2 SEM TDC BOTH (CBCS) C 3

2 0 2 2

(June/July)

BOTANY

(Core)

Paper : C–3

(Mycology and Phytopathology)

Full Marks : 53
Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. *(a)* Choose and write the correct answer of
   the following :   1×3=3

   (i) Peziza / Puccinia / Agaricus is a
   polymorphic fungi.

   (ii) In case of diseased plants, small
   spots or streaks of dead tissue
   appear. The phenomenon is
   referred as moulting / necrosis /
   chlorosis / distortion.

   (iii) Citrus canker is a viral / fungal /
   bacterial / algal disease.

(Turn Over)

(b) Fill in the blanks of the following : 1×2=2

    (i) The cell wall of fungi is mostly made up of _____ .

    (ii) Early blight of potato is caused by _____ .

2. Write short notes on any *three* of the following : 4×3=12

    (a) Heterothallism in *Rhizopus*

    (b) Role of fungi in agriculture

    (c) Conidia of *Alternaria*

    (d) Fungal toxins

    (e) Sexuality in fungi

3. What are heteroecious fungi? With suitable diagram, describe the life cycle of *Puccinia*. 1+4+7=12

Or

What are allied fungi? Mention the characters of slime moulds. Describe the life-cycle of typical cellular slime mould. 1+4+7=12

4. Name the algal and fungal components of lichen. Describe the different growth forms of lichen. Draw and describe the internal structure of homomerous and heteromerous lichen. 1+5+6=12

Or

Write about the role of fungi in food industry. How are fungi used as biofertilizers? Give examples. 6+4+2=12

5. Mention the symptoms, names of the causal organism, disease cycle and control measures of the diseases (any *two*) : (1+1+2+2)×2=12

    (a) Black stem rust of wheat

    (b) Yellow vein clearing of bhindi

    (c) Angular leaf spot of cotton

    (d) White rust of crucifers

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2 SEM TDC ZOOH (CBCS) C 3

2 0 2 2

(June/July)

ZOOLOGY

(Core)

Paper : C–3

(Non-Chordates–II)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

_The figures in the margin indicate full marks
for the questions_

1. Fill in the blanks : 1×6=6

   (a) The animals containing true coelom are called _____.

   (b) Metamerism is a characteristic of _____.

   (c) The phylum Arthropoda is characterised by _____.

(d) The larva of echinoderms shows _____ symmetry.

(e) Excretory organ of Annelida is termed as _____.

(f) 'Devilfish' is the name of _____.

2. Distinguish between (any *four*) : 3×4=12

(a) Branchial respiration and Pulmonary respiration

(b) Septal nephridia and Pharyngeal nephridia

(c) Simple eye and Compound eye

(d) Holometabolous and Hemimetabolous

(e) Dipleurula larva and Bipinnaria larva

3. Write short notes on (any *three*) : 4×3=12

(a) Septal nephridia of earthworm

(b) Significance of trochophore larva

(c) Metamerism

(d) General characters of Annelida

(e) Tracheal respiration

4. Describe briefly about the metamorphosis of insects. 6

5. Write a note on pearl formation in bivalves. 6

Or

Describe the mechanism of torsion in Gastropoda.

6. Explain different larval forms in Echinodermata. 6

Or

Describe the water vascular system in star-fish with diagram.

7. Describe the process of pulmonary respiration in Mollusca. 5

Or

Describe briefly on the social life in honey-bees.

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2 SEM TDC PHYH (CBCS) C 3

2 0 2 2

(June/July)

PHYSICS

(Core)

Paper : C-3

(Electricity and Magnetism)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct answer (any *five*) :   1×5=5

    (a) The electric flux passing through a sphere enclosing +Q coulomb of charge is

    (i) $\dfrac{Q}{3\varepsilon_0}$

    (ii) $\dfrac{Q}{\varepsilon_0}$

    (iii) $\dfrac{Q}{5\varepsilon_0}$

    (iv) $\dfrac{Q}{4\pi\varepsilon_0}$

(2)

(b) The magnitude of electric field intensity at any point which is at a distance r from an electric dipole is directly proportional to

(i) $\dfrac{1}{r^3}$

(ii) $\dfrac{1}{r}$

(iii) $\dfrac{1}{r^4}$

(iv) $\dfrac{1}{r^2}$

(c) Poisson's equation for a homogeneous medium is

(i) $\nabla^2 v = 0$

(ii) $\nabla^2 v = -\dfrac{\rho_v}{\varepsilon}$

(iii) $\nabla^2 v = \dfrac{\rho_v}{\varepsilon}$

(iv) $\nabla^2 v = \rho_v$

(3)

(d) The SI unit of magnetic vector potential is

(i) T

(ii) $\dfrac{A}{m^2}$

(iii) $\dfrac{Wb}{m^2}$

(iv) $\dfrac{Wb}{m}$

(e) An example of ferromagnetic material is

(i) zinc

(ii) manganese

(iii) cobalt

(iv) chromium

(f) Current in a circuit is wattless when the phase difference between current and voltage is

(i) zero

(ii) $\dfrac{\pi}{2}$

(iii) $+\pi$

(iv) $-\pi$

2. *(a)* State Gauss law in electrostatics. Derive the relation $\vec{\nabla} \cdot \vec{E} = \dfrac{\rho}{\varepsilon_0}$, where ρ is volume density of charge. 1+2=3

(b) If 1 coulomb charge is placed at the centre of a cube of side 10 cm, calculate the flux coming out of any face of the cube. 1

3. *(a)* Prove the relation $E = -\nabla\phi$, where the symbols have their usual meanings. What is the significance of negative sign here? 2+1=3

(b) Calculate the electric potential at a point distance r from a point charge q. 2

4. *(a)* Define capacitance. Derive an expression for the capacitance of a parallel plate capacitor. 1+3=4

(b) A point charge q is placed at a distance d from an infinite plane conductor held at zero potential. Using method of electrical image, calculate—

   (i) induced surface charge density;

   (ii) total induced charge;

   (iii) force of attraction between the charge and the conductor. 2+2+1=5

5. *(a)* Derive the relationship between electric susceptibility and atomic polarizability on the basis of microscopic description of matter at atomic level. 3

(b) Why does electric field inside a dielectric medium decrease due to polarization? 1

(c) Show that $D = \varepsilon_0 \vec{E} + \vec{P}$. Also give their units. 2

Or

The capacity of a capacitor is 50 pico-farads when it is filled with a dielectric. Calculate the dielectric constant of the dielectric.

6. *(a)* State the Biot-Savart law. Find the magnetic field at a point due to straight current carrying conductor using Biot-Savart law. 1+3=4

Or

Prove that $\oint_C \vec{B} \cdot d\vec{l} = \mu_0 I$. 4

(b) Show that divergence of magnetic field is zero. 3

7. Define magnetic induction $\vec{B}$ and intensity of magnetization $\vec{M}$. Prove that $\vec{B} = \mu_0(\vec{H} + \vec{M})$.

1+2=3

8. Derive Maxwell's equations of electromagnetic wave and write the physical significance of each equation. 4

Or

Show that Ampere's law for varying currents may be written as

$$\oint_C \vec{B} \cdot \vec{dl} = \mu_0 I + \mu_0 \varepsilon_0 \frac{d\phi}{dt}$$

9. A circuit has $R = 10$ ohm, $L = 0.05H$ and $C = 20\ \mu F$. An alternating potential difference of 100 V (RMS) is applied across it. Calculate *(a)* resonant frequency, *(b)* current at resonance and *(c)* Q-value of the circuit.

1+1+1=3

Or

A coil of self-inductance 0.7 henry is connected in series with a non-inductive resistance of 50 ohm. Calculate the wattless and power components as well as the total current when connected to a supply of 200 V at 50 Hz. 3

10. State and prove Thevenin theorem. What is the limitation of this theorem? 3+1=4

Or

In a network given below, find the current flowing through the 12 Ω resistance using the superposition theorem : 4
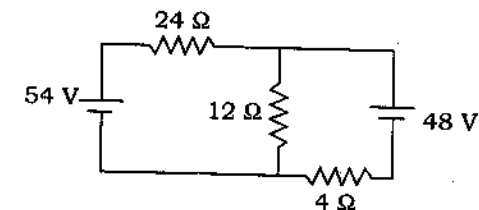
11. Show that the charge sensitivity is equal to $2\pi / T$ times the current sensitivity in case of the ballistic galvanometer. Under what conditions does a ballistic galvanometer become a dead beat galvanometer? 2+1=3

Or

The first three successive deflections of a ballistic galvanometer are found to be 15 cm, 14.9 cm and 14.8 cm. Calculate the first corrected deflection under damping. 3

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2 SEM TDC MTMH (CBCS) C 3

2 0 2 2

(June/July)

MATHEMATICS

(Core)

Paper : C–3

(Real Analysis)

Full Marks : 80
Pass Marks : 32

Time : 3 hours

The figures in the margin indicate full marks
for the questions

1. *(a)* Define ε-neighbourhood of a point. 1

   (b) Find the infimum and supremum, if it exists for the set $A = \{x \in \mathbb{R} : 2x + 5 > 0\}$. 2

(c) If

$$S = \left\{ \frac{1}{n} : n \in \mathbb{N} \right\}$$

then show that inf $S = 0$, where inf S denotes the infimum of S. 3

(d) State and prove that Archimedean Property of real numbers. 4

(e) Let $S \subseteq \mathbb{R}$ be a set that is bounded above and for $a \in \mathbb{R}$, $a + S$ is defined as $a + S = \{a + s : s \in S\}$. Show that $\sup(a + S) = a + \sup(S)$, where $\sup(S)$ denotes the supremum of S. 5

2. (a) State the Completeness Property of real numbers. 1

(b) Show that

$$\sup\left\{ 1 - \frac{1}{n} : n \in \mathbb{N} \right\} = 1$$

2

(c) Let

$$I_n = \left[0, \frac{1}{n} \right]$$

for $n \in \mathbb{N}$. Prove that

$$\bigcap_{n=1}^{\infty} I_n = 0$$

3

(d) Prove that the set of real numbers is not countable. 4

Or

If

$$S = \left\{ \frac{1}{n} - \frac{1}{m} : n, m \in \mathbb{N} \right\}$$

find inf S and sup S.

(e) State and prove the nested interval property. 5

Or

Prove that there exists a real number x such that $x^2 = 2$.

3. (a) State the Monotone Subsequence Theorem. 1

(b) Show that

$$\lim_{n \to \infty} \left(\frac{n}{n^2 + 1} \right) = 0$$

2

(c) Show that a convergent sequence of real numbers is bounded. 3

(d) Show that

$$\lim_{n \to \infty} (b^n) = 0$$

if $0 < b < 1$.　　　　4

Or

Show that

$$\lim_{n \to \infty} (c^{\frac{1}{n}}) = 1$$

for $c > 1$.

(e) State and prove the Monotone Convergence theorem.　　　　5

Or

Let $Y := (y_n)$ be defined as $y_1 = 1$, $y_{n+1} = \frac{1}{4} y_n + 2$, $n \geq 1$. Show that (y_n) is monotone and bounded. Find the limit.

4. *(a)* Give an example of two divergent sequences such that their sum converges.　　　　1

(b) Prove that the limit of a sequence of real numbers is unique.　　　　2

(c) Prove that

$$\lim_{n \to \infty} x_n = 0$$

if and only if

$$\lim_{n \to \infty} (|x_n|) = 0$$　　　　3

(d) Establish the convergence or divergence of the following sequences (any *one*) :　　　　4

(i) $x_n = \dfrac{(-1)^n n}{n+1}$

(ii) $x_n = \dfrac{n^2}{n+1}$

(iii) $x_n = \dfrac{2n^2 + 3}{n^2 + 1}$

(e) Define Cauchy sequence. Prove that a sequence of real numbers is Cauchy if and only if it is convergent.　　　　1+4=5

Or

Establish the convergence or divergence of the sequence

$$y_n = \frac{1}{n+1} + \frac{1}{n+2} + \cdots + \frac{1}{2n}$$

for $n \in \mathbb{N}$.　　　　5

5. *(a)* State the Cauchy Criterion for convergence of a series.   1

(b) Prove that if

$$\sum_{n=1}^{\infty} x_n$$

converges then

$$\lim_{n \to \infty} (x_n) = 0 \qquad 3$$

(c) Prove that if

$$\sum_{n=1}^{\infty} \frac{1}{n}$$

diverges.   3

(d) Show that the series

$$\sum_{n=1}^{\infty} x_n$$

converges if and only if the sequence $S = (s_k)$ of partial sums is bounded.   4

(e) Define absolute convergence. Show that if a series of real numbers is absolutely convergent then it is convergent.   1+3=4

(f) Let f be a positive, decreasing function on $\{t : t \geq 1\}$. Show that the series

$$\sum_{k=1}^{\infty} f(k)$$

converges if and only if the improper integral

$$\int_1^{\infty} f(t)dt = \lim_{b \to \infty} \int_1^b f(t)dt$$

exists.   5

Or

Show that the series

$$\sum_{n=1}^{\infty} \cos n$$

is divergent.

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2 SEM TDC CHMH (CBCS) C 3

2 0 2 2

(June/July)

CHEMISTRY

(Core)

Paper : C–3

(Organic Chemistry)
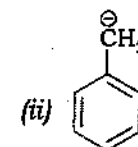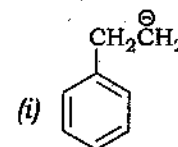
Full Marks : 53

Pass Marks : 21

Time : 3 hours
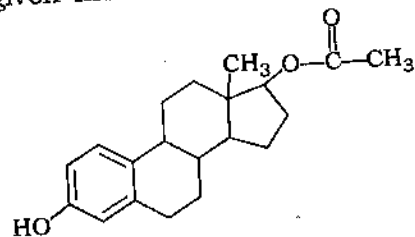
The figures in the margin indicate full marks
for the questions

1. Choose the correct answer from the following : 1×5=5

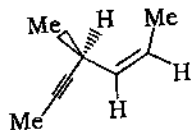   (a) Which is the most stable carbanion among the following?

   (i) $CH_2\overset{\ominus}{C}H_2$ (benzene ring)

   (ii) $\overset{\ominus}{C}H_2$ (benzene ring)

   (iii) $\overset{\ominus}{C}H_2$ (benzene ring with NO_2)

   (iv) $\overset{\ominus}{C}H_2$ (benzene ring with OCH_3)

(Turn Over)
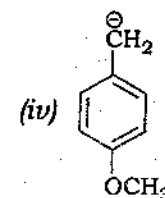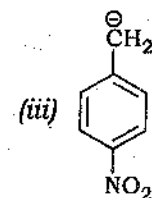
(2)

(b) How many chiral carbons are present in the given molecule?

(i) 1

(ii) 5

(iii) 3

(iv) 10

(c) Hydrogenation of the following compound in the presence of poisoned palladium catalyst gives

(i) an optically active compound

(ii) an optically inactive compound

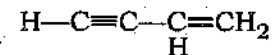(iii) a racemic mixture

(iv) a diastereomeric mixture

(3)

(d) The IUPAC name of the following compound

is

(i) neononane

(ii) tetraethyl carbon

(iii) 2-ethyl pentane

(iv) 3,3-diethyl pentane

(e) The hybridization of C atoms in C—C single bond of

$$H-C \equiv C - \underset{H}{C} = CH_2$$

is

(i) sp^3-sp^3 (ii) sp^2-sp^3

(iii) $sp-sp^2$ (iv) sp^3-sp

UNIT—I
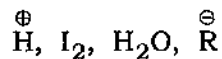
2. Answer the following questions : $2 \times 3 = 6$

(a) What do you mean by nucleophilicity and basicity?

(b) Alkyl groups attached to the benzene ring have electron releasing effect in the order

$$Me- > MeCH_2- > Me_2CH- > Me_3C-$$
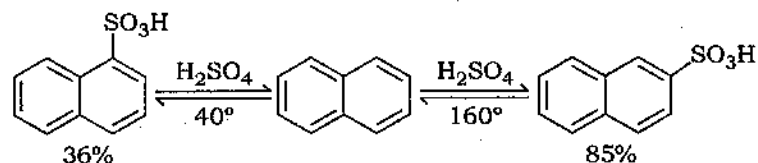
Explain this observation.

(c) Select soft and hard acids and bases from the following :

$$\overset{\oplus}{H}, \ I_2, \ H_2O, \ \overset{\ominus}{R}$$

Or

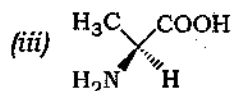Identify the following reactions as kinetically controlled and thermodynamically controlled :

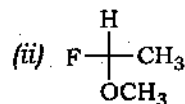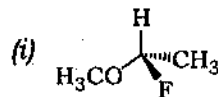
Draw the energy profile diagram for the above reactions.

UNIT—II

3. Answer the following questions : 2×6=12

(a) Specify the following stereoisomers as *R* and *S* (any *two*) : 1×2=2

(i)

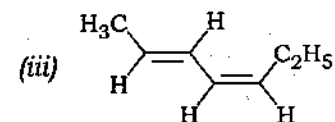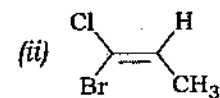*(ii)*

(iii)

(Continued)

(b) Specify the following geometrical isomers as *E* and *Z* (any *two*) : 1×2=2

(i)

(ii)

(iii)
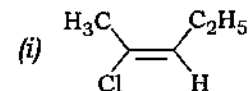
(c) Interconvert the following projections as directed (any *two*) : 1×2=2

(i)

 Fischer to Sawhorse

(ii)

 Sawhorse to Newman to Fischer

(iii)

 To Fischer projection
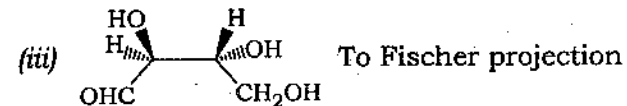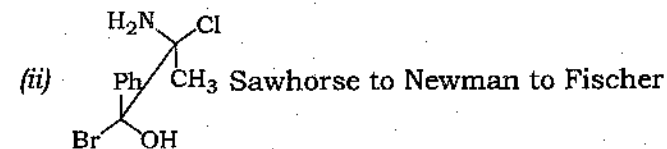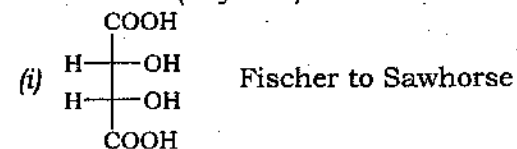
(d) Draw all the possible stereoisomers of tartaric acid

$$HO_2C(HO)HC—CH(OH)CO_2H$$
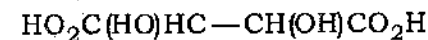
(Turn Over)

(e) Draw and give the stereochemical designation for the geometrical isomers of 2,4-heptadiene.
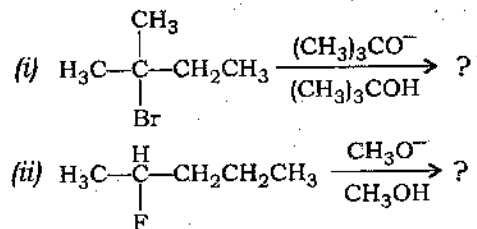
(f) Active 2-benzoyl propanoic acid undergoes racemization when treated with $NaOC_2H_5$ in ethanol. Explain.

UNIT—III

4. Answer the following questions :

(a) Prepare *n*-pentane with the help of Corey-House synthesis.   2

(b) An alkane has a molecular mass of 72. It forms only one monosubstituted product on chlorination in the presence of sunlight. Suggest a structure for the alkane.   1

(c) Addition of bromine in CCl_4 to *cis*-2-butene gives (±)-2,3-dibromo-butane while that for *trans*-2-butene gives *meso*-2,3-dibromobutane. Explain this with mechanism.   3

(d) Write the product(s) of the following elimination reactions :   1½×2=3

(i)
$$H_3C-\underset{\underset{Br}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_2CH_3 \xrightarrow[(CH_3)_3COH]{(CH_3)_3CO^-} ?$$

(ii)
$$H_3C-\underset{\underset{F}{|}}{\overset{\overset{H}{|}}{C}}-CH_2CH_2CH_3 \xrightarrow[CH_3OH]{CH_3O^-} ?$$

(e) "Markownikov's addition reaction is a regioselective reaction." Justify the statement.   2

(f) What do you mean by stereoselective and stereospecific reactions? Explain by giving examples of each.   2+1=3

(g) Write the mechanism of 1,4-addition of Br_2 to 1,3-butadiene.   2

Or

What is the stereoelectronic requirement of an *E2* process? Why *erythro*-1-bromo-1,2-diphenylpropane on base induced dehydrobromination yields *cis*-1,2-diphenylpropane exclusively?

$$\underset{\underset{Ph}{|}}{\overset{\overset{Ph}{|}}{\underset{Br-\overset{|}{\underset{|}{C}}-H}{H_3C-\overset{|}{\underset{|}{C}}-H}}} \xrightarrow[-HBr]{\bar{O}H} \overset{H}{\underset{Ph}{\diagdown}}C=C\overset{CH_3}{\underset{Ph}{\diagup}}$$

erythro-1-bromo-1,2-diphenylpropane   *cis*-1,2-diphenylpropene
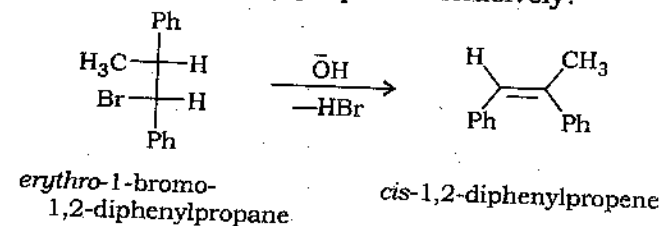
UNIT—IV

5. (a) Explain why Baeyer strain theory is not applicable to higher ring compounds.   2

(b) Draw the chair- and boat-conformation of cyclohexane in Newman projection.   2

Or

Explain why equatorial methyl-cyclohexane is more stable than axial methylcyclohexane.

(c) Discuss the factors responsible for the stability of a conformation.   2

(d) Draw the energy profile diagram for the conformations of *n*-butane.   2

UNIT—V

6. (a) Which of the following compounds are aromatic, anti-aromatic and non-aromatic?   2

(i)   (ii)

(iii)   (iv)
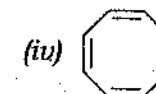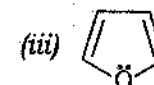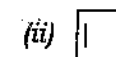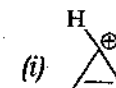
(b) Write the mechanism of Friedel-Crafts alkylation of benzene.   2

(c) Discuss the directing influence of —OCH_3 group towards the electrophilic aromatic substitution reactions.   2

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2 SEM TDC MTMH (CBCS) C 4

2 0 2 2

(June/July)

MATHEMATICS

(Core)

Paper : C–4

(Differential Equations)

Full Marks : 60
Pass Marks : 24

Time : 3 hours

The figures in the margin indicate full marks
for the questions

(Throughout the paper, notations $y'' = \dfrac{d^2 y}{dx^2}$, $y' = \dfrac{dy}{dx}$)

1. *(a)* Define an integrating factor of a differential equation. 1

   (b) Define implicit solution of the differential equation. 1

(c) Show that the function f defined by $f(x) = 2e^{3x} - 5e^{4x}$, is a solution of the differential equation $y'' - 7y' + 12y = 0$.   3

Or

Show that the function $x^2 + y^2 = 25$ is an implicit solution of the differential equation $x + yy' = 0$ on the interval $-5 < x < 5$

(d) Solve the initial value problem

$$y' = e^{x+y}, y(1) = 1 \qquad 2$$

(e) Verify the exactness of the differential equation,   2

$$(2x \sin y + y^3 e^x)dx + (x^2 \cos y + 3y^2 e^x)dy = 0$$

(f) Solve any *two* of the following :   3×2=6

   (i) $(3x^2 + 4xy)dx + (2x^2 + 2y)dy = 0$

   (ii) $xy' + (x+1)y = x^3$

   (iii) $y' + 3x^2 y = x^2$, $y(0) = 2$

2. (a) Draw the input-output compartmental diagram for lake pollution model. Write the word equation to derive this model.   1+1=2

(b) Derive the formula for half-life of radioactive material.   2

(c) Derive the differential equation of exponentially growth population model.   3

(d) Answer any *one* of the following :   3

   (i) Solve the differential equation $\frac{dC}{dt} = \frac{F}{V}(c_{in} - C)$ with initial condition $C(0) = c_0$.

   (ii) How long ago was the radioactive carbon (^{14}C) formed and, within an error margin, the Lascaux Cave paintings painted? (the half-life of ^{14}C is $5,568 \pm 30$ years). Decay rate of carbon ^{14}C is 1.69 per minute per gram and initially 13.5 per minute per gram.

3. (a) Define linear combinations of n functions.   1

(b) State the principle of superposition for homogeneous differential equation.   1

(c) Fill in the blank :

If the Wronskian of two solutions of 2nd order differential equation is identically zero, then the solutions are linearly ____.   1

(d) Show that e^{2x} and e^{3x} are the two solutions of the equation $y'' - 5y' + 6y = 0$ and also verify the principle of superposition.   3

(e) If $y_1(x)$ and $y_2(x)$ are any two solutions of the equation

$$a_0(x)y'' + a_1(x)y' + a_2(x)y = 0,$$
$$a_0(x) \neq 0, \ x \in (a, b)$$

then prove that the linear combination $c_1 y_1(x) + c_2 y_2(x)$, where c_1 and c_2 are constants, is also a solution of the given equation. 4

Or

Show that $e^x \sin x$ and $e^x \cos x$ are linearly independent solutions of $y'' - 2y' + 2y = 0$. Write the general solution. Find the solution $y(x)$ with the property $y(0) = 2, \ y'(0) = -3$.

4. Answer any *one* of the following : 5

(a) If $y = x$ is a solution of $(x^2 + 1)y'' - 2xy' + 2y = 0$, then find a linearly independent solution by reducing the order.

(b) Solve $x^2 y'' - 2xy' + 2y = x^3$

5. Answer any *two* of the following : 5×2=10

(a) Solve $y'' + ay = \sec ax$.

(b) Solve by method of undetermined coefficient $y'' - 2y' + y = x^2$.

(c) Solve by method of variation of parameter

$$y'' + y = \tan x$$

6. (a) Define equilibrium solution of a differential equation. 1

(b) Write the word equation and differential equation for the model of battle. 2

(c) Find the equilibrium solution of the differential equation of epidemic model of influenza. 3

(d) Draw the phase plane diagram of 4

$$dx/dt = 0 \cdot 2x - 0 \cdot 1 \, xy,$$
$$dy/dt = -0 \cdot 15 \, y + 0 \cdot 05 \, xy$$

Or

Sketch the phase-plane trajectory and determine the direction of trajectory of model of battle.

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2 SEM TDC ZOOH (CBCS) C 4

2 0 2 2

(June/July)

ZOOLOGY

(Core)

Paper : C–4

(Cell Biology)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Fill in the blanks : 1×5=5

   (a) Membrane bound organelles are absent in _____.

   (b) Virus that attaches bacteria is called _____.

   (c) Microtubules are hollow unbranched tubes composed of subunits of protein _____.

(d) Nucleoplasm is also known as _____.

(e) _____ is a multifunctional protein activated during G_1 phase.

2. Distinguish between (any *two*) : 3×2=6

(a) Osmosis and Diffusion

(b) Heterochromatin and Euchromatin

(c) Viroid and Virus

3. Write short notes on [(a) and (b) or (c) and (d)] : 3×2=6

(a) Function of lysosomes

(b) S-phase

(c) Desmosomes

(d) Nucleosome

4. Discuss the structure and function of microfilaments. 4+3=7

5. Discuss the structure of mitochondrial particle and respiratory chain. 4+5=9

Or

Give an account of chemiosmotic theory. Mention the functions of mitochondria. 5+4=9

(*Continued*)

6. Describe the various stages of mitosis with necessary diagrams. 5+2=7

7. Write about the structure of nuclear envelope and mention two important functions of it. 5+2=7

8. Discuss the role of second messengers. Write briefly about molecular structure of GPCR. 3+3=6

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2 SEM TDC CHMH (CBCS) C 4

2 0 2 2

(June/July)

CHEMISTRY

(Core)

Paper : C–4

(Physical Chemistry—II)

Full Marks : 53
Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct answer :　　　　1×6=6

   (a) For a system to be at equilibrium, the value of ΔG at constant temperature and pressure must be

   　(i) $\Delta G_{T,P} > 0$

   　(ii) $\Delta G_{T,P} < 0$

   　(iii) $\Delta G_{T,P} = 0$
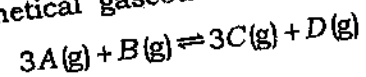
   　(iv) $\Delta G_{T,P} \geq 0$

(b) The value of ΔS for an irreversible process is

(i) positive

(ii) negative

(iii) zero

(iv) None of the above

(c) The chemical potential is

(i) partial molar enthalpy

(ii) partial molar volume

(iii) partial molar free energy

(iv) partial molar internal energy

(d) For equilibrium in case of a hypothetical gaseous reaction

$$3A(g) + B(g) \rightleftharpoons 3C(g) + D(g)$$

(i) $K_p = K_c RT$

(ii) $K_p = K_c(RT)^2$

(iii) $K_p = K_c$

(iv) $K_c = \dfrac{1}{K_p}$

(e) Regardless of the atmospheric pressure, the boiling point of a dilute solution as compared to that of pure solvent is

(i) same

(ii) lower

(iii) higher

(iv) Any of the above

(f) If z is a state function, then $\oint dz$ is equal to

(i) zero

(ii) positive

(iii) negative

(iv) infinity

2. Answer any *six* of the following questions :

$$2 \times 6 = 12$$

(a) Write any two differences between reversible and irreversible processes.

(b) Six moles of an ideal gas expand isothermally and reversibly from a volume of 1 dm^3 to a volume of 10 dm^3 at 27 °C. What is the maximum work done?

(c) Establish the relationship between enthalpy change and internal energy change for a gaseous reaction.

(d) What are partial molar properties? Define chemical potential.

(e) Derive the relation between K_p and K_c for the following reaction :

$$aA + bB \rightleftharpoons cC + dD$$

(f) How are osmotic pressure measurements utilized for determining molar mass of a non-volatile solute?

(g) What are extensive and intensive properties? Explain with examples.

UNIT—I

Answer any *two* questions from the following : 8×2=16

3. (a) Calculate the work done when a gas expands—

(i) isothermally and reversibly from volume V_1 to V_2;

(ii) isothermally and irreversibly from volume V_1 to V_2.

From these, show that the work done in a reversible process is greater than that in an irreversible process. 2+2+2=6

(b) What is Joule-Thomson coefficient? Derive a relation between Joule-Thomson coefficient and thermodynamic quantities. 2

4. (a) Deduce a relation between temperature and volume for an adiabatic reversible expansion of an ideal gas. 2½

(b) One mole of an ideal gas $(\overline{C_V} = 12 \cdot 55 \, J \, K^{-1} \, mol^{-1})$ at 300 K is compressed adiabatically and reversibly to one-fourth of its original volume. What is the final temperature of the gas? 2½

(c) Derive Kirchhoff's equation. 3

5. (a) Deduce an expression for the entropy changes associated with the changes in temperature and pressure of an ideal gas. 4

(b) For a reaction $\Delta H = 10 \cdot 5 \times 10^3 \, J \, mol^{-1}$ and $\Delta S = 31 \, J \, K^{-1} \, mol^{-1}$ at 298 K, decide whether the reaction is spontaneous or not at this temperature. 2

(c) State and explain the third law of thermodynamics. 2
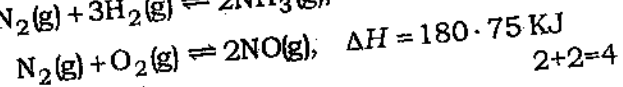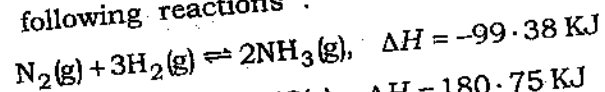
UNIT—II

6. Answer either (a) or (b) : 3

(a) Discuss the variation of chemical potential with temperature and pressure.

(b) Derive Gibbs-Duhem equation.

UNIT—III

7. Answer any *two* questions from the following : 4×2=8

(a) State and explain Le Chatelier's principle. With the help of this principle, work out the conditions which would favour the formation of ammonia and nitric oxide in the following reactions :

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g), \quad \Delta H = -99 \cdot 38 \, KJ$$

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g), \quad \Delta H = 180 \cdot 75 \, KJ$$
2+2=4

(b) (i) What are exergonic and endergonic reactions? 1

(ii) Calculate K_c and K_x for the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ for which $K_p = 0 \cdot 157$ atm at 27 °C and 1 atm pressure. 3

(Continued)

22P/1378

(c) Derive the relation between Gibbs' free energy change and reaction quotient. From this, establish the relation between standard Gibbs' free energy change and equilibrium constant of a reaction. 3+1=4

UNIT—IV

8. Answer any *two* questions from the following : 4×2=8

(a) What is osmotic pressure? Derive a relation between osmotic pressure and relative lowering of vapour pressure.

(b) What are isotonic solutions? A solution containing 8·77 g per dm^3 of urea (molar mass = 60 g mol^{-1}) was found to be isotonic with a 5-percent solution of an organic non-volatile solute. Calculate the molar mass of the latter. 1+3=4

(c) Derive the relation between the elevation of boiling point of a dilute solution and the molality of that solution. Define molal elevation constant. 3+1=4

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2 SEM TDC BOTH (CBCS) C 4

2 0 2 2

(June/July)

BOTANY

(Core)

Paper : C–4

(Archegoniate)

Full Marks : 53
Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks
for the questions

1. Choose the correct answer of the following :

1×5=5

(a) Spores of pteridophytes are haploid/ diploid / triploid / tetraploid.

(b) Three-chambered sporangium is found in _Lycopodium_ / _Selaginella_ / _Equisetum_ / _Psilotum._

(c) _Rhynia_ is known from Silurian / Ordovician / Cambrian / middle Devonian.

(d) Gymnospermic endosperm is haploid / diploid / triploid / tetraploid.

(e) Reticulate venation is found in the leaves of *Cycas/Pinus/Ginkgo/Gnetum.*

2. Write short notes on any *three* of the following :   4×3=12

   (a) Sporophyte of *Marchantia*

   (b) Merits of telome theory

   (c) Xerophytic characters of gymnosperm

   (d) Process of fossilization

3. With suitable sketch, compare the thallus structure of *Riccia*, *Marchantia* and *Anthoceros*. Which is most primitive according to your opinion and why?   9+3=12

Or

Describe the following :   6+6=12

   (a) Sporophyte of *Polytrichum*

   (b) Ecological importance of bryophyte

4. What is stele? Give an account of the stelar organization in pteridophytes from evolutionary point of view. Give suitable diagram.   2+7+3=12

Or

Write notes on the following :   6+6=12

   (a) Morphological nature of rhizophores in *Selaginella*

   (b) Sporocarp of *Marsilea*

5. Write short notes on any *three* of the following :   4×3=12

   (a) Development of male gametophytes of *Pinus*

   (b) *Psilophyton*

   (c) Fern like characters of *Cycas*

   (d) Angiospermic characters of *Gnetum*

   (e) Distribution of gymnosperms in India

2 SEM TDC PHYH (CBCS) C 4

2 0 2 2

(June/July)

PHYSICS

(Core)

Paper : C–4

(Waves and Optics)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks
for the questions

1. Choose the correct option from the following :

   $1 \times 5 = 5$

   (a) For a particle executing simple harmonic motion, its velocity $\dfrac{dy}{dt}$ at any instant is

   (i) $a^2 \sqrt{\omega^2 - y^2}$

   (ii) $\omega \sqrt{a^2 - 1}$

   (iii) $\omega \sqrt{a^2 - y^2}$

   (iv) None of the above

(_Turn Over_)

(b) If two simple harmonic vibrations of equal amplitude and frequency act simultaneously on a particle, then the resulting path of the particle will be

    (i) circular

    (ii) elliptical

    (iii) along a straight line

    (iv) parabolic

(c) The phase difference between two points on a wavefront separated by a distance λ is

    (i) 2λ

    (ii) λ

    (iii) 0

    (iv) None of the above

(d) In single-slit diffraction pattern when light of smaller wavelength is used, the width of central maximum

    (i) decreases

    (ii) increases

    (iii) remains unaffected

    (iv) cannot be predicted

     (Continued)

(e) When the diameter of the objective of an astronomical telescope is doubled, its limit of resolution

    (i) is doubled

    (ii) is quadrupled

    (iii) is halved

    (iv) remains unaffected

2. Answer the following questions :   2×5=10

(a) Describe any one method for demonstrating interference of sound.

(b) A note produces 4 beats/second with a tuning fork of frequency 512 Hz and 6 beats/second with a tuning fork of frequency 514 Hz. Find the frequency of the note.

(c) Distinguish between the terms 'temporal coherence' and 'spatial coherence'.

(d) Explain the term 'fringes of equal inclination'.

(e) Describe Kirchhoff's integral formula.

3. Answer any *five* of the following questions :

        6×5=30

(a) Derive an expression for velocity of transverse vibration along a stretched string. A wire gives out a fundamental note of 256 cycles/s when it is under a tension of 10 kg wt. Under what tension, the string will emit a frequency of 512 cycles/s?   4+2=6

     (Turn Over)

(b) Discuss Newton's formula for velocity of sound and Laplace's correction to Newton's formula. What are the effects of density and pressure on the velocity of sound? 4+2=6

(c) What are Newton's rings? Derive the radius of the nth dark ring. In a Newton's ring experiment, the diameter of the 10th dark ring due to wavelength 6000 Å is 0·5 cm. Find the radius of curvature of the lens. 1+3+2=6

(d) Describe the working of a Michelson's interferometer. Describe briefly how wavelength of light can be determined with a Michelson's interferometer. 3+3=6

(e) Discuss plane transmission grating. Derive an expression for resolving power of a plane transmission grating. 3+3=6

(f) Describe Fresnel's explanation of rectilinear propagation of light. Discuss Fresnel's diffraction at a straight edge. 3+3=6

4. Write short notes on any *two* of the following : 4×2=8

(a) Lissajous figure

(b) Stokes' theorem

(c) Holography

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