[Time: 3 Hours] **[Marks: 100]**

Please check whether you have got the right question paper.

N.B: 1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Draw neat and labeled diagrams wherever necessary.

Q.1 A) Fill in the blanks by choosing the correct option given in the bracket: **05**

a) Fossils in which only hard parts of organisms remain while the soft parts decay are called _____. (East, Mould, Petrification)
b) Evolution of resistance to pesticides is an example of _____ selection. (stabilizing, disruptive, directional)
c) Large scale phenotypic changes in populations at or above the species level in called _____. (microevolution, macroevolution, megaevolution)
d) _____ research is also called decisional research. (Translational, Basic, Applied)
e) In _____ research investigator uses already available facts which are analyzed and critically evaluated. (abstract, applied, analytical)

Q.1 B) Match the columns I and II and rewrite: **05**

Column A	**Column B**
a) Phylogenetic trees	1) Postzygotic isolating mechanism
b) Weismann	2) Prezygotic isolating mechanism
c) Hybrid breakdown	3) Alexander Fleming
d) Habitat isolation	4) Germplasm theory
e) Discovery of Penicillin	5) DNA sequencing

Q.1 C) Mention whether the given statement is **True or False**: **05**

a) Whales lost their hindlimbs as a consequence of the inherited effect of disease.
b) In IAEC, 'I' stands for India.
c) Presence of two or more morphs in the same habitat is called polymorphism.
d) When a population is in genetic equilibrium no evolution takes place.
e) A good introduction in research paper should be unipartite.

Q.1 D) Answer the following in one sentence: **05**

a) Define endosymbiosis
b) Define connecting link
c) Define the term gene pool
d) What is allele frequency?
e) Define dissertation

Q.2 A) Explain Mutation theory and Weismann's germ plasm theory of evolution. **10**

OR

A) Give a detailed account of the origin of eukaryotic cell. Add a note on geographical evidences in favour of organic evolution. **10**

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Q.2 B) Answer **any two** of the following: **10**
a) Explain in brief Darwinism.
b) Describe chemical evolution with Haldene and Oparin theory.
c) Give an account of homologous organs.
d) Write a note on vestigial organs.

Q.3 A) Describe the role of genetic drift and natural selection in evolution. **10**

OR

A) Describe the various sources of genetic variation within a population. **10**

Q.3 B) Answer **any two** of the following: **10**
a) Explain adaptive radiation with examples.
b) Describe the biological species concept.
c) Write a note on parapatric speciation.
d) Describe how migration disrupts Hardy Weinberg equilibrium in a population.

Q.4 A) Give an account of two broad approaches of scientific reasoning. **10**

OR

A) Give a brief account of approval from forest department to conduct research in protected area. **10**

Q.4 B) Describe **any two** of the following: **10**
a) Review paper writing.
b) Role of critical thinking in scientific research.
c) Scientific research: Definition and characteristics
d) Key features of popular report.

Q.5 Write short notes on **any four**: **20**
a) Neo-Darwinism
b) Recapitulation theory
c) Sympatric speciation
d) Role of geographical isolation in speciation
e) Application of knowledge gained by research
f) Informed consent in clinical research

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Time: 3 Hours **Marks: 100**

N. b.:

1. **All questions are compulsory and carry equal marks.**
2. **Figures to right indicate full marks.**
3. **Draw neat labelled diagrams wherever necessary.**
4. **Attempt the questions in order.**
5. **Please check whether you have got the right question paper.**

Q.1 A) Fill in the blanks by choosing the correct options given below **05**

a) ---------- contains the genetic information stored in DNA
(Golgi complex, , Nucleus, Mitochondria)

b) Communication between plant cells takes place through fine strands of actin called ----------.
(Plasmodesmata, Microvilli, Hemidesmosomes)

c) ---------- concerned with protein synthesis.
(Smooth Endoplasmic Reticulum, Rough Endoplasmic Reticulum, Nucleus)

d) ---------- outer membrane is smooth and allows many small molecules to pass through it.
(Golgi complex , Plasma membrane, Mitochondria)

e) ---------- is known as aldehyde or ketone derivatives of polyhydroxy alcohols.
(Minerals, Lipids, Carbohydrates)

B) Match the columns I and II and rewrite **05**

Column I	**Column II**
a) Lysosomes	**i.** Protein Synthesis
b) Plasma membrane	**ii.** Lecithin and Cephalin
c) Golgi Complex	**iii.** Intermediate product of hotosynthesis
d) Sucrose	**Iv** Cellular Digestion
e) Phospholipids	**v.** Fluid Mosaic Model

C) State whether True or False **05**

a) Hemidesmosomes form rivet like links between the extracellular matrix and cytoskeleton
b) Golgi complex are membrane bound vesicles filled with digestive enzymes
c) Mitochondria contain both DNA and RNA
d) Starch is composed of two types of glucose polymers
e) Vitamin C is associated with disease known as rickets

D) Define the following. **05**

a) Microvilli
b) Microtubules
c) Cisternae
d) Keratin
e) Steroids

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Q.2 **A)** Describe with suitable diagram difference in Prokaryotic and Eukaryotic cells **10**

OR

A) Describe with suitable diagram general structure and function of plasma membrane

B) **Explain any two from the following.** **10**

a) Describe size, shape and position of Nucleus.
b) With diagram classify membrane receptors
c) Describe endocytosis with example.
d) Describe functions of microfilaments.

Q.3 **A)** Explain an endomembrane system with suitable diagram **10**

OR

A) Explain various function of Lysosomes.

B) **Explain any two from the following.** **10**

a) Occurrence of endoplasmic reticulum
b) Ultrastructure of Golgi complex.
c) Polymorphism in lysosomes.
d) Origin and occurrence of mitochondria.

Q.4 **A)** Discuss the properties and classification of carbohydrates. **10**

OR

A) Discuss the structure and function of water soluble vitamins

B) **Discuss any two from the following.** **10**

a) Oligosaccharides
b) Primary structure of proteins
c) Collagen
d) Unsaturated fatty acids.

Q.5 **Write short notes on any four** **20**

a) Anchoring junctions in cell membranes
b) Microfilaments
c) Smooth endoplasmic reticulum
d) Biogenesis of Mitochondria.
e) Glycogen
f) Haemoglobin

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[Time: 3 Hours] **[Marks: 100]**

Please check whether you have got the right question paper.

N.B: 1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Draw a neat labeled diagram wherever necessary.

Q.1 A) Fill in the blanks by choosing the correct options from the bracket. **05**

a) Inside the egg, the area of heavy deposition of yolk is known as _____. (animal pole, vegetal pole, nuclear pole)

b) _____ of the sperm contains proteolytic enzymes which help in the entry into the ovum during fertilization. (Mid piece, Principle piece, Acrosome)

c) The first menstruation begins at puberty and is called as _____. (menarch, ovulation, gestation)

d) Absence of sperms in semen is called as _____. (oligospermia, azoospermia, teratozoospermia)

e) PUC test is related to _____ (eutrophication, vehicular emission, salinity)

Q.1 B) Match the column I with column II & rewrite **05**

Column I	Column II
a) Mosaic egg	i) LH surge
b) Rotational cleavage	ii) Klinefelter syndrome
c) Primary hypogonadism	iii) Predetermined development
d) Green House Gas	iv) Isolecithal mammalian egg
e) Ovulatory phase	v) Methane

Q.1 C) State whether true or false: **05**

a) Protostomes are inclusive of invertebrates in which the mouth develops from blastopore.

b) Non cleidoic eggs have calcareous shell.

c) Salpangitis is the inflammation of testis in human.

d) RU-486 contains high doses of steroids.

e) Industrial effluent pipes can be considered as non-point source of pollution.

Q.1 D) Answer in one sentence: **05**

a) What is blastodisc?

b) Name the organism responsible to cause Gonorrhea

c) Give full form of PCOS.

d) Give full form of CFC.

e) What is soil erosion?

Q.2 A) Answer **any one** of the following: **10**

a) Describe types of holoblastic cleavage.

b) What is coelom? Describe its formation.

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Q.2 B) Answer **any two** of the following: **10**

a) Describe epiboly
b) Describe meroblastic cleavage
c) Describe oligolecithal eggs
d) Describe different types of sperms in animals

Q.3 A) Answer **any one** of the following: **10**

a) Describe the anatomy of female reproductive system in human.
b) Describe the hormonal regulation of male reproductive system in human.

Q.3 B) Answer **any two** of the following: **10**

a) Describe andropause
b) Write short note on Syphilis
c) Write note on abortion
d) Describe ZIFT

Q.4 A) Answer **any one** of the following: **10**

a) Describe effects of water pollution.
b) Describe types and sources of air pollutants.

Q.4 B) Answer **any two** of the following: **10**

a) Describe radioactive pollution.
b) Describe health hazards of noise pollution.
c) Describe control measures of soil pollution.
d) Describe control measures of solid wastes.

Q.5 Write short notes on **any four** of the following: **20**

a) Gastrulation in protochordates
b) Discoblastula
c) Hormonal methods of contraception
d) Accessory glands and external genitalia in male
e) E-waste
f) Control measures of air pollution

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Time: 3Hrs **Marks:-100**

N.B : (1) All questions are compulsory.
(2) Figures to the right indicate maximum marks.
(3) Use of non-programmable calculators is permitted.
(4) Symbols used have their usual meaning

Q1. A) Select correct answer (12)

1 The positive gravitational anomaly indicates---------
(a) an excess of mass (b) a deficiency of mass
(c) a reversal of the gravitational field (d) none

2 A Seismometer is an instrument used to detect and record----------
(a)Earth quake (b) Rainfall
(c) Atmospheric pressure (d)Weather condition

3 Which of the following is a data transfer instruction
MOV A, C b) ANA B c)ADD D d) INR E

4 Which instruction below will always clear the accumulator
ORI,00h b)ANI,00h c) SUI,00h d)ADI ,00h

5 Which of the following is not a natural source of radiation?
a) Sea water b) Cosmic rays
c) Earth d) Fluorescent lamp

6 Frequency modulation is _____
a) Modulation of analog carrier by an analog signal
b) Modulation of analog carrier by a digital signal
c) Modulation of digital carrier by an analog signal
d) Modulation of digital carrier by a digital signal

B) Answer in one sentence (03)

1 What do you mean by Radioactive pollution?
2 Identify the op-code and operand in the instruction STA , 3400h
3 Define Radiation Exposure.

C) Fill in the Blanks (5)

1 ---------- water is the water that seeps through rocks and soil and is stored below the ground.
2 ---------island is an example of hot-spot generated volcanic peak that originated about 70 million years ago.
3 Number of bytes in the instruction MOV A, B is ……
4 RAR belongs to …… functional category of instructions.
5 The _____ of digital signal is the number of bits sent out by its transmitter in one second.

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Q2. A) Attempt any one (8)

1 What is Seismology? What are seismic waves? What are the different types of seismic waves.

2 Define 'Environmental Management'. Explain the importance of Environmental Management.

B) Attempt any one

1 Discuss the internal structure of earth. (8)

2 State the methods used for determination of the age of earth. Explain any one of them in detail.

C) Attempt any one

1 What is the difference between Geophysics and Geology?

2 What is Geodynamo? Explain (4)

Q3. A) Attempt any one (8)

1 Explain in brief different registers in 8085 microprocessor.

2 Write short notes on ALU, data bus and address bus.

B) Attempt any one (8)

1 Six data bytes are stored in memory locations starting from 2400h. Write an assembly language program to add these bytes and store the sum and carry in the next consecutive locations.

2 Write the content of the registers involved at the end of each instruction

i) MVI C , 56h
ii) MOV A,C
iii) RRC
iv) ADI , 78h
v) LXI H , 3200h
vi) MOV M,A
vii) INX H

C) Attempt any one (4)

1 Write instructions to

a) AND the content of B with A
b) Complement A
c) Subtract data 73h directly from A
d) Load DE register pair with address 2400h

2 Write the difference between following instructions with examples

a) CMP B and SUB B b) DCR D and DCX D

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Q4. A) Attempt any one (8)

1 What is Radiotherapy? Explain the different ways of Radiotherapy.

2 Explain the signal transmission process through broadband communication with examples. What are the advantages of broadband communication?

B) Attempt any one (8)

1 Explain the properties of α, β and γ radiations.

2 What is digital communication? What are the advantages of digital signals over analog signals?

C) Attempt any one (4)

1 A person's stomach and colon are exposed to radiations separately of equivalent value of 90 mSv and 80 mSv respectively. Weighing factor for colon is 0.18 and for stomach 0.12. Calculate the effective dose and comment.

2 What is the maximum length of antenna required for FM transmission which is between 88MHz and 108MHz?

Q5. Attempt any Four (20)

1 Draw a neat and labeled diagram of an absolute gravimeter

2 Explain the difference between oceanic and continental crust.

3 Give flag format of 8085 microprocessor.

4 Explain with example any two addressing modes in 8085microprocessor.

5 Define various types of radiation detectors.

6 Explain three stages of demodulation with the help of suitable diagram.

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Time: 3Hrs **Marks:-100**

N.B : (1) All questions are compulsory.
(2) Figures to the right indicate maximum marks.
(3) Use of non-programmable calculators is permitted.
(4) Symbols used have their usual meaning

Q1. A) Select correct answer (12)

1 Hamiltonian operator is the
a) linear momentum operator. b) kinetic energy operator.
c) Total energy operator. d) angular momentum operator.

2 Eigen function of operator $\frac{d}{dx}$ with eigenvalue a is (A is Constant)
a) Ae^{ax} b) $Ae^{i\sqrt{ax}}$ c) $Ae^{\sqrt{ax}}$ d) Aae^{ax}.

3 The solution of Schrodinger wave equation are describe by stationary states when particle is moving in
a) time independent potential. b) time dependent potential.
c) velocity dependent potential. d) velocity independent potential.

4 Wave function ψ_n for a particle in one dimensional box has
a) (n +1) nodes b) n nodes c) (n – 1) nodes d) infinite nodes

5 Quantum mechanical tunneling is due to the
a) particle nature of matter. b) dual nature of matter.
c) wave nature of matter. d) random nature of matter.

6 Scanning tunneling microscope (STM) type of microscope is based on the quantum mechanical phenomenon known as
a)Tunneling effect. b) Ramsur-Townsend effect.
c) Correspondence principle. d) Ramsur effect.

B) Answer in one sentence (03)

1 What are operators?
2 What is degeneracy of energy states?
3 Give one example of harmonic oscillator.

C) Fill in the Blanks (5)

1 Steady state is when wave function representing the system is ---------- of time.
2 The Eigen functions are ----------to each other.
3 The total probability of finding the particle in space must be _____.
4 A particle is confined to an infinite square well. The probability of locating it just outside the well is _____.
5 _____ is the ratio of the reflected probability current density to the incident probability current density.

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Q2. A) Attempt any one (8)

1 Explain what is meant by expectation value of x. Why is it necessary to use the operator form of a physical quantity in calculating its expectation value? Why should the operator be sandwiched between $\psi*$ and ψ in the equation of expectation value?

2 Derive equation of continuity in quantum mechanics. State significance of probability flux.

B) Attempt any one (8)

1 State and explain the basic postulates of quantum mechanics.

2 Show that when the potential energy is a function of position alone, the Schrodinger time dependent equation reduces to Schrodinger time independent equation. What is meant by stationary states?

C) Attempt any one (4)

1 The eigen function for a free particle in a box is given by
$\Psi_n = A \sin \frac{n\pi x}{2L}$, n is an integer
Find its allowed energies.

2 For eigen function $\Psi(x) = \sqrt{\frac{2}{l}} \sin \frac{\pi x}{l}$; $0 < x < l$ determine $< x >$.

Q3. A) Attempt any one (8)

1 A beam of particles each of mass m and energy E, moving in a region of zero potential energy, approaches a step potential barrier of height V_0, where $E < V_0$. Obtain the reflection and transmission coefficients.

2 Solve the Schrodinger wave equation for a particle moving in an infinitely deep one dimensional potential well and obtain its energy levels. Draw the energy level diagram.

B) Attempt any one (8)

1 Solve the Schrodinger wave equation for a particle moving in a rectangular three dimensional box and obtain its energy levels. Obtain the total normalized wave-functions inside the box.

2 Set up Schrodinger's equation for free particle. Solve the equation to obtain the wave-function. Show that the wave function for the particle is an Eigen function of the linear momentum operator.

C) Attempt any one (4)

1 Find the probability of a particle trapped in a one dimensional box of length L can be found between 0.45 L and 0.55 L for the ground state.

2 Consider an atom as a cubical box of each side 10^{-10} m. Calculate the energy of an electron trapped in the atom in the ground state and the first excited state.

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Q4. A) Attempt any one (8)

1 A particle of mass ***m*** and energy $E > V_0$ travelling along x-axis has a potential barrier described by

$$V(x) = \begin{cases} 0 & \text{for } x < 0 \\ Vo & \text{for } 0 \leq x \leq a \\ 0 & \text{for } x > a \end{cases}$$

Write down the time-independent Schrodinger wave equation for the motion of particle, solve it and derive the expression for reflection and transmission coefficient of the particle.

2 Define Tunneling effect. Derive an expression of the approximate transmission coefficient of a potential barrier of height V_0 and width a.

B) Attempt any one (8)

1 Solve the linear harmonic oscillator equation and obtain an expression for energy eigenvalues.

2 State correspondence principle. Explain it with the help of probability density plot.

C) Attempt any one (4)

1 The potential barrier problem is a good approximation to the problem of an electron trapped inside but near the surface of a metal. Calculate the probability of transmission that a 2 eV electron will penetrate a potential barrier of 5 eV when the barrier width is 2 A°.

2 A harmonic oscillator consists of a mass 1 kg on a spring and it oscillates with amplitude 1 m and angular frequency 1 rad/s. What is the order of magnitude of the quantum number associated with the energy of the system and comment on the result?

Q5. Attempt any Four (20)

1 If $\Psi_1(x)$ and $\Psi_2(x)$ are normalized solutions of STIE for two different energy eigenvalues of a system, then is the following general solution $\Psi = 4\Psi_1 + 3\Psi_2$ normalized.
What is probability of locating the system in the state Ψ1?

2 What is meant by superposition of wave functions? Show that wave functions obey the principle of superposition but the corresponding probability densities do not.

3 Obtain the Eigen-values of the momentum of the particle in a one dimensional box.

4 Show that the ground state energy level of a particle in one dimensional potential box with rigid walls is in agreement with uncertainty principle.

5 Show that for a simple harmonic oscillator $\frac{\Delta E}{E_n} = \frac{2}{2n+1}$.
What will happen to this ratio if $n \to \infty$?

6 Find the expectation value $< x >$ for the first excited state of a simple harmonic oscillator.

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Q.P.Code: 34640

[Time: 3 Hours] **[Marks: 100]**

N.B: **(1) All questions are compulsory.**
(2) Figures to the right indicate maximum marks.
(3) Use of non-programmable calculator is permitted.
(4) Symbols used have their usual meaning.

Q 1 A **Select the correct option:** **12**

(i) A beam of parallel light of wavelength 5550Å is incident on a plane transmission grating which has 6000 lines per cm. The highest order spectrum that can be observed is

(a) 3 (b) 2 (c) 4 (d) 8

(ii) The bending of light into the geometrical shadow is commonly known as

(a) Interference (b) Diffraction (c) Polarization (d) none of these

(iii) Optic axis is

(a) an imaginary line inside the crystal (b) A real line inside the crystal
(c) A direction inside the crystal (d) None of the above.

(iv) Quarter wave plates produce

(a) path difference of $\lambda/4$ OR phase difference of $\pi/2$ radians between O and E – waves.
(b) path difference of $\lambda/4$ OR phase difference of π radians between O and E – waves.
(c) path difference of $\lambda/2$ OR phase difference of $\pi/2$ radians between O and E – waves.
(d) None of the above.

(v) JK flip-flop operates in a toggle mode when its J and K inputs are ___ and ___ respectively.

(a) 0 and 0 (b) 1 and 1 (c) 1 and 0 (d) 0 and 1

(vi) The decimal number 110 is represented in hexadecimal number system as

(a) 6E (b) 66 (c) E6 (d) 6F

Q 1 B **Answer in one sentence:** **(3)**

(i) Give one distinguishing point between Fraunhofer diffraction and Fresnel's diffraction.

(ii) State Malus' law.

(iii) What is asynchronous counter?

TURN OVER

Q 1 C **Fill in the blanks:** **(5)**

(i) Fresnel diffraction is due _____wave front.

(ii) In Fraunhofer's diffraction due to double slit, interference fringes of _____width are observed.

(iii) When unpolarized light passes through a _____, transmitted light is linearly polarized.

(iv) Transverse nature of light was confirmed by the phenomenon of _____ of light.

(v) In a D flip flop, output is 1 when D input is _____.

Q2 A **Attempt any one:** **8**

(i) Give the mathematical treatment of intensity distribution in the illuminated region for Fresnel's diffraction phenomenon due to straight edge. Draw relevant diagrams.

(ii) Give the theory of plane transmission grating. Draw the diagram of intensity distribution on the screen clearly indicating the positions of secondary maxima and secondary minima.

Q2 B **Attempt any one:** **8**

(i) In case of Fraunhofer diffraction due to a single slit, show that the intensity at any point on the screen is proportional to $\left(\frac{\sin\alpha}{\alpha}\right)^2$ where α is the phase difference between the secondary waves from the two ends of the slit. Draw the intensity distribution curve for this type diffraction.

(ii) What are half-period zones? Show that the radii of half period zones are proportional to the square roots of natural numbers and the area of each half period zone is πbλ.

Q2 C **Attempt any one:** **4**

(i) A cylindrical wire of 0.01cm radius is placed in front of a slit illuminated by a monochromatic wavelength of 6328 Å . Find the width of the interference band on the screen at a distance of 150cm from the wire in the geometrical shadow.

(ii) A single slit diffraction produces a central maximum of width 0.5cm on a screen placed at 40 cm from the lens. Calculate the distance between the first dark and the next bright fringe on the screen. Wavelength of light used is 5890 Å

TURN OVER

Q3 A **Attempt any one:** **8**

(i) Discuss theoretically the superposition of two linearly polarized light wave propagating in the same direction having same frequency when the optical vectors are mutually perpendicular to each other for phase difference of odd and even multiple of $\pi/2$.

(ii) A right circularly polarized beam of wavelength 5893 Å is incident on a quartz crystal whose surface is cut parallel to the optic axis. If the thickness of the crystal is 0.025 mm, find the state of polarization of an emerging beam.
Given: μ_E =1.55336 and μ_o= 1.54425

Q3 B **Attempt any one:** **8**

(i) Describe in brief the following methods for producing plane polarized light
a) Polarization by scattering.
b) Polarization by selective absorption.

(ii) Describe the phenomenon of double refraction. Explain double refraction in calcite crystal.

Q3 C **Attempt any one:** **4**

(i) Find the degree of polarization when a beam of light passes through a pile of 10 plates such that at one critical angle of incidence the coefficient of amplitude reflection of glass plates is 2% for parallel vibrations and 8% for perpendicular vibrations. (Neglect absorption)

(ii) Ice is an example of positive uniaxial crystal with refractive indices of refraction 1.309 and 1.310. Determine the wavelength of light if ice acts like a quarter wave plate of thickness 0.15 mm.

Q4 A **Attempt any one:** **8**

(i) Draw a block symbol of RS flip-flop. Explain how RS flip-flop can be constructed using NAND gates. Write truth-table.

(ii) Describe three bit binary ripple counter with the help of relevant circuit diagram. Write truth-table. Draw also the waveforms.

Q4 B **Attempt any one:** **8**

(i) What is a shift register? Explain each of its type briefly using block symbol.

(ii) Using 2's complement arithmetic, find (–A+B) and (-A-B).
Given: A = 1001 and B = 0101

TURN OVER

Q4 C **Attempt any one:** **4**

(i) Convert decimal number 47.625 into binary number

(ii) a) Convert hexadecimal number D5 into decimal number.
b) A computer has 64 KB memories. How many numbers of bytes it can store?

Q 5 **Attempt any four:** **20**

(i) Derive an expression for the width of central maximum in case of single slit Fraunhofer diffraction.

(ii) A narrow slit illuminated by a light of wavelength 5890Å is located at a distance of 0.1m from a straight edge. If the measurement is made at a distance of 0.5m from the edge, calculate the distance between the first and the second dark band.

(iii) Explain the working of Quarter- Wave Plate.

(iv) State the five applications of polarized light.

(v) Write the logic symbol of JK flip flop and show how JK Master-Slave flip-flop can be constructed from JK flip flop. Write its truth table.

(vi) a) Using streamline method, convert binary number 1011011.01 into decimal number.
b) Draw the circuit diagram of mod 5 counter.

……..

(3 Hours) **[Total Marks: 100]**

Note: (i) **All** questions are **compulsory**.
(ii) **Figures** to the right **indicate marks** for **respective parts**.

Q.1 Choose correct alternative in each of the following : **(20)**

i. If $f:[a,b] \to IR$ be bounded function and P ,Q be partitions of $[a,b]$ then

(a) $L(P,f)) \leq U(Q,f)$ (b) $L(P,f) \geq U(Q,f)$

(c) $L(P,f)) = U(Q,f)$ (d) None of the above

ii. The norm of a partition $P = \{0 < \frac{1}{2} < 1 < \frac{4}{3} < \frac{7}{3} < 3\}$ is

(a) $\frac{1}{3}$ (b) $\frac{2}{3}$

(c) 1 (d) None of the above

iii. If $f:[a,b] \to IR$ is R- integrable then which of the following is true

(a) f must be continuous (b) f must be differentiable

(c) f must be monotonic (d) None of the above

iv. Let$f : \mathbb{R} \to \mathbb{R}$ be a continuous function. Then $\int_{-a}^{a} f(t)dt = 0, \forall a > 0$ if and only if

(a) $f \equiv 0$ (b) $f$is an odd function

(c) $f \neq 0$ for only finitely many real numbers. (d) None of the above.

v. If $f, g:[a,b] \to \mathbb{R}$ are continuous functions such that $\int_a^b f(x)dx = \int_a^b g(x)dx$ then

(a) $f \equiv g \; on \; [a,b]$ (b) $f(x) = g(x)$ is a constant.

(c) $\exists \; c \in [a,b]$ such that $f(c) = g(c)$ (d) None of the above.

vi. The type 2 integral $\int_0^2 \frac{1}{x-1} \, dx$

(a) Diverges (b) Converge to 0

(c) Converge to $\frac{1}{2}\ln 3$ (d) Converges to $\frac{8}{9}$

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vii. Integral $\int_1^\infty \frac{1}{x^p}\,dx$ converges if

(a) p > 1 (b) p < 1

(c) p = 1 (d) None of the above

viii. Find $\int_0^{\frac{\pi}{2}} cos^{11}x\ sin^9x\ dx$

(a) $\frac{1}{10!}$ (b) $\frac{5!\,4!}{2(10!)}$

(c) $\frac{10!}{5!\,4!}$ (d) 0

ix. $\int_0^\infty x^{3/2}e^{-x}\,dx=$

(a) $\frac{3\sqrt{\pi}}{4}$ (b) $\frac{\pi}{2}$

(c) $\frac{\sqrt{\pi}}{5}$ (d) None of these

x. Identify the definite integral that computes the volume of the solid generated by revolving the region bounded by the graph of $y = x^3$ and the line $y = x$, between $x = 0$ and $x = 1$ about the line $x = 1$.

(a) $\pi\int_0^1 \left(y^{\frac{2}{3}} - y^2\right)dy$ (b) $\pi\int_0^1 \left(y^{\frac{1}{3}} - y\right)^2 dy$

(c) $2\pi\int_0^1 \left(4-x^2\right)(4-x^6)\,dx$ (d) $\pi\int_0^1 \left(4-y\right)^2(4-y^{\frac{1}{3}})^2\,dx$

Q2. Attempt any **ONE** question from the following : **(08)**

a) i. Let $f:[a,b] \to IR$ be a bounded function. Prove that f is Riemann integrable on [a, b] if and only if for any $\in > 0$ there exist a partition P of [a, b] such that $U(f,P) - L(f,P) < \in$.

ii. If $f; g:[a,b] \to IR\ are\ R$- integrable then prove that $f + g$ is R- integrable and $\int_a^b f + g = \int_a^b f + \int_a^b g$

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Q.2 Attempt any **TWO** questions from the following : **(12)**

b) i. Let f be a bounded function on [a, b]. Let P and P' are two partitions of $[a, b]$ with $P \subseteq P'$. Show that $L(P', f) \geq L(P, f)$

ii. If f is an R-integrable function on $[a, b]$ then prove that $|f|$ is R-integrable on $[a, b]$.

iii. Using Riemann Criterion, prove that the function $f : [0, 1] \longrightarrow \mathbb{R}$ defined by $f(x) = x$ is Riemann integrable.

iv. If f , g : [a, b]$\rightarrow \mathbb{R}$ are integrable functions such that $f(x) \leq g(x)$, $\forall\, x \in$ [a, b] then prove that $\int_a^b f(x)\, dx \leq \int_a^b g(x)\, dx$.

Q3. Attempt any **ONE** question from the following : **(08)**

a) i. State and prove the Fundamental Theorem of Calculus.

ii. State and prove Comparison Test for improper integrals of type-I.

Q3. Attempt any **TWO** questions from the following : **(12)**

b) i. Let $F : [0, 1] \rightarrow \mathbb{R}$be defined by $F(x) = \begin{cases} x^2 \sin\left(\frac{\pi}{x}\right) & if\ 0 < x \leq 1 \\ 0 & if\ x = 0 \end{cases}$

Show that is differentiable over [0, 1].Let $f : [0, 1] \rightarrow \mathbb{R}$be given by $f(x) = F'(x)$. Find $\int_0^1 f(t)dt$.

ii. Evaluate $\lim_{x\to\infty} \frac{1}{x^3} \int_0^x \frac{t^2}{1+t^4} dt$

iii. Prove that $\int_a^b \frac{1}{(b-x)^p}\, dx$ converges if and only if $p < 1$.

iv. State Abel's and Dirichlet's Tests for the conditional convergence of type 1 improper integral and discuss convergence of $I = \int_0^\infty \sin x^2\, dx$

Q4. Attempt any **ONE** question from the following : **(08)**

a) i. Prove that $\int_0^1 x^{m-1}(1-x)^{n-1} dx$ converges if and only if m and n are both positive.

ii. With usual notations for beta and gamma functions prove that

(p) $\beta(m, n) = \beta(n, m)$

(q) $\frac{\beta(m,n+1)}{n} = \frac{\beta(m+1,n)}{m} = \frac{\beta(m,n)}{m+n}$.

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Q4. Attempt any **TWO** questions from the following : **(12)**

b) i. Prove that $\beta(m,n)=\int_0^\infty \frac{t^{m-1}}{(1+t)^{m+n}}\,dy$.

ii. Show that $\Gamma\left(\frac{1}{2}\right)=\sqrt{\pi}$.

iii. Find the volume of the solid whose base is the disk $x^2+y^2\le 1$ and the cross sections by the planes perpendicular to the $y-axis$ between $y=-1$ and $y=1$ are isosceles right triangles with one leg in disk by the method of slicing.

iv. Find the volume of the solid generated by revolving the regions bounded by the lines $y=2x\ , y=x\ , x=1$ and about $x-axis$ by the Washer method.

Q5. Attempt any **FOUR** questions from the following : **(20)**

a) If $f(x)=1+2x, x\in$ IR and P be a partition such that $0<0.25<0.5<0.75<1$, then find $U(P,f)$.

b) If f is Riemann integrable on $[a,b]$ then for any $k\in$ IR prove that kf is also Riemann integrable on $[a,b]$.

c) Show that if $F'(x)=0\ ,\forall x\in[a,b]$ then f is a constant function.

d) Identify the type and discuss the convergence of each of the following integrals

$(I)\int_0^1 \frac{dx}{x^2(1+x)^3}$ (II)$\int_1^\infty \frac{sin^2x}{x^2}dx$

e) Prove that $\int_0^{\frac{\pi}{2}}\sqrt{\sin x}\ dx\int_0^{\frac{\pi}{2}}\frac{1}{\sqrt{\cos x}}\,dx=\pi$.

f) Find the area of the surface generated by revolving the curves about $x=2\sqrt{4-y}$, $0\le y\le\frac{15}{4}$ about $y-$axis.

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(3 Hours) **[Total Marks: 100]**

Note: (i) All questions are compulsory.

(ii)Figures to the right indicate marks for respective parts.

Q.1 Choose correct alternative in each of the following (20)

$i.$ A group G is said to be Abelian if

(a) $\forall x, y \in G, xy = yx$ (b) $\forall x, y \in G, xy \neq yx$

(c) For some $x, y \in G$, $xy = yx$ (d) None of the above

$ii.$ The set $\mathbb{Q}$ forms a group under the binary operation

(a) ' + ' (b) ' − '

(c) '.' (d) None of the above

$iii.$ Let D_n denote the dihedral group. Then $|D_n| =$

(a) n (b) $2n$

(c) $n!$ (d) None the above

$iv.$ Let H be a subgroup of a group G. then

(a) $\forall x, y \in H, xy^{-1} \in H$ (b) $\forall x, y \in H, xy^{-1} \in G$

(c) $\forall x, y \in H, xy^{-1} \notin H$ (d) None of the above

$v.$ The order of 0 in the cyclic group of integers $\mathbb{Z}$ under addition is

(a) 0 (b) Infinite order

(c) 1 (d) None of the above

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vi. Let $G = \mathbb{C}^*$ be the multiplicative group of non-zero complex numbers and $i \in G$ then o(i) is

(a) 1 (b) 2

(c) 3 (d) 4

vii. Which of the following is false?

(a) Any infinite cyclic group has exactly two generators

(b) A subgroup of a cyclic group need not be cyclic.

(c) There is only one subgroup of order d where d is a divisor of n for a cyclic group of order n

(d) The multiplicative group of n^{th} roots of unity is cyclic.

viii. Let $G = (\mathbb{C}^*, \cdot)$ and $H = \{z \in \mathbb{C}^* : |z| = 1\}$ then the cosets of H in G are

(a) $\{z \in \mathbb{C}^* : |z| = k\}\ \forall k \in \mathbb{R}^+$ (b) $\{z \in \mathbb{C}^* : |z \cdot w| = 1\}\ \forall w \in \mathbb{C}^*$

(c) $\{z \in \mathbb{C}^* : |z + w| = 1\}\ \forall w \in \mathbb{C}^*$ (d) None of these

ix. The number of group homomorphism from $\mathbb{Z}_{12}$ to $\mathbb{Z}_{30}$ is

(a) 6 (b) 7

(c) 8 (d) None of these

x. Which of the following groups are isomorphic

(a) $(\mathbb{Z}_4, +)$ and V_4 (Klein-4 group) (b) $(\mathbb{Z}_4, +)$ and μ_4 (4^{th} root of unity)

(c) V_4 and μ_4 (d) None of these

Q2. Attempt any **ONE** question from the following: (08)

a) i. Show that $\mathbb{Z}_n$, the set of residue class of modulo *n* form a group under the binary operation '+'.

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ii. Prove that if for $a \in G$, $o(a) = m$ then $o(a^k) = \frac{m}{g.c.d.(m,k)}$.

Q.2 Attempt any **TWO** questions from the following: (12)

b) i. Let G be a group. Prove that

p) Identity element of G is unique.

q) The inverse of every element in G is unique.

ii. If $a^2 = e$ for every a in a group G then show that G is abelian group.

iii. Let $G = GL_2(\mathbb{R})$. Let $H = \{A \in G \mid \det A = 2^n, \text{for some } n \in \mathbb{Z}\}$. Prove that H is a subgroup of G.

iv. Let $\alpha = (1\ 2\ 5)(6\ 13\ 5)$ and $\beta = (1\ 3\ 4)(2\ 6\ 5)(2\ 3\ 4)$ .Write α and β as a product of disjoint cycles. Further, verify the following.

p) $o(\alpha) = o(\alpha^{-1})$

q) $o(\alpha\beta) = o(\beta\alpha)$

r) $o(\alpha\beta\alpha^{-1}) = o(\beta)$

Q3. Attempt any **ONE** question from the following: (08)

a) i. Prove that subgroup of a cyclic group is cyclic

ii. Prove that if G be a finite cyclic group of order n then G has $\phi(n)$ generators.

Q3. Attempt any **TWO** questions from the following: (12)

b) i. Show that the group of positive rational numbers under multiplication is not cyclic.

ii. List all the elements of $\mathbb{Z}_{40}$ that have order 10.

iii. Show that an infinite cyclic group has exactly two generators.

iv. Show that if G is a group with more than $p - 1$ elements of order p, where p is a prime then G cannot be cyclic.

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Q4. Attempt any **ONE** question from the following: (08)

$a)$ i. Let H be a subgroup of a group G and $a, b \in G$ then show that

(p) $a \in aH$ (q) $aH = bH$ *or* $aH \cap bH = \emptyset$ (r) $|aH| = |bH|$

ii. Let $f: G \longrightarrow G'$ is onto group homomorphism. Prove that

(p) If H is subgroup of G then $f(H) = \{f(h)/h \in H\}$ is subgroup of G'.

(q) If H' is subgroup of G' then $f^{-1}(H') = \{a \in G/f(a) \in H'\}$ is subgroup of G and $kerf \subseteq f^{-1}(H')$.

Q4. Attempt any **TWO** questions from the following: (12)

$b)$ i. Let H and K be two subgroups of G. If $o(H) = p$, a prime integer, then show that either $H \cap K = \{e\}$ or $H \subseteq K$.

ii. Let G be a group of order pq where p and q are distinct prime integers. Show that every subgroup $H \neq G$ is a cyclic subgroup of G.

iii. Let G be an abelian group of order n and $(m, n) = 1$, $m \in \mathbb{Z}$ then show that $f: G \longrightarrow G$ defined by $f(x) = x^m, \forall x \in G$ is an automorphism.

iv. Show that the map $f: GL_2(\mathbb{R}) \longrightarrow GL_2(\mathbb{R})$ defined by $f(A) = (A^t)^{-1}$ is an group automorphism.

Q5. Attempt any **FOUR** questions from the following: (20)

$a)$ Define Center $Z(G)$ of a group G. Show that $Z(G)$ is a subgroup of G.

$b)$ Construct composition table of $U(10)$ under multiplication modulo 10. Also find the order of each of its elements.

$c)$ How many elements does the group $U(10)$ have? List them. Also find order of each element. Is $U(10)$ cyclic?

$d)$ Show that a cyclic group is abelian.

$e)$ Give an example of a group G and a subgroup H of G such that $aH = bH$ but $Ha \neq Hb$ for some $a, b \in G$.

$f)$ Show that the map $f: (\mathbb{C}, +) \longrightarrow (\mathbb{C}, +)$ defined by $f(a + bi) = a - bi$ is an group isomorphism.

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(3 Hours) **[Total Marks: 100]**

Note: (i) All questions are compulsory.
(ii)Figures to the right indicate marks for respective parts.

Q.1 Choose correct alternative in each of the following **(20)**

$i.$ The order and degree of differential equation $\sqrt{\left(\frac{d^3y}{dx^3}\right)^2 + x + 4\left(\frac{dy}{dx}\right)^3} = 3x^3$ is
(a) 1 and 3 (b) 2 and 1
(c) 2 and 2 (d) 3 and 2

$ii.$ Which of the following equations is exact?
(a) $xdx + ydy + \frac{xdy - ydx}{x^2 + y^2} = 0$ (b) $x^2y^2dx + (y^2 + x)dy = 0$
(c) $(3x + y)^2dx + x^2dy = 0$ (d) None of these.

$iii.$ Which of the following substitution converts non-homogeneous differential equation $(x + y)dy + (5x - 3y + 8)dx = 0$ into a homogeneous differential equation?
(a) $x = X - 1, y = Y + 1$ (b) $x = X + 1, y = Y + 1$
(c) $x = X + 1, y = Y - 1$ (d) $x = X - 1, y = Y - 1$

$iv.$ Which of the following functions are not linearly independent on $[1, 2]$?
(a) $y = \sin x$ and $y = \cos x$ (b) $y = x^2$ and $y = x^3$
(c) $y = \log x^2$ and $y = \log x^3$ (d) None of these

$v.$ One of the solutions of the differential equation $y'' - y = 0$ is
(a) $y = k$, where $k \in \mathbb{R}\backslash\{0\}$ (b) $y = \sin x$
(c) $y = e^x$ (d) None of these

$vi.$ The Wronskian of $y_1 = \sin x$ and $y_2 = \cos x$ is
(a) 1 (b) 0
(c) –1 (d) None of these

$vii.$ The roots of the auxiliary equation of the differential equation $y'' - 4y' + 3y = 0$ are
(a) 1 and 4 (b) 3 and 4
(c) 1 and 3 (d) None of these

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viii. The auxiliary equation of the system of homogeneous linear differential equations $\begin{cases} \frac{dx}{dt} = a_1x + b_1y \\ \frac{dy}{dt} = a_2x + b_2y \end{cases}$ is

(a) $m^2 - (a_1 + b_2)m + a_1b_2 - a_2b_1 = 0$

(b) $m^2 - (a_2 + b_1)m + a_1b_2 - a_2b_1 = 0$

(c) $m^2 + (a_1 + b_2)m + a_1b_2 - a_2b_1 = 0$

(d) $m^2 - (a_2 + b_1)m + a_2b_1 - a_1b_2 = 0$

ix. One of the solutions of the system $\begin{cases} \frac{dx}{dt} = y - x \\ \frac{dy}{dt} = 3x + y \end{cases}$ is

(a) $\begin{cases} x = 3e^{2t} \\ y = e^{2t} \end{cases}$ (b) $\begin{cases} x = e^{2t} \\ y = 3e^{2t} \end{cases}$

(c) $\begin{cases} x = e^{t} \\ y = 3e^{t} \end{cases}$ (d) None of these

x. The auxiliary equation of the system $\begin{cases} \frac{dx}{dt} = 3x + 2y \\ \frac{dy}{dt} = -5x + y \end{cases}$ has

(a) Real and distinct roots (b) Roots which are complex conjugates

(c) Real and repeated roots (d) Does not have any roots

Q2. Attempt any **ONE** question from the following: **(08)**

a) i. Show that the general solution of the linear differential equation $\frac{dy}{dx} + P(x)y = Q(x)$ is $y = e^{-\int P\,dx}\left[\int Q \cdot e^{\int P\,dx}dx + c\right]$.
Hence solve $(x^2 + 1)\frac{dy}{dx} + 2xy = 4x^2$.

ii. Show that a necessary and sufficient condition for the differential equation $M(x,y)dx + N(x,y)dy = 0$ to be exact is $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$ where the functions M, N possess continuous first order partial derivatives on the domain under consideration.

Q.2 Attempt any **TWO** questions from the following: **(12)**

b) i. Solve $(x^2y - 2xy^2)dx - (x^3 - 3x^2y)dy = 0$.

ii. Using Bernoulli's method find the general solution of $x\frac{dy}{dx} + y + 2x^6y^4 = 0$.

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iii. Find the family of orthogonal trajectories of the family of parabolas $y^2 = 4ax$ where a is a parameter.

iv. Solve $y(xy + 2x^2y^2)dx + x(xy - x^2y^2)dy = 0$

Q3. Attempt any **ONE** question from the following: **(08)**

a) i. Let y_1 be a non-zero solution of the homogeneous differential equation $y'' + P(x)y' + Q(x) = 0$. Assuming $y_2 = vy_1$, show that another solution (which is linearly independent of y_1) of the same differential equation can be found out, where $v = \int \frac{1}{y^2} e^{-\int P dx} dx$.

If $y_1 = x$ is one solution of $x^2y'' + xy' - y = 0$, then find another solution of the same, which is linearly independent of y_1.

ii. Explain the method of variation of parameters to find the general solution of a non-homogeneous differential equation, when the general solution of the corresponding homogeneous differential equation is known.

Q3. Attempt any **TWO** questions from the following: **(12)**

b) i. Show that any linear combination of two solutions of the homogeneous equation $y'' + P(x)y' + Q(x)y = 0$ is also a solution of the same. Hence or otherwise, show that $e \sin x + \pi \cos x$ is a solution of $y'' + y = 0$.

ii. Verify that $y_1 = x^2$ is one solution of $x^2y'' + xy' - 4y = 0$, and find the general solution of the same.

iii. By using the method of undetermined coefficients, find the general solution of the differential equation, $y'' - y' - 6y = 20e^{-2x}$.

iv. By using the method of variation of parameters, find the general solution of the differential equation: $y'' + 4y = \tan 2x$.

Q4. Attempt any **ONE** question from the following: **(08)**

a) i. Define Wronskian $W(t)$ of the two solutions

$\begin{cases} x = x_1(t) \\ y = y_1(t) \end{cases}$ and $\begin{cases} x = x_2(t) \\ y = y_2(t) \end{cases}$ of the system $\begin{cases} \frac{dx}{dt} = a_1(t)x + b_1(t)y \\ \frac{dy}{dt} = a_2(t)x + b_2(t)y \end{cases}$

where $a_1(t), a_2(t), b_1(t), b_2(t)$ are continuous functions on $[a, b]$. Show that their Wronskian is either identically zero or nowhere zero on $[a, b]$.

ii. Find the general solution of system $\begin{cases} \frac{dx}{dt} = a_1x + b_1y \\ \frac{dy}{dt} = a_2x + b_2y \end{cases}$ where a_1, a_2, b_1 *and* b_2 are constants when the roots of auxiliary equation are real and distinct.

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Q4. Attempt any **TWO** questions from the following: **(12)**

$b)$ i. Show that $x = e^{4t}, y = e^{4t}$ and $x = e^{-2t}, y = -e^{-2t}$ are linearly independent solutions of the system $\begin{cases} \frac{dx}{dt} = x + 3y \\ \frac{dy}{dt} = 3x + y \end{cases}$. Hence find the general solution.

ii. Find the general solution of the system $\begin{cases} \frac{dx}{dt} = 4x - 3y \\ \frac{dy}{dt} = 8x - 6y \end{cases}$.

iii. Find the general solution of the system $\begin{cases} \frac{dx}{dt} = x - 4y \\ \frac{dy}{dt} = x + y \end{cases}$.

iv. Let $\begin{cases} x = x_1(t) \\ y = y_1(t) \end{cases}$ and $\begin{cases} x = x_2(t) \\ y = y_2(t) \end{cases}$ be two solutions of the homogeneous system $\begin{cases} \frac{dx}{dt} = a_1(t)x + b_1(t)y \\ \frac{dy}{dt} = a_2(t)x + b_2(t)y \end{cases}$ where $a_1(t), a_2(t), b_1(t), b_2(t)$ are continuous functions on $[a, b]$.
Then show that $\begin{cases} x(t) = c_1x_1(t) + c_2x_2(t) \\ y(t) = c_1y_1(t) + c_2y_2(t) \end{cases}$ is also a solution of the above system of equation for $t \in [a, b]$.

Q5. Attempt any **FOUR** questions from the following: **(20)**

$a)$ Solve $(5xy + 4y^2 + 1)dx + (x^2 + 2xy)dy = 0$

$b)$ Find the solution to the differential equation $\frac{dx}{dy} + 2x \tan y = \sin y$ given that $x = 0$ when $y = \frac{\pi}{3}$.

$c)$ Show that the functions x^3 and $x^2|x|$ are linearly independent on $[-1, 1]$.

$d)$ Solve: $y'' - 11y' + 28y = 0$.

$e)$ Define a system of homogeneous linear differential equations of order 1. State the condition for two solutions (x_1, y_1) and (x_2, y_2) to be linearly independent. Also write the general solution.

$f)$ Show that $x = -\frac{1}{4}e^{-3t}, y = e^{-3t}$ and $x = e^{2t}, y = e^{2t}$ are solutions of the homogeneous system $\begin{cases} \frac{dx}{dt} = x + y \\ \frac{dy}{dt} = 4x - 2y \end{cases}$.

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Q. P. Code: 34266

(2 ½ hours) Total marks: 75

N. B. (1) All questions are compulsory
(2) All questions have internal choice
(3) Figures to the right indicate full marks.

1) A. Explain the following concepts: **(any five)** (15)
1. Product liability
2. *Locus Standi*
3. Polluter Pays Principle
4. Remote sensing
5. Lateral thinking
6. Verbal Ability
7. Synthetic food
8. Eco-centrism

OR

B Write a comprehensive note on the Foundation Course (Semester IV) project submitted by you.

2) A. Explain in detail, the various features of Consumer Protection Act, 1986. (15)

OR

B. Discuss the features of the RTI Act, 2005.

3) A. Comment on the various approaches to understanding ecology. (15)

OR

B. Discuss the various goals of sustainable development as adopted in the UN Sustainable Development Summit, 2015.

4) A. Comment on the various applications of biotechnology in agriculture. (15)

OR

B. Discuss India's achievements in the field of satellite technology.

5) A. Discuss the format of any three competitive exams conducted for entry into jobs. (15)

OR

B. Discuss any three different theories of motivation.

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Q. P. Code: 34266

वेळ: २ तास ३० मिनिटे गुण:७५

सूचना: १. सर्व प्रश्न अनिवार्य आहेत.
२. उजवीकडील अंक पूर्ण गुण दर्शवितात.

प्रश्न.१ अ) खालील संकल्पना स्पष्ट करा.**(कोणत्याही पाच)** १५

१. उत्पादन उत्तरदायित्व
२. उपस्थानाधिकार
३. प्रदुषकाने भरपाई देणे तत्व
४. दूर संवेदन
५. सर्वांगीण विचार
६. शाब्दिक क्षमता
७. कृत्रिम आहार
८. निसर्गकेंद्रित दृष्टीकोण

किंवा

ब. पायाभूत अभ्यासक्रम (सत्र-४) साठी तुम्ही सादर केलेल्या प्रकल्पावर व्यापक टीप लिहा. १५

२.अ) ग्राहक संरक्षण कायदा,१९८६ ची विविध वैशिष्ट्ये सविस्तर स्पष्ट करा. १५

किंवा

ब. माहितीचा अधिकार कायदा,२००५ च्या वैशिष्ट्यांची चर्चा करा.

३.अ) परिस्थितीकीशास्त्राच्या आकलनासाठीच्या विविध दृष्टीकोणावर टिपण्णी करा. १५

किंवा

संयुक्त राष्ट्रसंघ शाश्वत विकास शिखर परिषद,२०१५ मध्ये शाश्वत विकासासाठी स्वीकारलेल्या शाश्वत विकासाच्या विविध उद्देशांची चर्चा करा.

४.अ) जैवतंत्रज्ञानाच्या कृषीमधील विविध उपयोगांवर टिपण्णी करा. १५

किंवा

ब) अंतराळ तंत्रज्ञानाच्या क्षेत्रातील भारताच्या कामगिरीची चर्चा करा.

५.अ)नोकरीत प्रवेश मिळविण्यासाठीच्या कोणत्याही तीन स्पर्धात्मक परीक्षेच्या स्वरुपाची चर्चा करा. १५

किंवा

ब) अभिप्रेरणेच्या वेगवेगळ्या कोणत्याही तीन सिद्धांतांची चर्चा करा.

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Time: 3 Hours **Marks: 100 Marks**

Note: 1 All questions are compulsory
2. Figures to right indicate full marks
3. The use of log-table/nonprogrammable calculator is allowed.

Q 1 A Select the correct option & complete the sentences (**any TWELVE**) **(12)**

i. Electrophoresis is a _____ method.
a. separation b. electroanalytical c. thermal

ii. _____ is a chemical method of separation.
a. Precipitation b. Centrifugation c. Filtration

iii. Solvent extraction is governed by _____ law.
a. Nernst Distribution b. Beer's c. Boyle's

iv. Chromatography consists of _____ phases.
a. three b. infinite c. two

v. In chromatography R_f value is _____ factor.
a. real b. rate c. retardation

vi. _____ is a planar chromatographic technique.
a. GLC b. TLC c. GSC

vii. Quinhydrone electrode is used as _____ electrode in acid base potentiometric titration
a. reference b. indicator c. counter

viii. When a strong base like NaOH is added to the solution of strong acid, pH of mixture _____
a. remains constant b. increases c. decreases

ix. The unit of conductance is _____.
a. Siemens b. ohms c. volts

x. In conductometric titrations, _____ is measured during the course of titration.
a. pH b. corrected conductance c. conductance

xi. If the pH of the aqueous solution is 11.2, then it will be _____.
a. acidic b. neutral c. alkaline

xii. The plot of pH vs. volume of titrant added is _____ shaped.
a. "V" b. "U" c. "S"

xiii. Variance is _____ .
a. s^2 b. s c. v^2

xiv. Mode of the following set of data is _____.
Data: 19.10, 19.12, 19.10, 19.11
a. 19.11 b. 19.12 c. 19.10

xv. In normal error curve _____ is plotted on Y - axis.
a. observation b. frequency of occurrence c. mean

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xvi. Confidence limit using range can be obtained by _____ formula.

a. $\pm C_n R$ b. $C_v R$ c. $C_w R$

xvii. _____ is used as rejection of the doubtful observation from the set.

a. F – test b. T - test c. Q - test

xviii Null hypothesis is valid means _____.

a. $t_{cal} < t_{tab}$ b. $t_{cal} > t_{tab}$ c. $t_{cal} = t_{tab}$

Q 1 B State whether the following statements are true or false (any **THREE**) **(03)**

i. The partition coefficient and distribution ratio are always same.

ii. Batch extraction method is used for solvent with small "D" value.

iii. Potential of an indicator electrode remains constant.

iv. Glass electrode is a type of ion selective electrode.

v. The process of finding, how dependent variables are linked to independent variable is known as regression analysis. .

vi. Variance ratio test is also known as Q - test.

Q 1 C Match the columns (Any **FIVE**) **(05)**

Column A	Column B
1. Distillation	a. Rejection of result
2. Adsorbent	b. Volatilization
3. Saturated KCl	c. Centrifugation
4. Glass electrode	d. Salt bridge
5. Gaussian curve	e. pH – metry
6. 4.0 d rule	f. Al_2O_3
	g. Conductometry
	h. Bell - shaped

Q 2 Answer Any **FOUR** of the following **(20)**

a. What are the different types of separation methods? Explain any two of them in detail.

b. Prove that multiple extractions using small volume of extractant are more efficient than carrying out a single extraction involving same total volume.

c. i. Explain the term "separation factor".

ii. When 0.1 dm^3 of an aqueous solution containing 0.2 g of a substance "S" is extracted with 0.5 dm^3 of ether; the ether layer was found to contain 0.186 g of "S". Calculate distribution ratio ($D_{o/w}$) in favour of ether.

d. Describe the preparation of plates used in TLC. What are the other steps involved in TLC?

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e. 100 cm^3 of aqueous solution containing 100 µg of substance "M". the solution is to be extracted with an organic solvent. If the distribution ratio D = 12.0, calculate
(i) The extraction efficiency for five extractions using 100 cm^3 solvent.
(ii) the minimum number of extractions using 10 cm^3 solvent to leave 1µg of "M" un-extracted.

f. What are the different methods used for the development of chromatogram in paper chromatography? Explain any one of it in detail with suitable diagram.

Q 3 Answer Any **FOUR** of the following **(20)**

a. Describe different methods used to determine the equivalence point from the "S" shape graph of E_{cell} vs. volume of titrant added.

b. What are the advantages and limitations of conductometric titrations?

c. Describe construction and working of glass electrode.

d. What is the principle of conductometric titration? Give an account of conductivity cell with a neat and labelled diagram.

e. Explain the terms with suitable examples and give electrode representation:
i. Indicator electrode ii. Reference electrode

f. What is the principle of pH–metry? Give an account of titration curve when a strong acid is neutralized by a strong base using pH meter.

Q 4 Answer Any **FOUR** of the following **(20)**

a. What is variance ratio test?
Following are the two sets of observations for analysis of calcium in the given sample of limestone by two independent methods. Verify whether the two standard deviations are same or different.

Set I (% Ca)	10.25	10.32	10.40	-
Set II (% Ca)	10.42	10.29	10.35	10.26

b. What are the salient features of Gaussian distribution curve?

c. The following table gives dependence of y on x

x	0	1	2	3	4	5
y	0.0	2.4	4.7	7.3	9.8	11.8

Assuming a linear relationship between the variables make least square analysis of the data to derive an equation of the type y = mx

d. What is Q – test? What are the different steps involved in Q – Test?

e. In the analysis of a sample for its Fe content, the values reported are: 4.5, 4.7, 4.6 and 4.9. on the basis of 2.5 d rule and 4.0 d rule, find whether the value 4.9 can be retained or rejected.

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f. The following results were obtained in the replicate analysis of the samples of blood for its lead content

Sample I (ppm)	0.752	0.756	0.760
Sample II (ppm)	0.764	0.768	0.772

If the combined standard deviation value is 0.004. Find whether the two methods differ statistically or only numerically.

Q 5 Answer Any **FOUR** of the following **(20)**

a. Explain the term chromatography. Give classification of chromatogra- phic methods on the basis of nature of phases involved in it.

b. What are the criteria for selection of an extracting solvent?

c. Explain any two applications of conductometry in neutralization titrations.

d. What are the different types of pH meters? What is the use of pH metry in biological analysis?

e. Five replicate measurements for the determination of iron in the sample gave the following results:

15.61, 15.52, 15.63, 15.68 and 15.64

Calculate 95% confidence limit for the mean if

i. No additional information about the precision of the method is known.

ii. A large number of measurements have given $\sigma = 0.02$

($t = 2.78$, $Z = 1.96$ at 95% confidence limit.)

f. In six lead determinations from the sample, each of which contain 400 mg of Lead, the following results were obtained.

Sample	1	2	3	4	5	6
Pb in mg	398	392	398	396	393	401

Calculate the mean , median, range, average deviation and standard deviation

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Time: 3 Hours **Marks: 100**

Please check whether you have got the right question paper.

N.B. 1. All questions are compulsory
2. Figures to the right indicate full marks
3. The use of log-table/ non-programmable calculator is allowed
4. Answers for the same question as far as possible should be written together.

Q.1 A) Select the correct option & complete the following sentences (any **Twelve**) **(12)**

i) Centrifugation is a _____method of separation.
a) chemical b) mechanical c) physical

ii) Liquid –liquid chromatography is based on _____.
a) sublimation b) adsorption c) partition

iii) Production of liquid fuels is an industrial process which involves_____.
a) distillation b) fractional distillation c) steam distillation

iv) Electrophoresis is based on _____.
a) ion exchange b) solubility c) electrical charge

v) The separation in TLC is because of _____of solute between the two phases.
a) adsorption b) partition c) both adsorption and partition

vi) Separation factor in solvent extraction is the ratio of _____ of two solutes.
a) solubility product b) ionic product c) distribution ratio

vii) _____is used as primary reference electrode.
a) Hydrogen electrode b) Standard Hydrogen Electrode c) Calomel eclectrode

viii) A voltaic cell is also known as _____.
a) galvanic cell b) electrolytic cell c) half cell

ix) Quinhydrone electrode works satisfactorily in the pH range of _____.
a) 1 to 8 b) 8 to 11 c) 11 to 14

x) Glass electrode is an example of _____ electrode.
a) metal-metal ion b) redox c) membrane

xi) Reduction potential of saturated calomel electrode is _____.
a) 0.242 V b) 0.282 V c) 0.338 V

xii) The unit of specific conductance is _____.
a) $S\ cm^{-1}$ b) S cm c) S^{-1} cm

xiii) The Guassian Curve is a _____.
a) bell shape curve b) closed curve c) simple closed curve

xiv) For rejection of a result, the test used is _____.
a) F-test b) Q-test c) Null hypothesis

xv) Method of averages is used for _____.
a) rejection of data b) test of significance c) obtaining best fitting line

xvi) The 4.0 d rule is used for _____.
a) rejection of result b) test of significance c) for comparison of means

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xvii) Confidence limits are defined as _____.
a) $\pm ts/\sqrt{n}$ b) $\pm t/\sqrt{sn}$ c) $\pm s/\sqrt{tn}$

xviii) In the expression for confidence limit C_nR, R denotes_____.
a) probability level b) reduced values c) range

Q.1 B) State True or False (any **Three**) **(03)**

i) Solvent extraction is based on Plate theory.
ii) Crystallization is a physical method based on solubility.
iii) pH meter can be used for soil analysis.
iv) Potentiometric titrations involve construction of an electrolytic cell.
v) F-test is also known as variance ratio test.
vi) A test rejected by 2.5 d rule can be retained by 4.0 d rule.

Q.1 C) Match the column (any **Five**) **(05)**

Column A	Column B
i) Least square method	a) Saturated KCl solution
ii) Plot of frequency vs x_i	b) Conductivity cell
iii) Salt bridge	c) Precipitation
iv) Platinum electrode	d) Normal error curve
v) Chemical methods	e) TLC
vi) Chromatogram	f) Best fitting line
	g) Glass electrode
	h) Distribution ratio

Q.2 Attempt the following (any **Four)** **(20)**

A What is the principle involved in separation based on Thin layer Chromatography? Write various steps involved in this technique.
B List the important applications of TLC.
C Explain with respect to paper chromatography : i) Ascending technique
ii) Two dimensional technique of development of chromatogram.
D Explain in brief, the various steps involved in paper chromatography.
E Multi-step extractions with smaller volumes of extractant are more efficient than single step extractions using entire volume of extracting solvent. Explain.
F The distribution ratio D for a solute between an organic solvent and water in favour of organic solvent. Calculate the percentage extraction if the two extractions are carried out with the volume ratio of 1 and 10.

Q.3 Attempt any **Four** **(20)**

A Describe the experimental procedure for carrying out potentiometric titration.
B Discuss the methods of determination of equivalence point from the following curves
a) E vs Volume of titrant b) $\Delta E/\Delta V$ vs Volume of titrant.
C Discuss the pH metric titration curves obtained when a weak acid is neutralized by a strong base.
D Write the important applications of pH measurement in biological and environmental analysis.

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E Discuss the conductometric titration curve in the neutralization of strong acid against a weak base.

F List the advantages and limitations of conductometric titrations.

Q.4 Attempt any **Four** **(20)**

A Give the equation for the Gaussian distribution curve. Write the salient features of this curve.

B What is Null hypothesis? Outline a procedure for the application of null hypothesis to data.

C Describe the method of least square for obtaining the best fitting line.

D The results for estimation of mercury in a water sample for 10 replicate measurements are given below:
0.164, 0.175, 0.172, 0.176, 0.152, 0.155, 0.157, 0.166, 0.168, 0.167
Calculate the confidence interval for the mean at 95% level
(Given: t= 2.26 for 95% confidence level).

E The Eight different replicate analysis of a steel sample for cobalt content are given below,
0.071, 0.069, 0.073, 0.072, 0.070, 0.072, 0.076, 0.072
Calculate (i) mean (ii) median (iii) standard deviation (iv) range.

F Using the method of averages, obtain the best fitting standard line of the type y=mx+c for the following spectrophotometric analysis.

Na(conc.) in ppm	0.1	0.2	0.4	0.7	1.0	1.5
Intensity	1.2	2.6	4.4	7.6	10.8	15.6

Q.5 Attempt any **Four** **(20)**

A Discuss the principle of electrophoresis. List its important applications.

B Describe the continuous extraction technique of solvent extraction when the organic solvent is lighter than the water.

C Explain the term "indicator electrode". Describe the construction and working of Quinhydrone electrode.

D List the advantages and limitations of glass electrode.

E Two sets of observations are represented below for the analysis of magnesium content in two samples:

Sample I	Sample II
1.22%	1.31%
1.25%	1.34%
1.26%	1.35%

If the standard deviation is 0.021, determine whether the two means differ statistically or only numerically.
Given: t(tabulated) = 2.78

F In a chemical analysis of a sample of arsenic, the following results were obtained
ppm of As 4.3, 4.5, 4.5, 4.6, 4.7, 5.0,
Decide on the basis of 2.5 d and 4.0 d rule, whether the last measurement can be rejected.

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(3 Hours) **[Total Marks: 100]**

Please check whether you have got the right question paper.

N.B. : 1. All Questions are compulsory.
2. Figures to the right indicate full marks.
3. Use of log-table/nonprogrammable calculator is allowed.
4. Answers for the same question as far as possible should be written together.

1. (A) Select the correct option and complete the following sentences. (any **twelve**) **12**

(i) The Bragg's equation for diffraction of X-rays is _____ .
(a) $n\lambda = d\sin\theta$ (b) $n\lambda = 2d\sin\theta$ (c) $2n\lambda = d\sin\theta$

(ii) The total number of effective atoms in _____ system is 4.
(a) face centred cubic (b) body centred cubic (c) simple cubic.

(iii) _____ deaccelerates a reaction by increasing the energy of activation of the reaction.
(a) Catalyst (b) An inhibitor (c) Temperature.

(iv) The enzyme which can catalyse the conversion of maltose into glucose is _____.
(a) maltase (b) invertase (c) zymase.

(v) There are seven crystal system and _____ Bravais lattices.
(a) 14 (b) 7 (c) 9

(vi) Tetraethyl lead, when added to petrol, acts as _____.
(a) promoter (b) an inhibitor (c) suppressor

(vii) In aqueous solution of _____ ions, concentration of H_3O^+ ions is maximum.
(a) Na^+ (b) Cs^+ (c) Sn^{4+}

(viii) Acidity of aqueous solution of cation _____ with increase in its hydration energy.
(a) decreases (b) increases (c) remains same

(ix) During hydration of anion in aqueous solution _____.
(a) energy is released (b) energy is absorbed
(c) energy is neither absorbed nor released

(x) Phosphoric acid has formula _____.
(a) H_2PO_3 (b) H_2PO_4 (c) H_3PO_4

(xi) Phenomenon of photochemical smog leads to _____ .
(a) eye irritation (b) decrease in acid strength (c) increase in visibility

(xii) _____is used in soft drinks.
(a) Sulphuric acid (b) Phosphoric acid (c) Nitric acid.

(xiii) When pyridine is treated with sodamide in liquid ammonia it gives a mixture of _____ aminopyridines.
(a) 2- and 3- (b) 2- and 4- (c) 2- and 5-

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(xiv) Electrophilic substitution reaction in thiophene takes place at position ____ .
(a) 3 and 4 (b) 2 and 5 (c) 2 and 4

(xv) Two moles of _____ diketone are required in Hantzsch synthesis of pyridine.
(a) 1,3- (b) 1,4- (c) 1,5-

(xvi) Primary amine reacts with nitrous acid to form _____ and nitrogen gas.
(a) N-nitrosoamine (b) alcohol (c) ammonium salt

(xvii) Coupling of phenol with diazonium salt is usually carried out in _____ medium.
(a) slightly alkaline (b) slightly acidic (c) neutral

(xviii) _____ is the strongest base.
(a) Aniline (b) p-Nitroaniline (c) Dimethyl aniline

(B) State whether the following statements are true or false. (any **three**) **3**

(i) Temperature accelerates the rate of a catalysed reaction.
(ii) Sodium chloride crystallises in the body centred cubic lattice form.
(iii) In aqueous solution of Na^+ ions, H_3O^+ ions do not exist.
(iv) Sulphuric acid is used in the production of fertilisers.
(v) Pyrrole is a stronger base than pyrrolidine.
(vi) Sulphonation of the furan can be carried out by the action of H_2SO_4.

(C) Match the column. (any **five**) **5**

(i)	Decreases activity of catalyst	(a)	pK_b between 11.5 and 14
(ii)	Nano catalyst	(b)	pK_b between 6 and 11.5
(iii)	Strongly basic anion	(c)	Inhibitor
(iv)	Feebly basic anion	(d)	Temperature
(v)	Azocoupling reaction	(e)	Gold supported on metal oxide.
(vi)	Aldehyde & Ketones to Amines	(f)	pK_b between -4 and 1
		(g)	Synthesis of azo dyes
		(h)	Reaction with nitrous acid
		(i)	Reductive amination

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

(A) Explain three laws of crystallography.
(B) State Bragg's equation. Derive and explain $n\lambda = 2d\sin\theta$.
(C) What is homogenous and heterogenous catalysis? Explain with suitable examples.
(D) What are the characteristic features of a catalyst?
(E) What is acid base catalysis? Explain with suitable examples.
(F) CsCl crystallises in the body centred cubic lattice form its unit cell edge is 4.59 x 10^{-10} m. The density of CsCl is 3.75 x 10^3 Kg m^{-3} and its molecular weight is 168.4. Calculate Avogadro's number from this data.

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3. Attempt any **four** of the following. **20**
   (A) 'The aqueous solution containing monoatomic cations becomes acidic'. Explain with a suitable example.
   (B) Write Latimer equation to calculate hydration energy of cation and explain the terms involved in it. Using this equation, calculate ΔH_{hyd} for Sc^{3+} ion. The radius of Sc^{3+} ion is 88pm.
   (C) How cations are classified on the basis of their acidity? Explain any one category with the help of suitable predominance diagram.
   (D) With suitable predominance diagram and example, explain the following
   (i) non basic anion (ii) weakly basic anion.
   (E) Write physical properties of sulphuric acid.
   (F) Write a note on uses of nitric acid.

4. Attempt any **four** of the following.
   (A) (i) Give preparation of a) 2-bromothiophene, b) 2-nitrothiophene and c) 2-acetyl thiophene from thiophene. **3**
   (ii) Why is piperidine more basic than pyridine ? **2**
   (B) (i) Explain Diel's-Alder reaction of furan. **3**
   (ii) Write N – alkylation of aromatic primary amine. **2**
   (C) (i) 'Pyridine gives nucleophilic substitution at 2,4 and 6 positions'. Explain. **3**
   (ii) Give carbylamine reaction of amines. **2**
   (D) (i) Explain two methods of preparation of aromatic amines from aromatic nitro compounds using reduction reactions. **3**
   (ii) Give Paal-Knorr synthesis for the preparation of thiophene. **2**
   (E) (i) How is quaternary ammonium iodide obtained from aniline? **3**
   (ii) Discuss aromaticity of pyrrole. **2**
   (F) (i) How is benzene diazonium salt reduced to aryl hydrazine and hroazobenzene? **3**
   (ii) What is Sandmeyer reaction? **2**

5. Attempt any **four** of the following.
   (A) Derive Michalis-Menten equation for enzyme catalysis with suitable graphical representation. **5**
   (B) The first order reflection of beam X-rays from (100) plane of KCl occurs at an angle of 4.2°. Calculate the wavelength of X-rays. What would be the angle of reflection if X-rays of wavelength 201.0 pm are used? (Given d_{100} for KCl is 258.0 pm) **5**
   (C) With the help of predominance diagram explain the behaviour of Cr^{3+} ions in aqueous solution. **5**
   (D) Write a note on acid rain. **5**
   (E) (i) What are diazonium salts? How is benzene diazonium chloride prepared? **3**
   (ii) Write a note on Gattermann reaction. **2**
   (F) (i) Write note on sulfonation of pyridine. **3**
   (ii) Explain Vilsmeier-Haack reaction of pyrrole. **2**

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(3 Hours) **[Total Marks: 100]**

Please check whether you have got the right question paper.

N.B. : 1. All Questions are compulsory.
2. Figures to the right indicate full marks.
3. Use of log-table/nonprogrammable calculator is allowed.
4. Answers for the same question as far as possible should be written together.

1. (A) Select the correct option and complete the following sentences. (any **twelve**) **12**

(i) There are _____ crystal system and _____ Bravais lattices.
(a) 7 ,14 (b) 14,7 (c) 7,7

(ii) The total number of effective atoms in body centered cubic system is ____.
(a) 4 (b) 2 (c) 3

(iii) A _____ accelerates a reaction by decreasing the energy of activation of the reaction.
(a) catalyst (b) inhibitor (c) pressure

(iv) The enzyme which can catalyse the conversion of _____ into glucose is maltase.
(a) maltose (b) invertase (c) zymase

(v) The _____ equation for diffraction of X-rays is $n\lambda = 2d\sin\theta$.
(a) Bragg's (b) Plank's (c) de-Broglie

(vi) The total number of effective atoms in _____ system is 2.
(a) face centred cubic (b) body centred cubic (c) simple cubic.

(vii) pKa range for strongly acidic cation is in between _____.
(a) 1 to 6 (b) 6 to 11.5 (c) -4 to 1

(viii) The cation is strongly acidic if z^2/r is in between _____.
(a) 0.1 to 0.16 (b) 0.01 to 0.04 (c) 0.04 to 0.1

(ix) Pure phosphoric acid is _____ crystalline solid.
(a) yellowish (b) greyish (c) white

(x) _____ acid is responsible for acid rain.
(a) H_2SO_4 (b) HCl (c) CH_3COOH

(xi) pKa values are greater than 14 for _____ cation.
(a) non acidic (b) weakly acidic (c) feebly acidic

(xii) _____ is called king of chemicals.
(a) HNO_3 (b) H_2SO_4 (c) H_3PO_4

(xiii) Two moles of _____ diketone are required in Hantzsch synthesis of pyridine.
(a) 1,3- (b) 1,4- (c) 1,5-

(xiv) Electrophilic substitution reaction in furan takes place at position _____ .
(a) 2 and 5 (b) 3 and 5 (c) 3

(xv) Sulphonation of furan can be carried out by action of ____ .
(a) H_2SO_4 (b) SO_3 and pyridine (c) oleum

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(xvi) Benzene diazonium chloride when reduced with $NaHSO_3$ gives _____.
(a) phenyl hydrazine (b) phenyl hydrazone (c) hydrazobenzene

(xvii) Nitration of aniline mainly gives _____ as major products.
(a) o- and p-nitroaniline (b) m- and o-nitroaniline (c) p- and m-nitroaniline

(xviii) Reaction of aniline with bromine water at room temperature gives ____.
(a) 2- bromoaniline (b) 4-bromoaniline (c) 2,4,6-tribromoaniline

(B) State whether the following statements are true or false. (any **three**) **3**

(i) As temperature increases the rate of reaction decreases and the energy of activation increases.
(ii) Sodium chloride crystallises in the face centred cubic lattice form.
(iii) Hydrolysis of hydrated cation renders the solution basic.
(iv) Phosphoric acid is a mineral acid.
(v) Friedel - Crafts reaction of the furan can be carried out by using $AlCl_3$.
(vi) Pyrrolidine is a stronger base than pyrrole.

(C) Match the column. (any **five**) **5**

(i)	Inhibitor	(a)	Zn^{2+}
(ii)	Promoter	(b)	Al^{3+}
(iii)	Weakly acidic cation	(c)	$K_b = 54 \times 10^{-5}$
(iv)	Moderately acidic cation	(d)	Increases activity of catalyst
(v)	Dimethyl amine	(e)	Ba^{2+}
(vi)	Aniline	(f)	Face centred cubic
		(g)	$K_b = 3.8 \times 10^{-10}$
		(h)	$K_b = 37 \times 10^{-5}$
		(i)	Retards rate of reaction

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

(A) What are (100), (110) and (111) planes for the body-centred cube?
(B) How are X-rays used to determine the interplanar distances in cubic crystals?
(C) Derive Michalis-Menten equation for enzyme catalysis.
(D) Explain characteristic features of a catalysis.
(E) An inorganic salt of molecular weight 74.36 and density 1.874×10^3 $Kg.m^{-3}$ crystallises in a form like NaCl. Calculate the length of the edge of the unit cell if Avogadro's number is 6.023×10^{23} molecules mol^{-1}.
(F) Explain the kinetics of acid-base catalysis.

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

(A) Explain the process of hydration of cation with suitable diagram. How can cation render acidity to the solution?
(B) Explain the relationship between pK_a, acidity and Z^2/r ratio of monoatomic cations by means of graphical presentation.
(C) With the help of predominance diagrams explain non acidic cations and feebly acidic cations with suitable examples.

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(D) Write Latimer equation to calculate hydration energy of anion and explain the terms involved in it. Using this equation, calculate ΔH_{hyd} for F^- ion. (Given radius of F^- ion is 119pm.)
(E) Write physical properties of sulphuric acid.
(F) Write a note on uses of phosphoric acid.

4. Attempt any **four** of the following.
(A) (i) Give the preparation of a) 2-chlorothiophene, b) 2-nitrothiophene and c) thiophene-2-sulphonic acid from thiophene. **3**
(ii) Discuss aromaticity of furan. **2**
(B) (i) Explain Chichibabin reaction of pyridine. **3**
(ii) Give the carbylamine reaction of primary amines. **2**
(C) (i) 'Pyridine gives nucleophilic substitution at 2,4 and 6 positions'. Explain. **3**
(ii) How is primary amine obtained by reductive amination of aldehyde and ketone? **2**
(D) (i) Write a note on Hofmann exhaustive methylation (HEM). **3**
(ii) Give Paal-Knorr synthesis for the preparation of pyrrole. **2**
(E) (i) How will you distinguish between ethyl amine, diethyl amine and triethyl amine using nitrous acid? **3**
(ii) Explain Vilsmeier-Haack reaction of pyrrole. **2**
(F) (i) Give azo-coupling reaction of benzene diazonium chloride with a) Phenol and b) N,N-dimethyl aniline. **3**
(ii) How is hydrazobenzene prepared from nitrobenzene? **2**

5. Attempt any **four** of the following.
(A) Sodium chloride has a face centred cubic lattice and the length of the cube edge is 6.56 A°. Calculate d_{110} and d_{111}. **5**
(B) Write a note on activity of nanoparticles as a catalyst. **5**
(C) With the help of suitable predominance diagram, explain the behaviour of F^- and S^{2-} in aqueous solution. **5**
(D) Write a note on acid rain. **5**
(E) (i) Describe Hofmannn degradation of amides. **3**
(ii) How is chlorobenzene obtained by Sandmeyer reaction? **2**
(F) (i) Explain Diel's-Alder reaction of furan. **3**
(ii) Why is pyridine more basic than pyrrole? **2**

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[Time : 3 Hours] **[Total Marks : 100]**

Please check whether you have got the right question paper.

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.
4. Answers for the same question as far as possible should be written together.

1. (A) Select the correct option and complete the following sentences. (any **twelve**) **12**

(i) Substances with higher reduction potentials are strong _____ .
(a) reducing agents (b) oxidising agents (c) acids

(ii) All metals lying above in electrochemical series can liberate H_2 gas by reaction with _____ .
(a) bases (b) covalent compounds (c) acids

(iii) In galvanic cell, electrons are given off _____ electrode.
(a) by anode (b) at cathode (c) by platinum

(iv) A system with zero degrees of freedom is known as _____ .
(a) bi-variant (b) non variant (c) mono-variant

(v) The eutectic temperature of lead silver system is _____ .
(a) 762K (b) 576K (c) 726K

(vi) All metals lying above hydrogen in electrochemical series can liberate H_2 gas by reaction with _____ .
(a) acids (b) bases (c) covalent compounds

(vii) In first transition series _____element has its 3d level exactly half filled.
(a) Sc (b) Cr (c) Co

(viii) Solution containing hydrated Ti^{3+} is ___in colour.
(a) purple (b) red (c) yellow

(ix) ____ among following shows ferromagnetism.
(a) Ti (b)V (c) Ni

(x) The complex $[NiCl]_4^{2-}$ has _____ structure
(a) tetrahedral (b) square planar (c) square pyramidal

(xi) Fe^{2+} salts give blue colour with _____
(a) KOH (b) K- ferrocyanide (c) K –ferricyanide

(xii) The molecular formula of chromium carbonyl is_____
(a) $Cr(CO)_4$ (b) $Cr(CO)_5$ (c) $Cr(CO)_6$

(xiii) e to presence of electron withdrawing group strength of carboxylic acid _____.
(a) increases (b) decreases (c) remains Same

(xiv) Aromatic carboxylic acid on heating with soda lime forms _____.
(a) alkane (b) arene (c) aldehyde

(xv) Carboxylic acid is prepared from grignard reagent by action of _____.
(a) H_2SO_4 (b) CO_2 (c) HCl

(xvi) _____ are salts of sulfonic acids.
(a) Detergents (b) Paints (c) Perfumes

(xvii) Naphthalene on reaction with concentrated H_2SO_4 at 160° C forms _____.
(a) 1- naphthalene sulphonic acid
(b) 2- naphthalene sulphonic acid
(c) 7- naphthalene sulphonic acid

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(xviii) Nitro Benzene on reaction with oleum forms _____.
(a) m-nitro sulphonic acid (b) o-nitro sulphonic acid
(c) p-nitro sulphonic acid

(B) State whether the following statements are true or false. (any **three**) **3**
(i) Any uni-univalent type of salt can be used in preparation of salt bridge
(ii) Aqueous salt solution is an classic example of single phase system.
(iii) With the increase in covalent character, acidic character of transition compound increases.
(iv) Ionisation isomerism is a form of stereoisomerism in coordination compounds
(v) Acetic acid is stronger than chloro acetic acid.
(vi) In IPSO substitution – SO_3H group is replaced by NO_2 group

(C) Match the column. (any **five**) **5**

(i) Salt bridge	(a) Crossed Claisen condensation
(ii) Clpyeron equation	(b) Ambidentate ligand
(iii) SCN^-	(c) To connect two half cells
(iv) Mo	(d) Half filled state
(v) Acyl nucleophilic subsitution	(e) $dP/_{dT} = \frac{\Delta H_f}{T(V_{liq.} - V_{vapour})}$
(vi) Reaction of different esters	(f) To minimize liquid junction potential
	(g) Forms tetrahedral intermediate
	(h) $dP/_{dT} = \frac{\Delta H}{T\Delta V}$
	(i) Hydrolysis reaction

2. Attempt any **four** of the following.
(A) Differentiate between concentration cells and chemical cells. **05**
(B) Explain any two applications of Nernst equation in the study of galvanic cells? **05**
(C) The emf of a cell Zn | $ZnSO_4$ || $CuSO_4$|Cu at 25°C is 0·3 V and the temperature coefficient of emf is -1·4 x 10^{-4} V per degree. Calculate the heat of reaction per mole for the reaction that taking place inside the cell. **05**
(D) Justify the number of phases and components present in the following system – **05**
$CaCO_3$ (solid) ⇋ CaO (solid) + CO_2 (gas)
(E) Derive Gibbs phase rule thermodynamically. **05**
(F) The boiling point of a given solvent is 352·2K at 1·013 x 10^5 N m^{-2}. Calculate the boiling point of the given solvent at 0·63 x 10^5 N m^{-2}. (molar heat of vaporization of a solvent at 352.2 K is 31·8 kJ mol^{-1}; R= 8·314 JK^{-1} mol^{-1}) **05**

3. Attempt any **four** of the following.
(A) Explain the terms with suitable examples:- **05**
(i). Primary and secondary valency (ii). Geometrical isomerism.
(B) Name the important oxides of titanium and vanadium. Give properties of any two oxides of vanadium. **05**
(C) Explain in brief different evidences for the formation of co-ordination compounds. **05**
(D) Comment on the colour property of transition metals. **05**

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(E) Give an account of Werner's theory of coordination compounds. **05**
(F) Write a note on" Variable oxidation states of transition elements' **05**

4. Attempt any **four** of the following.
(A) a) How will you prepare –
i) benzamide from benzoic acid **02**
ii) benzoyl chloride from benzoic acid?
b) Explain Claisen condensation with mechanism. **03**

(B) a) Give preparation of Benzoic acid from- **03**
a) toluene b) Grignard reagent.
b) Explain oxidation of 1-propanol. **02**

(C) a) Explain sulphonation of naphthalene at different temperatures. **03**
b) How will you convert :
a) bromobenzene to benzoic acid.
b) salicylic acid to methyl salicylate? **02**

(D) a) What is IPSO substitution? Explain with example. **03**
b) What is decarboxylation? Give an example. **02**
(E) a) What is the effect of substituents on acid strength of aliphatic acids? **04**
b) Draw structure of 2-methyl butanoic acid. **01**

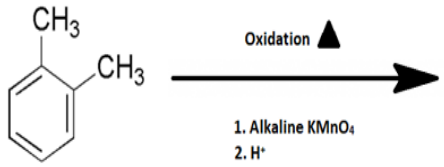
(F) Discuss HVZ reaction giving mechanism and applications. **05**

5. Attempt any **four** of the following.
(A) What are the advantages and disadvantages of quinhydrone electrode in the determination of pH? **05**
(B) Ether boils at 306K at 1.00×10^5 Pa pressure. At what temperature will it boil at a pressure of 9.85×10^3 Pa? Given that the molar enthalpy of vaporization of ether is 2.74×10^4 J mol^{-1}. **05**
(C) Represent the electronic configuration of 3d transition elements and mention the names of elements with special stability. **05**
(D) What are the different rules for nomenclature of coordination compounds? Explain with examples. **05**
(E) Explain following reactions with example. **05**
i) Fischer's Esterification
ii) Ammonolysis

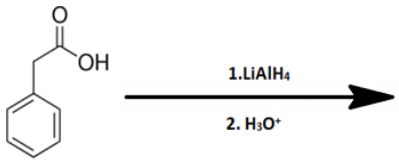
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(F) Complete the following reactions-- **05**

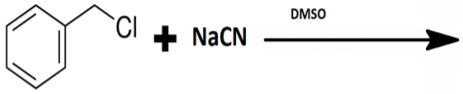
a)



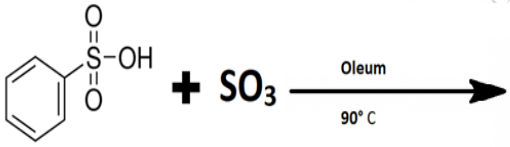
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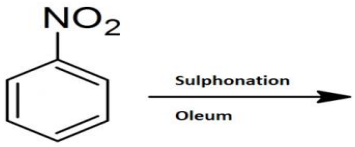
c)



d)



e)



== XXXXXX ==

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[Time: 3 Hours] **[Total Marks: 100]**

Please check whether you have got the right question paper.

N.B : 1. All Questions are compulsory.
2. Figures to the right indicate full marks.
3. Use of log-table/nonprogrammable calculator is allowed.
4. Answers for the same question as far as possible should be written together.

1. (A) Select the correct option and complete the following sentences. (any **twelve**) **12**

(i) In Galvanic cell, any electrical work done is on the expense of _____.
a) increase in free energy b) decrease in free energy c) decrease in chemical free energy

(ii) In an electrochemical cell, the reduction reaction always takes place at the electrode which is at _____ potential.
(a) higher oxidation (b) reduction (c) higher reduction

(iii) Quinhydrone is a mixture of **_____.**
(a) quinine and hydroquinone (b) quinone and hydroquinone
(c) equimolar mixture of quinone and hydroquinone

(iv) The least number of variable factors required to specify the mixture of gases are _____.
a) one b) three c) two

(v) Clapeyron equation can be used to study the effect of pressure on _____.
(a) melting points of solids (b) boiling points of liquids (c) melting points of solids and boiling points of liquids

(vi) The eutectic point of two component system is_____ .
a) bi-variant (b) non variant (c) mono-variant

(vii) Cr^{3+} ions form _____ color precipitate on addition of lead acetate and acetic acid.
a) green b) yellow c) red

(viii) Coordination no. of Fe in K_3 [Fe $(C_2O_4)_3$] is _____ .
a) three b) six c) four

(ix) The number of unpaired electrons in $[Ni(CO)_4]$ is / are
a) Zero b) one c) two

(x) _____ among the following is used as a catalyst in the manufacture of polyethylene.
a) Fe_2O_3 b) $TiCl_4$ c) TiO_2

(xi) _____ among the following is ferromagnetic in nature.
a) cobalt b) scandium c) manganese

(xii) According to IUPAC nomenclature, the name of the positively charged ligands end with the suffix _____.
a) 'ate' b) 'ium' c) 'o'

(xiii) Reaction of phenyl magnesium bromide with dry ice followed by acid hydrolysis gives_____.
a)phenol b)benzoic acid c)phenyl acetic acid

(xiv) Salicylic acid on heating strongly with soda lime gives _____.
a)phenol b)benzoic acid c)benzene

(xv) The weakest acid among the following_____
a)p-toluic acid b)p-nirobenzoic acid c)benzoic acid

(xvii) Coversion of diester having α-hydrogen atom into cyclic β-keto ester on heating with base is known as _____.
a)Dieckmann condensation b)Clasien condensation c)Benzoin condensation

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(xviii) Acetic acid when heated with P_2O_5 gives _____.
a) ethanol b) acetic anhydride c) acetone.

(B) State whether the following statements are true or false. (any **three**) **03**

(i) Valency of an ion can be determined by measuring an emf of an electrolyte concentration cell without transference.
(ii) In phase diagram of one component system, along the curves, the system is bi-variant.
(iii) Oxalate ion is a chelating ligand.
(iv) Diamagnetic substances are attracted towards the magnetic field.
(v) An intermediate formed in nucleophilic acyl substitution have tetrahedral structure.
(vi) Formic acid is weaker acid than acetic acid.

(C) Match the column. (any **five**) **05**

(i)	Invariant system	(a)	Ore of scandium
(ii)	Salt bridge	(b)	Ore of Titanium
(iii)	Patronite	(c)	Degrees of freedom
(iv)	Ilmenite	(d)	α-halogen acid
(v)	HVZ reaction	(e)	Ore of Manganese
(vi)	Sulfonation of benzene	(f)	F = 0
		(g)	Ore of vanadium
		(h)	Nucleophilic substitution reaction
		(i)	γ-halogen acid
		(j)	Electrophilic substitution reaction
		(k)	To minimize liquid junction potential

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

(A) Explain - any two applications of Electrochemical series. **05**

(B) Derive Nernst equation for determination of emf of a galvanic cell. **05**

(C) The basic reaction which takes place in cell is - **05**
$Cd + Hg_2SO_4 = CdSO_4 + 2Hg$
The emf of a cell is 1.018V at 298K. Its temperature coefficient at constant pressure is $(-3{\cdot}9) \times 10^{-5}$ VK^{-1}. Calculate ΔG, ΔS and ΔH for the given cell reaction of Weston Cell.

(D) State and explain the phase rule and the terms involved in it. **05**

(E) Define congruent melting point. Explain it with labelled diagram for sodium –potassium system. **05**

(F) Ether boils at 306K at 1.00×10^5 Pa pressure. At what temperature will it boil at a pressure of 9.85×10^3 Pa? Given that the molar enthalpy of vaporization of ether is 2.74×10^4 J mol^{-1}. **05**

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

(A) i) Give the characteristic properties of transition elements. **03**
ii) Write the tests by which presence of iron can be detected in the given salt. **02**

(B) i) Name the first five elements of 3d series of transition elements and give their electronic configuration. **05**
ii) Give an account of the special stability of d^0, d^5 and d^{10} configurations with reference to first transition series.

(C) i) Explain the isomerism exhibited by $[Co(Cl)_3(NH_3)_3]$ complex. **05**
ii) What is hydrate isomerism? Explain with a suitable example.

(D) Account for the following: **05**
i) Manetic moment of transition elements is determined by using spin only formula.
ii) Lanthanum though is a d block element , is always considered as a member of f block elements.

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(E) Comment on the following statements. **05**
i) Colour of transition metal compounds can be explained on the basis of d-d transition of electrons.
ii) Cu^{2+} salts are coloured but Zn^{2+} salts are colourless.

(F) What are inner orbital and outer orbital complexes? Explain the same with the help of $[Fe(H_2O)_6]^{3+}$ and $[Fe(CN)_6]^{3-}$. Comment on their magnetic property. **05**

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

(A) i) How will you prepare benzoic acid from **03**
a) alkyl benzene b) aromatic alcohol c) phenyl cyanide ?
ii) What is the action of following reagents on benzene sulfonic acid **02**
a) PCl_5 b) oleum at 90^0C ?

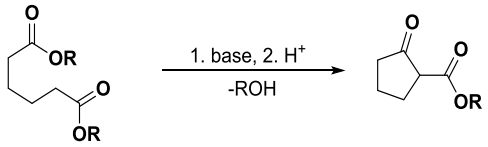
(B) What is nucleophilic acyl substitution? How will you convert an amide into carboxylic acid? Give its mechanism. **05**

(C) i) What is aryl sulfonation? Give one example. What are different sulfonating agents? **03**
ii) How picric acid is prepared from phenol via sulfonation and Ipso substitution? **02**

(D) Explain Hell-Volhard-Zelinskii reaction with mechanism. **05**

(E) What happens when **05**
a)Ethyl benzoate is heated with ammonia
b) Naphthalene is heated with conc.H_2SO_4 at 80^0C.
c)Acetic acid is heated with PCl_5
d) Benzoyl chloride is heated with excess of ammonia.
e) Benzoic acid is treated with $LiAlH_4$ followed by acid hydrolysis.

(F) **05**



Name the reaction and give its mechanism.

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

(A) Explain the origin of liquid junction potential and show how it can be minimized. **05**

(B) Give a brief account of meta-stable equilibrium in sulphur system. **05**

(C) i) Name the different oxides of vanadium. Mention the oxidation state of vanadium in each of them. **05**
ii) Explain the role of Ti^{3+} salts in titrimetric analysis.

(D) Distinguish between - **05**
i) ambidentate ligand and bidentate ligand
ii) double salt and complex compound

(E) What is Claisen condensation? Explain its mechanism with suitable example. **05**

(F) i) Explain why sulphonic acids are stronger than carboxylic acids. **03**
ii) What is desulfonation? Explain with suitable example. **02**

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[Duration: Three Hours] **[Marks: 100]**

N.B: 1**. All** questions are **compulsory**.
2. **Figures** to the **right** indicate full marks.
3. Draw **neat and labelled** diagrams wherever necessary.

Q.1 (A) Choose the correct option from the following **and rewrite the sentence.** **(10)**

i. Cultivation and marketing of vegetables is known as _____.
a) olericulture b) pomology c) floriculture d) arboriculture

ii. An enclosed area where plants like fruits, vegetables, flowers and ornamental plants are intensively cultivated is called_____.
a) garden b) lawn c) forest d) edges

iii. A National Park, which is situated in the heart of a metropolitan city of Mumbai, is _____.
a) Sanjay Gandhi National Park b) Maharashtra Nature Park
c) Kamla Nehru Udyan d) Rajiv Gandhi National Park

iv. To carry out aseptic transfer of media or culture, _____ instrument is commonly used.
a) autoclave b) Laminar Air Flow c) illuminated rack d) incubator

v. Haploid plants can be achieved by _____ culture.
a) root b) embryo c) pollen d) shoot tip

vi. The enzyme used for joining the DNA fragments is _____.
a) phosphatase b) ligase c) exonuclease d) helicase

vii. When the amount of one variable tends to bear a constant ratio to the amount of the change in second variable, it is called as _____ correlation.
a) linear b) nonlinear c) sigmoid d) horizontal

viii. Coefficient of correlation can range from _____.
a) -1 to +1 b) 0 to +10 c) -10 to +10 d) -2 to +2

ix. One of the following is a Nucleic acid sequence database_____.
a) DDBJ b) UNI PROT c) SWISS PROT d) PDB

x. NCBI stands for :
a) National Centre for Bioinformatics Institute.
b) National Centre for Biotechnology Information.
c) Natural Centre for Biotechnology Information.
d) National Council for Bioinformatics Information.

Q.1 (B) Answer the following in **one or two sentences:** **(10)**

i. Define horticulture.
ii. What is totipotency ?
iii. What is organogenesis?
iv. What do you mean by perfect negative correlation?
v. Define Bioinformatics.

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Q.2 Answer **any two** of the following: **(20)**

i. What is a botanical garden? Discuss its importance.
ii. Describe water garden and focal point.
iii. Highlight on the importance of horticulture. Add a note on flower bed.
iv. Citing suitable botanical names of plants explain in detail avenues, lawn and edges.

Q.3 Answer **any two** of the following: **(20)**

i. Describe the different applications of Plant Tissue Culture.
ii. Describe the process of root culture. Add a note on it's importance.
iii. Describe the process of r-DNA technology/ gene cloning.
iv. What are cloning vectors? Give an account of different vectors used in r-DNA Technology.

Q.4 Answer **any two** of the following: **(20)**

i. In a certain plant, blue colour of flower is dominant to yellow colour. When two heterozygous blue flower coloured plants were crossed, 120 blue flowers and 30 yellow flowers were obtained. Calculate X^2 to test the hypothesis for Mendelian monohybrid 3:1 ratio.
(Given: Tabulated X^2 at 5% significance = 3.84)

ii. The following are the length in cm and breadth in cm of chilli fruits:

Length (cm)	9	10	11	10	9	9	10	11	11	10
Breadth (cm)	2	3	3	2	3	2	3	4	3	5

Calculate the coefficient of correlation and comment on the result.

iii. Explain BLAST as a retrieval tool of biological data.
iv. Give an account of bioinformatics programme in India.

Q.5 Write **short notes: (Any Four)** **(20)**

i. Informal garden.
ii. Hedges.
iii. Wet Sterilization.
iv. Importance of embryo culture.
v. Steps involved in calculating coefficient of correlation.
vi. www and its different components.

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DURATION: 3HRS. **TOTAL MARKS : 100**

N.B. 1. ALL QUESTIONS ARE COMPULSORY.
2. FIGURES TO THE RIGHT INDICATE FULL MARKS.
3. DRAW NEAT AND LABELED DIAGRAMS WHEREVER NECESSARY.

Q.I (A) CHOOSE THE CORRECT OPTION FROM THE FOLLOWING AND REWRITE THE SENTENCE. **10**

1. The two straps of the 'I – girder' are also known as _____.
(a) webs (b) neutral axis (c) flanges (d) null lines

2. Phloem sclerenchyma are also known as _____.
(a) hard fibres (b) bast fibres
(c) medullary rays (d) medullary fibres

3. _____ is also known as cork cambium.
(a) Phelloderm (b) phellem (c) phellogen (d) periderm

4. _____is the process by which energy in the organic molecules is released by oxidation.
(a) Respiration (b) Photosynthesis (c) Photoperiodism (d) Vernalization

5. The response of plants to the photoperiod expressed in the form of flowering is called as _____.
(a) Photosynthesis (b) Photoperiodism
(c) Vernalization (d) Respiration

6. Vernalized plant can be devernalized by _____.
(a) treatment with low temperature (b) treatment with high temperature
(c) treatment with very low temperature (d) None of the above

7. The first stable product in photorespiration is_____
a. Malate b. PEP c. Glycolate d. OAA

8. _____are absolutely essential for the normal growth of the plant.
(a) Rocks (b) Salts (c) Nutrients (d)Sulphates

9. The study of the relationship of plants and animals making up a natural community is called _____.
(a) Community ecology (b) autoecology
(c) population ecology (d) succession

10. In aquatic ecosystem nitrogen compounds are lost by the process of _____.
(a) Sedimentation (b) Calcification (c) Oxidation (d) Reduction

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Q.I (B) ANSWER IN ONE OR TWO SENTENCES **10**

1. What is heart wood? What is its function?
2. What are the types of collateral vascular bundles?
3. Mention the site of vernalization.
4. Name the factors that influence the soil pH.
5. What is water holding capacity?

Q. II ANSWER THE FOLLOWING QUESTIONS IN BRIEF (ANY TWO) **20**

1. Give a detailed account of periderm formation.
2. Write a detailed note on sclerenchyma as mechanical tissue.
3. Discuss the secondary growth in dicot stem. How is it different from that of the root?
4. Explain the formation of growth rings in woody perennial plants.

Q. III ANSWER THE FOLLOWING QUESTIONS IN BRIEF (ANY TWO) **20**

1. Explain different components of electron transport system.
2. Explain the importance of vernalization in plants.
3. Give an account of photorespiration in C3 plants.
4. Differentiate between aerobic & anaerobic respiration.

Q. IV ANSWER THE FOLLOWING QUESTIONS IN BRIEF (ANY TWO) **20**

1. Give an account of physiognomy and stratification with reference to plant community.
2. Give a detailed account of Nitrogen cycle.
3. What is soil profile? Explain soil profile in detail.
4. Discuss two quantitative characters of a Community.

Q. V WRITE SHORT NOTES ON(ANY FOUR) **20**

1. Xylem as mechanical tissue
2. Lenticels
3. Significance of photoperiodism
4. Schematic Diagram of Kreb's cycle
5. Soil texture
6. Biological spectrum

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[Time: Three Hours] **[Marks: 100]**

N.B: 1. **All** questions are compulsory.
2. Figures to the right indicate full marks.
3. Draw **neat and labelled** diagrams wherever necessary.

Q.1. (A) **Choose the correct option from the following & rewrite the sentence.** **10**

i. Ascospores are _____ in origin.
a. exogenous b. endogenous
c. epigynous d. perigynous

ii. The fruiting body of *Erysiphe* is called _____.
a. apothecium b. perithecum
c. cleistothecium d. peridium

iii. *Usnea* is an example of _____ Lichen.
a. crustose b. fructicose
c. terricose d. foliose

iv. *Selaginella* is a _____
a. Angiosperm b. Pteridophyte
c. Bryophyte d. Gymnosperm

v. _____ is not used as fungicide to control Late blight of Potato.
a. Xanthane b. Karathane
c. Elosal d. Morocide

vi. _____ is heterosporous.
a. *Rhynia* b. *Calamites*
c. *Nephrolepis* d. *Selaginella*

vii. _____ fossil is the best kind of fossil.
a. Pterified b. Cast
c. Mummified d. Amber

viii. *Pinus* archegonium do not possess _____.
a. egg b. neck cells
c. venter canal cell d. neck canal cell

ix. In *Pinus*, the pollen grains are _____ in colour .
a. yellow b. red
c. green d. brown

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x. Inner cortex of *Cordiates* stem show _____.
   a. gum canals b. vascular canal
   c. resin canal d. tube canal

Q.1.(B) Answer the following in **one or two sentence**: **10**

i. Name the fruiting body of *Xylaria*. Mention the number of spores found in one ascus .
ii. Name the plant disease and symptoms caused by *Phytophthora infestans*.
iii. What is geological time scale? Name any one era.
iv. Mention the types of shoot seen in *Pinus*.
v. Give the other name of root and seed of *Cordiates*.

Q.2. Answer **any two** from the following: **20**

i. With the help of neat labeled diagram explain sexual reproduction in *Xylaria*.
ii. Explain in detail the sexual reproduction in *Erysiphe*.
iii. Give a detailed account of disease cycle of powdery mildew. Add a note on its control measures.
iv. Discuss the economic importance of Lichen.

Q.3 Answer **any two** from the following: **20**

i. Give an account of Lepidophyta. Add a note on its classification up to order.
ii. With reference to *Selaginella* describe i) T.S. of rhizophore ii) T.S. of stem
iii. What is fossilization? Describe any two types of fossil studied by you.
iv. Explain the asexual reproduction in *Rhynia*. Add a note on its classification.

Q.4 Answer **any two** from the following: **20**

i. Give the salient features of Coniferophyta.
ii. Describe T.S. of *Pinus* old stem with the help of neat labelled diagram.
iii. Describe the male cone of *Pinus*. Add a note on its systematic position.
iv. With reference to *Cordaites* describe i) Male strobilus ii) Female Strobilus

Q.5 Write short notes. **(Any Four)** **20**

i. Systematic position of *Xylaria*.
ii. Classification on lichen based on habitat.
iii. T.S. of *Selaginella* leaf.
iv. T.S. of *Rhynia* stem
v. Structure of *Pinus* seed
vi. Systematic position of *Cordaites*

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