n to Starch n+1
   a. Starch synthase b.Starch synthetase
   c. Starch polymerase d.Starch peroxidase

4. Pepidoglycan is a polymer of
   a. Sugar and amino acids
   b. Sugar and fatty acid
   c. Sugar and nucleic acid
   d. Glucose

5. Name the hormones that regulate cholesterol biosynthesis.

6. High levels of cholesterol in blood in humans is correlated to _____.

7. Define glycogenesis.

8. Write role of SCAP in regulation of cholesterol biosynthesis.

9. Condensation of three acetate units during cholesterol biosynthesis leads to the formation of
   a. Mevalonate b.Isoprene c. Squalene d.Ethylene

Q.2 b. Answer the following questions: (Any Two) **14**

1. Explain the first two steps of cholesterol biosynthesis.
2. Explain the synthesis of peptidoglycan in bacteria.
3. Diagrammatically explain starch biosynthesis.

Q.3 a. Do as directed: (Any Six) **06**

1. ..... is responsible for the release of milk from the mammary gland.
2. State true/False :Growth hormone is antagonistic to insulin and causes hypoglycemia
3. Name the hormone associated with increase weight of ovaries and production of estrogen.
4. Give an example of antidiuretic hormone.
5. Mention the effect of glucagon on blood glucose level?
6. What is the cause of goiter?
7. What is the role of epinephrine?
8. ..... is associated with increase TSH level and an abnormal increase in the size of thyroid gland.
9. Sate true/False: Prolactin is primarily concerned with initiation and maintenance of lactation in mammals.

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Q.3 b.	**Answer the following: (Any Two)**	**14**
1.	Discuss the effect of insulin on carbohydrate metabolism.	
2.	What are androgens? Give an account of biosynthesis and physiological and biochemical function of androgen?	
3.	Explain in brief on posterior pituitary hormone-ADH	

Q.4 a.	**Do as directed: (Any six)**	**06**
1.	Name the sulfur containing amino acids.	
2.	_____ is a lysosomal enzyme required for phagocytosis and killing of bacteria by neutrophils.	
3.	State true / false: Deficiency of copper causes Mauke's disease.	
4.	What do you mean by scurvy?	
5.	A mutation in the gene that encodes copper binding ATPase is believed to be responsible for _____ disease.	
6.	Mention the role of Vitamin E.	
7.	Xerophthalmia is due to the deficiency of _____.	
8.	State true / false: The teeth Ca undergoes decalcification to meet the body needs.	
9.	Give any two examples of non - essential trace elements.	

Q.4 b.	**Answer the following questions: (Any Two)**	**14**
1.	Give an account on the absorption of Fe and factors that affect the absorption of Fe.	
2.	Explain why man is unable to synthesize vitamin C? Mention its requirements and any four of its biochemical functions.	
3.	Describe obesity - its cause, classification based on BMI and its treatment.	

Q.5	**Write Short notes on the following (Any four)**	**20**
a.	Protein purification by salting out method.	
b.	Protein denaturation	
c.	Ketogenesis.	
d.	Cushing's Syndrome	
e.	Progesteron	
f.	Marasmus	

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(10)

TYBSc – Sem VI

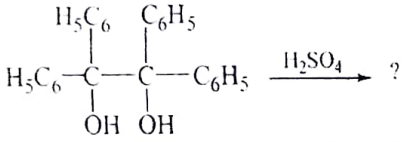
Time: 3 Hrs. Marks: 100

Please check whether you have got the right question paper.

N.B. 1. All questions are compulsory.
2. Figures to right indicates full marks.

Q.1		**Answer ANY FOUR of the following:**	
A		Discuss the mechanism and stereochemistry of S_N1 reactions using suitable example.	5
B		Explain the stereochemistry of epoxidation on cis-2-butene and trans-2-butene.	5
C	a)	Write a note on enantiotopic faces.	3
	b)	Explain the term: Prochiral centre	2
D		Explain the stereochemistry of OsO_4 oxidation of alkenes.	5
E	a)	What are α-amino acids? How are they classified?	3
	b)	Explain the primary structure of proteins.	2
F		Explain stepwise synthesis of a tripeptide using Merrifield's solid phase synthesis method. Give two advantages of this method of synthesis.	5

Q.2		**Answer ANY FOUR of the following:**	
A		What is Wittig reaction? Explain the mechanism of the reaction and identify the intermediate.	5
B	a)	How would you convert D-Arabinose to D-Glucose.	3
	b)	Give reactions for the periodic acid oxidation of D-Glucose and D-Fructose.	2
C		Complete the following reaction, identify it and give its mechanism:	5



D	a)	Write reactions for the stepwise methylation of β-D-Glucopyranose. Identify the products.	3
	b)	Draw the Fischer projection of D- Fructose and Haworth formula (α-pyranose form).	2
E		Distinguish between anomers and epimers. Give examples and draw structures to explain.	5
F		What is mutarotation? Explain mutarotation in D- Glucose with mechanism.	5

Q.3		**Answer ANY FOUR of the following:**	
A	a)	Explain the symmetrical and asymmetrical stretching vibrations?	3
	b)	Discuss the importance of D_2O exchange in PMR spectroscopy?	2
B	a)	Explain the effect of magnetic anisotropy on acetylenic protons.	3
	b)	What are fundamental bands and overtones?	2
C	a)	Write the structure of Purine bases present in RNA?	3
	b)	Give the hydrolysis of nucleic acids?	2
D		Explain the term nucleotide? Write the structure of any two nucleotide present in DNA?	5
E		An organic compound has the molecular formula C_4H_9NO. Determine the index of its hydrogen deficiency and deduce its structural formula from the following spectral data and justify your answer? IR Spectrum (cm^{-1}) : 3500-3400, 1680, 1610, 1390-1380 PMR Spectrum: (in δ ppm): 1.1(d), 2.1(m),8.1(s, D_2O exchangeable)	5

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1 An organic compound has the molecular formula C_3H_6O. Determine the index of its hydrogen deficiency and deduce its structural formula from the following spectral data and justify your answer.

IR Spectrum (cm^{-1}): 1715

PMR Spectrum: (in δ ppm): 0.9(3H, t), 1.6(2H, m), 2.2(3H, s), 2.4(2H, t)

Q.4 Answer **ANY FOUR** of the following

A **a)** How is Raney nickel prepared? Explain its use in reduction of Olefinic double bond and Nitriles giving suitable examples?

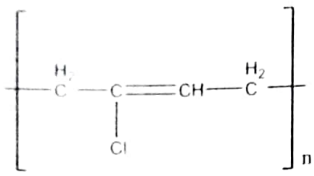
b) What is Rosenmund reduction? Give example of Rosenmund reduction?

B **a)** Give the use of SeO_2 in oxidation of active methylene, methyl and allylic H atoms.

b) Write one reaction of epoxidation using m-CPBA.

C **a)** Identify the monomers in the following polymers

i)



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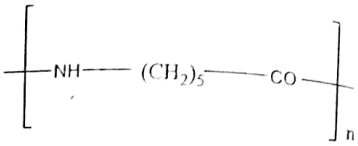

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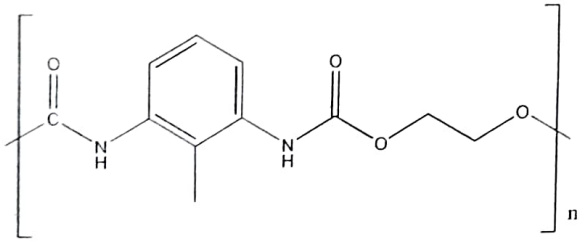


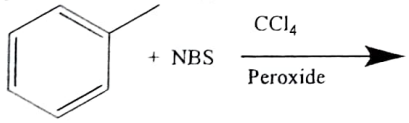
b) Explain the terms with examples?
Plastic ii) Fibers

D What is tacticity? Explain stereoisomers with examples?

E **a)** Explain the role of $NaBH_4$ in reduction of carbonyl compounds with suitable examples.

b) Complete the following reaction

i)



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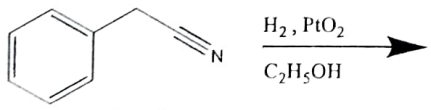

F **a)** Explain the following terms:
i) Biodegradable polymers ii) Stabilizers iii) Fillers

b) Give any two biomedical uses of polymers?

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(12)

A State whether the following are true or false: (ANY FIVE) 5

a) The two faces in acetone are homotopic in nature.
b) E-elimination reaction requires syn-periplanar geometry of the two leaving groups of substrate.
c) The bromination of cis-2-butene is neither stereoselective nor stereospecific reaction.
d) The reactions where only one diastereomer of all the possible diastereomers of the product is formed, are known as diastereoselective reactions.
e) Zwitter ions are containing only positive charge.
f) Oxidation of alkene using $KMnO_4$ gives a geminal diol.
g) A dipeptide is formed from two α-amino acids.
h) In Gabriel's synthesis of α-amino acids, K-phthalimide is used as one of the reactants.

B Choose the most correct option to answer the following **(ANY FIVE):** 5

a) The Beckmann rearrangement involves migration of an alky/aryl group to which species?
   i) Electron deficient carbon iii) Electron deficient nitrogen
   ii) Electron rich carbon iv) Electron rich nitrogen
b) Identify the intermediate formed in Favorskii reaction.
   i) Carbanion iii) Cabocation
   ii) Carbon free radical iv) Carbene
c) Michael's reaction requires which type of catalyst?
   i) Acidic iii) Basic
   ii) Amphoteric iv) Aprotic
d) Which of the following is the most abundant carbohydrate in nature?
   i) α-D-Glucofuranose iii) β-D-Glucofuranose
   ii) α-D-Glucopyranose iv) β-D-Glucopyranose
e) How would you classify D-Threose?
   i) Aldotriose iii) Aldopentose
   ii) Aldotetrose iv) Aldohexose
f) What is the product formed on treatment of D-Glucose with bromine water?
   i) D-Gulonic acid iii) D-Gluconic acid
   ii) D-Glucaric acid iv) D-Glycolic acid
g) In glucofuranose the hydroxyl group at which carbon atom is linked to the aldehyde group?
   i) C_3 iii) C_4
   ii) C_5 iv) C_6

C **Fill in the blanks: (ANY FIVE)** 5

a) For non-linear polyatomic molecule the number of possible modes of vibrations is given by the formula ----------
b) The left side of the NMR spectrum is called----------
c) A broad absorption band due to -O-H stretching in alcohols appears in the region around ----------
d) TMS stands for ----------
e) Magnetic anisotropy brings about ---------- of aromatic protons
f) The sugar component in RNA is ----------
g) The backbone of nucleic acid molecule is a ---------- chain.
h) Guanine and Cytosine are bonded by ---------- hydrogen bonds.

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D State whether the following are True or False: (ANY FIVE)

a) Copolymer is prepared by polymerization of two or more different types of monomers.
b) The triple bond of alkyne can be partially reduced by using Lindlar's catalyst.
c) Monomer of Nylon 6,6 is ε- caprolactum.
d) Ziegler- Natta Catalyst is organoaluminium compound such as $(CH_3CH_2)_2$ $AlCl_3$ and $TiCl_4$
e) Buna-S rubber is natural rubber.
f) Wilkinson's catalyst is $RhCl(PPh_3)_3$.
g) $LiAlH_4$ and Red Al reduces polar unsaturated groups like C=O, C=NH, N=O, $-NO_2$

(19)

T9BSc - Sem VI

[Time: 3 Hours] [Total marks :100]

N.B.: (1) All questions are compulsory.
(2) Figures to the right indicate full marks.
(3) Use of logarithmic table/non-programmable calculator is allowed.

1. Attempt **any four** of the following:
   - A. What is crystal field splitting? Explain with reference to tetrahedral complexes. 5
   - B. Explain the following factors affecting crystal field splitting. 5
     i] Nature of the ligands.
     ii]position of metal in transition series.
   - C. Explain the term crystal field stabilization energy [CFSE]. Calculate CFSE for d^8 and d^9 configurations in strong field octahedral complexes. 5
   - D. Discuss any five merits of crystal field theory. 5
   - E. Explain Jahn-Teller distortions in octahedral complexes with suitable example. 5
   - F. Write a note on intensity of d-d transition as an evidence of covalent bonding in metal complex. 5

2. Attempt **any four** of the following:
   - A. Discuss molecular orbital diagram of $[Fe(H_2O)_6]^{3+}$ complex and give its magnetic behaviour. 5
   - B. Write a note on Steric effect on the stability of metal complexes. 5
   - C. Explain charge transfer transitions in metal complexes. 5
   - D. Write a note on S_N1 mechanism in ligand substitution reaction of octahedral metal complexes. 5
   - E. Distinguish between thermodynamic and kinetic stability in metal complexes. 5
   - F. Write a note on base hydrolysis in ligand substitution reaction of octahedral metal complexes. 5

3. Attempt **any four** of the following:
   - A. Define organometallic compound. Write a note on multicentred electron deficient organometallic compound. 5
   - B. Describe the method of preparation of organometallic compound by oxidative addition reaction. 5
   - C. Write a note on Complex formation reactions of organometallic compounds. 5
   - D. What is ferrocene? Explain structure of ferrocene according to valence bond theory. 5
   - E. Write a note on any five chemical reactions of ferrocene. 5
   - F. Differentiate between homogeneous and heterogeneous catalysis. 5

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4. Attempt **any four** of the following:
   - A. Define metallurgy. Explain Hydrometallurgy with suitable example.
   - B. What are the different methods used for concentration of ore? Discuss in detail Hydraulic Classifier Method.
   - C. Name the steps involved in extraction of copper. Explain the electrolytic refining of copper.
   - D. How inert gases are isolated by Charcoal Adsorption methods.
   - E. Give the method of preparation and structure of following compound on the basis of VSEPR Theory:
     i) XeF_6
     ii) XeO_3
   - F. Write a note on importance of sodium potassium ion pump in biological system.

5. **Answer the following:**

A. Select the correct option and complete the following statements: (any five)

a. CFSE for strong field octahedral complexes with d^5 configuration is ----------
a)-6Dq+4P b) -12Dq+3P c) -24Dq+3P d) -20Dq+2P

b. In Octahedral complex, d-orbital of central metal degenerates into ---------- energy levels
a) 1 b) 3 c) 4 d) 2

c. Jahn-Teller distortions are more common among the octahedral complexes with ----------distribution of electrons.
a) proportional b) symmetric b) asymmetric c) equal

d. Crystal field splitting energy in square planar complex is denoted as --------
a) Δt b)Δsp c) Δq d) Δo

e. ---------- is a strong field ligand.
a)S^{2-} b) Cl^- c) CO d) F

f. In transition metal complexes, d-orbitals of the metal are affected by ----------
a)Metal b) Co-ions c)Ligands d)cations.

g. Colour observed for a complex is ---------- to the colour that is absorbed.
a)same b) complimentary c)alike d)identical

h. Electron spin resonance spectra of $[IrCl_6]^{2-}$ shows --------- curve
a)Double hump b) smooth c) Serrated d) linear

B. State whether true or false: (any five) 5

a. $[Ti(H_2O)_6]^{3+}$ is low spin complex .
b. Number of microstates for p^1 configuration 21.
c. $\Delta l = \pm 1$ is transition is Laporte allowed.
d. Ground state term for $1s^1$ is ^2S.
e. Complexes with polydentate ligands are more stable than those with unidentate ligands.
f. Associative mechanism for ligand substitution reaction form seven coordinate intermediate with pentagonal bipyramidal structure.
g. (2S-1) is called spin multiplicity.

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C. **Fill in the blanks with correct alternatives given in the bracket : (any five)** 5

(M – C, increases, CH_3MgCl, oxidation, heterogeneous, reductive elimination, 2 C_5H_6 , Mannich.)

a. The essential requirement for an organometallic compound is the presence of at least one …… bond

b. In preparation of organometallic compound by oxidative addition reaction, oxidation number of metal ……

c. …… is the example of organometallic compound.

d. Condensation of ferrocene rings with formaldehyde and amine is called as …….. reaction.

e. During nitration ferrocene undergoes…… .

f. Fe + …… → $(C_5H_5)_2Fe$ + H_2

g. When the reactants and catalyst are in the different phase, catalyst is referred as ……

h. High formal positive charge on the metal and presence of bulky groups on the molecule, facilitates …… reactions.

D. **Match the column: (Any five)** 5

Column A	Column B
a. Grinding	i. Source of β radiation
b. Frothing agent	ii. Incandescent electric bulbs
c. Acidic impurities	iii. Iron Deficiency
d. Bessemerisation	iv. Source of α radiation
e. Krypton Clathrates	v. Pulverization
f. Argon	vi. Skin pigmentation
g. Anaemia	vii. Pine oil
h. Tryosinase	viii. Used in treatment of cancer
	ix. Blister Copper
	x. Basic Flux

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TYBSC Semester -VI

Time: 3Hrs Marks: 100

N.B: (1) All questions are compulsory.

(2) Figures to the right indicate full marks.

(3) Use of log table, non-programmable calculator is allowed.

Q.1 **Attempt any four of the following.** 20

A) Explain the basic principles of DC polarography with current voltage relationship.

B) Write any five advantages of DME?

C) Explain with respect to polarography-
1) polarographic maxima
2) interference of dissolved oxygen

D) Explain the construction and working of rotating platinum electrode with labelled diagram. Give any two advantages.

E) Discuss any two amperometric titration curves with examples.

F) Calculate the diffusion current produced at DME for 2mM Pb(II) ions at 300K.
$D = 9.8 \times 10^{-6}$ cm^2 sec^{-1} , m = 4 mg sec^{-1} , t= 3.5 sec.

Q.2 **Attempt any four of the following.** 20

A) Draw schematic diagram of gas chromatograph and explain any three components.

B) In GC, using a 30 cm column, the retention times for two components A & B were 10.5 min & 12.4 min respectively. The corresponding peak width at the base were 1.10 min and 1.30 min respectively. Calculate 1) The number of plates in each peak
2) The plate height for the column.

C) Give any five points of comparison between gas solid chromatography and gas liquid chromatography.

D) What is the role of detector in GC? With the help of a labelled diagram, explain the working of thermal conductivity detector.

E) What is ion exchange chromatography? Give any four properties of an ion exchange resin.

F) Explain the following applications of ion exchange chromatography:
1) demineralisation of water 2) separation of amino acids.

Q.3. **Attempt any four of the following.** 20

A) What is food processing? Discuss the use of sulphur dioxide, sodium benzoate and sodium chloride as food preservatives.

B) Explain different types of milk on the basis of fat content.

C) Explain Cole's Ferricyanide method to estimate reducing sugars in honey.

D) Write the constituents of tea. Discuss detection of any two adulterants present in tea.

E) What are sensory properties of cosmetics? Explain ash analysis of lipstick.

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F) Write composition of face powder. Write any two properties of deodorants.

Q.4 Attempt any four of the following. 20

A) Give any five requirements of good thermobalance.

B) What is thermogravimetric analysis? Discuss any two instrumental factors affecting TGA curve.

C) Explain the following DTA curve for decompositions of.

1) $CuSO_4.5H_2O$ 2) $CaC_2O_4.H_2O$

D) Draw a neat and labelled diagram of instrument used in DTA and discuss its working.

E) Define thermometric titration. Discuss any two applications of thermometric titrations.

F) What do you mean by method validation? Discuss any three parameters with respect to method validation process.

Q.5 A) Select the correct option and complete the following statements: (any five) 05

a) Polarographic technique was invented by ----------
1) Nernst 2) Heyrovsky 3) Ostwald

b) Residual current is also known as ---------- current.
1) Faradic 2) non-Faradic 3) alternating

c) Polarography is --------- technique.
1) qualitative 2) quantitative 3) both qualitative and quantitative

d) The concentration of supporting electrolyte should be ------ times the concentration of analyte.
1) 100 2) 1000 3) 1/1000

e) ---- is used as supporting electrolyte.
1) Potassium Carbonate 2) Potassium chloride
3) Cesium chloride

f) ---------- is used as polarographic maxima suppressor.
1) KCl 2) Tritium 3) Triton-X 100

g) Amperometric titrations are carried out at constant ----------
1) current 2) potential 3) volume

h) Rotating platinum electrode can be used upto ----- volts.
1) zero 2) +0.4 3) +0.9

Q.5 B) State whether true or false: (any five) 05

a) Resolution can be improved by decreasing plate height.

b) In quantitative measurement by GC, the parameter used is retention time.

c) Band broadening due to concentration gradient within the band is known as eddy diffusion.

d) A strong cation exchange resin contain -COOH group as the functional group.

e) The affinity of the resin for the ion increases as the charge on the ion increases.

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f) Capacity of ion exchanger is measure of its ability to exchange ions

g) Helium gas is used as mobile phase in gas chromatography

Q.5 C) **Fill in the blanks with correct alternatives given in the bracket: (any five)** 05

(LTLT, Ethyl alcohol, $KMnO_4$, NaOH, Inedible, Acetic acid, Castor oil, HTST, Antiperspirant, Insulin)

a) Chicory root extract is high in _____.

b) _____ in the form of vinegar has been used to preserve pickled vegetable.

c) _____ pasteurization of milk is carried out at 63 °C for 30 minutes.

d) _____ is used as titrant for estimation of tannin in tea by Lowenthal's method.

e) Food spoilage and decay makes the food _____.

f) _____ is used in lipstick mainly to dissolve the dyes.

g) Deodorant lotions contain large amount of _____ which give a very good cooling sensation.

h) _____ is an astringent substance that is applied to the skin to reduce or prevent perspiration.

Q.5 D) **Match the columns: (any five)** 05

A	B
i) Phase transition	a) Set of specific directions
ii) DTA	b) Platinum
iii) TGA	c) Thermometric titration
iv) Heat generated	d) Disodium tartarate
v) Sample holders	e) Endothermic peak
vi) Titration of Zn^{2+} ion	f) Oxidation
vii) Protocol	g) Differential thermogram of sulphur

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