N.B.: 1. All questions are compulsory.
       2. Each question has internal options.
       3. Figures to the right indicate full marks.

Q. 1. A. Examine the origin of the RTI Act, 2005. What is the importance of transparency and accountability of Public Authorities?   (15)

OR

Q. 1. B. Give a detailed account of the procedure for filing a PIL.   (15)

Q. 2. A. Write a detailed note on the Polluter Pays Principle.   (15)

OR

Q.2. B. Explain the Human Rights Principle of Environment.   (15)

Q 3. A. List the various uses of Laser technology in everyday life.   (15)

OR

Q.3. B. Discuss the various uses of Nanotechnology.   (15)

Q. 4. A. What is motivation? Examine Maslow's and McGregor's theories of Motivation.   (15)

OR

Q.4. B. Briefly account for 'SMART' goals. Discuss the types of goals.   (15)

N.B.: 1) All questions are compulsory.
  2) Draw neat and labelled diagrams wherever necessary.
  3) All questions carry equal marks.

Q.1) Answer any <u>TWO</u> Of the following.   (15)
  a. Describe internal structure of stem of *Rhynia* and give systematic position with reasons of the same.
  b. Enlist the salient features of divisions – Psilophyta and Lepidophyta.
  c. Describe male and female gametophytes of *Selaginella*.
  d. Describe the structure of strobilus of *Selaginella*.

Q.2) Answer any <u>TWO</u> Of the following.   (15)
  a. Explain in detail the T.S. of young stem in *Pinus*.
  b. Describe the L.S. of Male cone in *Pinus*.
  c. Write an account on V.S. of ovule in *Pinus*.
  d. Discuss T.S. of *Cordaites* root. Add a note on its systematic position.

Q.3) Answer any <u>TWO</u> Of the following.   (15)
  a. Define Inflorescence. Describe types of Cymose inflorescence.
  b. What is aestivation? Describe various types of aestivation you have studied.
  c. What is placentation? Describe various types of placentation you have studied.
  d. Give the morphological peculiarities, systematic position, floral formula and two plants of economic importance of family Magnoliaceae.

Q.4) Answer any <u>THREE</u> Of the following.   (15)
  a. Fossil and fossilizaton.
  b. Protostele and its types.
  c. R.L.S. of wood in *Pinus*.
  d. Outline classification of Coniferophyta upto order as per Chamberlain.
  e. Head or capitulum inflorescence
  f. Forms of thalamus

········ *Best of Luck* ········

DAY: TUESDAY   TIME: 11:00 am TO 1:00pm

DATE: 14/05/2019   MAX MARKS: 60

N.B. 1) All questions are compulsory.

2) Figures to the right indicate full marks.

3) Use of log table or non-programmable calculators is allowed.

Q1. Attempt **any three** of the following.

A. Define quantum yield. Write a note on photosensitizer and photosensitized reactions.   5

B. Explain Odd-Even rule.

State whether following elements are radioactive or not:

$_{17}Cl^{35}$ $_{17}C^{36}$ $_{20}Ca^{40}$ $_{20}Ca^{45}$

$_{80}Hg^{195}$ $_{80}Hg^{196}$ $_{8}O^{16}$ $_{8}O^{17}$ 5

C. State and explain Grotthus-Draper law.

Explain the term: Fluorescence, Phosphorescence and Chemiluminescence.   5

D. Derive an expression for decay constant. Explain the term half- life. Give relation

between decay constant and half life.   5

E. Explain photoelectric effect. Calculate the value of de-broglie wavelength associated

with an electron moving with the speed of 6.0×10^7 m/s.

Given mass of electron = 9.1×10^{-31} Kg, h = 6.626×10^{-34} Js. C = 3×10^8 m/s   5

Q2. Attempt **any three** of the following:

A. What is an outer orbital complex? Explain with a suitable example.   5

B. Explain the following with suitable example:

(a) Coordination isomerism   3

(b) Optical isomerism in coordination compounds of the type $M(A-A)_2B_2$.   2

C. (a) Give the IUPAC name of the following: 3

(i) $[CoCl(NH_3)_5]^{2+}$

(ii) $Na[Au(CN)_2]$

(iii) $Na_3[Fe(C_2O_4)_3]$

(b) Calculate the EAN of Co in $[Co(NH_3)_6]^{3+}$.   2

D. Give the name, symbol and electronic configuration of the first five elements of the third

series of transition elements.   5

E. Give an account of the variable oxidation states of the elements of the first series of

transition elements.   5

Q3. Attempt **any three** of the following:

A. Give the reaction involved in the conversion of aniline to benzene diazonium chloride and explain the mechanism .   5

B. (a) Give the Paal – Knorr synthesis of pyrrole and thiophene.   3

   (b) What is the action of the following reagents on pyridine ?   2

      i)   Oleum in presence on $HgSO_4$

      ii)   Na + ethanol

C. (a) How is aniline converted to :

      i) acetanilide   ii) phenylisocyanide   3

   (b) How are aromatic amines prepared from nitroarenes ? Illustrate with an example.   2

D. (a) Discuss the aromaticity of pyrrole.   3

   (b) Explain why furan dose not undergo nucleophilic substitution ?   2

E. (a) Give the reaction involved in :   3

      i)   Vilsmeier – Haack reaction in thiophene

      ii)   action of acetyl nitrate on furan.

      iii) Chlorination of pyrrole

   (b) Give the preparation of phenyl hydrazine.   2

Q4. Attempt **any five** of the following:

a. State and explain Stark-Einstein law of photochemical equivalence.   3

b. Calculate mass defect of $_{25}Mn^{53}$ The actual mass is 52.941290 amu.   3

      (Given Me = 0.00055, Mn = 1.00866, Mp = 1.00727)

c. State and explain Heisenberg's Uncertainity principle.   3

d. Give any three biological applications of coordination compounds.   3

e. Give the name and formula of any three chlorides of vanadium.   3

f. (i) Give a balanced reaction for the action of HF on TiO_2.   1

   (ii) Complete and balance the following reaction: 1

      $V_2O_3 + NH_3 \longrightarrow$

   (iii) Give any one test for the detection of Mn^{2+} ions qualitatively.   1

g. On the basis of resonance, explain why amination in pyridine takes place at positions 2 and 4.   3

h. Give the synthesis of p-nitroaniline from aniline.   3

i. Explain the effect of electron – donating and electron – withdrawing substituents on basic strength of aromatic amines with examples.   3

Instructions: 1. All questions are compulsory.

2. Figures to the right indicate full marks of the question.

3. Use of a calculator or any electronic device is not allowed.

Q.1. A)   Attempt any one.   [08]

(i) Define the Riemann integral of a bounded function $f : [a, b] \to \mathbb{R}$. Show with usual notation that $m(b - a) \leq \int_a^b f(x)\, dx \leq M(b - a)$.

(ii) If f is continuous on $[a, b]$ and g is integrable on $[a, b]$ such that $g(x) \geq 0 \ \forall x \in [a, b]$, then prove that there exists $c \in [a, b]$ such that $\int_a^b f(x)g(x)dx = f(c) \int_a^b g(x)dx$.

Q.1. B)   Attempt any two.   [12]

(i) Let $f : [0, 3] \to \mathbb{R}$ be defined by $f(x) = 2x$. Show that for every partition P of $[0, 3]$ $U(f, P) > 9$ and $L(f, P) < 9$.

(ii) Using Riemann's criterion show that $f : [0, 3] \to \mathbb{R}$ defined by $f(x) = \begin{cases} 0 & \text{for } x \in [0, 3] \setminus \mathbb{Z} \\ -1 & \text{for } x \in [0, 3] \cap \mathbb{Z} \end{cases}$

is Riemann integrable on its domain and evaluate $\int_0^3 f(x)dx$.

(iii) State second fundamental theorem of calculus and using it compute $\int_0^{10} \lfloor x \rfloor dx$.

(iv) Let $f : \mathbb{R} \to \mathbb{R}$ be continuous function such that $\int_0^x f(t)dt = x^2 + x \sin 2x + \dfrac{1}{2} \cos 2x - \dfrac{1}{2}$. Then find $f(\frac{\pi}{4})$ and $f'(\frac{\pi}{4})$.

Q.2. A)   Attempt any one.   [08]

(i) Let $f : [a, b] \to \mathbb{R}$ be a continuously differentiable function such that $\forall \ x \in [a, b]$, $f(x) \geq 0$. Then prove that the surface area of surface of revolution obtained by revolving the arc of the curve $y = f(x)$ joining the points $(a, f(a))$ and $(b, f(b))$ about the x-axis is

$$\int_a^b 2\pi y \sqrt{1 + \left(\frac{dy}{dx}\right)^2}\, dx = \int_a^b 2\pi f(x) \sqrt{1 + (f(x))^2}\, dx.$$

1

(ii) Let $f(x)$ and $g(x)$ be two functions such that $0 \leq f(x) \leq g(x)$ $\forall x \in [a, b)$ and $\lim\limits_{x \to b^-} f(x) = \infty$, $\lim\limits_{x \to b^-} g(x) = \infty$. Then show that

    (a) $\int_a^b f(x)dx$ converges when $\int_a^b g(x)dx$ converges.

    (b) $\int_a^b g(x)dx$ diverges when $\int_a^b f(x)dx$ diverges.

Q.2. B)   Attempt any two.   [12]

(i) Find the volume of the solid obtained by revolving about the x-axis region bounded by the curves $y = x$ and $y = x^2$.

(ii) Find the length of the curve $y = \ln\left(\dfrac{e^x - 1}{e^x + 1}\right)$ from $x = 1$ to $x = 2$.

(iii) Examine the convergence of $\int_2^\infty \dfrac{1}{\ln x}\, dx$.

(iv) Evaluate $\int_0^1 x^m \, (\ln x)^n \, dx$.

Q.3. A)   Attempt any one.   [08]

(i) State and prove Fubini's theorem for a rectangular domain in $\mathbb{R}^2$.

(ii) State the change of variables formula for triple integral, stating clearly the condition under which it is valid. Explain further, how will you use it to express the triple integral in cylindrical coordinates (r, θ, z).

Q.3. B)   Attempt any two.   [12]

(i) Sketch the region of integration and evaluate $\int_0^2 \int_{1+y^2}^5 ye^{(x-1)^2} dx\, dy$ by reversing the order of integration.

(ii) Let $f(x, y) = x + y$ and S is bounded by the parabolas $y = x^2$ and $y = 1 - x^2$. Sketch the region S of integration. Write both the iterated integrals and use Fubini's theorem to evaluate $\iint_S f(x, y)\, d(x, y)$.

(iii) Evaluate $\iint_S \left(\dfrac{x - 2y}{x + 2y}\right)^3 d(x, y)$ where S is the region bounded by the lines $x - 2y = 1$, $x - 2y = 2$, $x + 2y = 1$, and $x + 2y = 3$ by a suitable change of variables.

(iv) Evaluate $\int_1^3 \int_x^{x^2} \int_0^{\ln z} xe^y \, dy\,dz\,dx$.

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DAY: TUESDAY   TIME: 11:00 am TO 1:00pm

DATE: 14/05/2019   MAX MARKS: 60

N.B.   1.   Figures to the right indicate full marks
        2.   Use of non-programmable calculator is permitted

All questions are compulsory   16 M

Q. 1   A   Attempt **ANY FOUR.**
        i.   In an experiment of Fresnel's diffraction due to a straight edge, the diffraction pattern is observed on a screen at a distance of 2.5 m from the rectangular slit at a distance of 1.0 m from the straight edge. Determine the separation of the first three bright bands. Given : Wavelength of light is 5500.0 Angstroms.
        ii. A light of wavelength 5500.0 Angstroms is placed at a distance of 8.0 cm from a narrow straight rectangular slit. If the distance between the second and the first dark band is 1.5 mm find the distance of screen from the straight edge.
        iii. A light of wavelength 5500.0 Angstroms illuminates a narrow rectangular slit placed at a distance of 0.2 m from a straight edge. Find the separation between the first and second bright band when observed on a screen at a distance of 0.8 m from the edge.
        iv. Monochromatic light of wavelength 5000.0 Angstroms falls normally on a grating 1.0 cm wide. The order 1.0 spectrum is produced at an angle 15.0 degrees from the normal. Calculate the total number of lines per meter for the grating.
        v.   Fraunhoffer type diffraction occurs through a double slit that has separation b = 0.07 mm and slit width a = 0.05 mm. When a monochromatic light of wavelength 6000.0 Angstroms illuminates the slit; fringes are observed on a screen 0.3 m away from the slit. What is the fringe spacing on the screen?
        vi. A plane transmission grating has 16000.0 lines / inch. What is the angular separation of the 5000.0 Angstroms and 4972.0 Angstroms lines of helium in the order 1.0 spectrum?

                                                                     04 M

        B   Attempt **ANY ONE.**
        i.   Explain Fresnels diffraction due to a narrow aperture. Illustrate with diagrams.
        ii. Write a note on Fraunhoffer diffraction due to double slit.
        iii. Using diagrams explain Fresnel's half period zones.

                                                                     08 M

Q. 2   A   Attempt **ANY ONE.**
        i.   What are retarders? Quarter wave plates are often made out of thin sheets of mica. It is a biaxial material. You are given two refractive indices μ_e = 1.5692 and μ_o = 1.6049 for sodium yellow light of wavelength 589.3 nm. How thick must be the mica sheet to provide (a) $\lambda/4$ and (b) $\lambda/2$ retarder?
        ii. What is polarization? How one can identify the following state of polarizations (a) linearly polarized (b) circularly polarized (c) mixture of unpolarized and linearly polarized

B   Attempt **ANY THREE.**   12 M

i. What is an optic axis? Draw wave surfaces for positive and negative crystals. At least give one characteristic of positive and negative crystals.

ii. Draw a y-polarized light wave travelling along X-axis through a calcite crystal, optic axis of which is parallel to Z-axis. Which vibrations will be blocked?

iii. State and explain Malus law

iv. Explain polarization by selective absorption.

v. Explain by taking an example when one can get a Left circularly and a Right circularly polarized light.

Q. 3   **A**   Attempt **ANY ONE.**   08 M

i. Describe Michelson's interferometer and show, how it can be used for measuring the wavelength of monochromatic light source in a spectrum.

ii. Explain Rayleigh criterion? Also, explain and derive the resolving power of telescope.

B   Attempt **ANY THREE.**   12 M

i. In Michelson's Interferometer

a) If a tube is 2.5cm long ,which is first evacuated and then slowly filled with air (μ=1.0003),how many fringes will cross the centre? Assume λ=600nm.

b) If the contrast in an Interference pattern is 50%,and if the maxima receives 15 units of light, how much do the minima receives?

ii. In Febry-Perot Interferometer

a) Determine the least separation of two spectral line, near 500nm,that can be resolved by an etalon that is 10nm long and has a reflecting coefficient 0.59.

b) What plate separation is needed in a Febry-Perot Interferometer to resolve two spectral lines 0.05Å apart if the average wavelength is 633nm

and reflected coefficient $\dfrac{(1+r^2)^{1/2}}{(1-r^2)}$.

iii. Two pin holes 1.5 cm apart are placed in front of a source of light of wavelength 5500Å and seen through a telescope with its objective stopped down to a diameter of 0.4cm.Find the maximum distance from the telescope at which the pin holes can be resolved.

iv. Calculate the useful magnifying power of a telescope of ·8 cm objective. Assuming that the limit of resolution of the eye is 2mintes of an arc. Wavelength of light used is 600nm.

v. Calculate the minimum thickness of the base of a prism which will just resolve the D_1 and D_2 lines of Na. The refractive index of glass is 1.6545 for λ=5270Å and 1.6635 for λ=6563Å.also justify the result?

******Best of Luck******

DAY: WEDNESDAY   TIME: 11:00 am TO 1:00pm

DATE: 15/05/2019   MAX MARKS: 60

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

Q1. Attempt **any three** of the following.

A. Explain primary and secondary process of photochemical reaction with suitable example. Discuss reasons for high and low quantum yield of photochemical reaction.   5

B. Distinguish between thermal reactions and photochemical reactions. State and explain Grotthus Draper law.   5

C. Explain photoelectric effect. Calculate kinetic energy of an electron that has wavelength of 100×10^{-9} m. Given mass of electron = 9.1×10^{-31} kg.   5

D. Explain the terms neutron -proton ratio and belt of stability. Calculate binding energy per nucleon in MeV for $_2He^4$ which has mass defect 0.03036.   5

E. Explain the term half life. The activity of radioactivity element reduces to 25% of its original amount after an hour And forty minutes. Calculate its half life.   5

Q2. Attempt **any three** of the following:

A. On the basis of valence bond theory, explain the bonding involved in $[Fe(CN)_6]^{3-}$.   5

B. Explain the following with suitable example:
(a) Ionization isomerism   3
(b) Geometrical isomerism in coordination compounds of the type $M(A-A)_2B_2$.   2

C. (a) Give the IUPAC name of the following: 3
   (i) $[CoCl_2(en)_2]^+$
   (ii) $[Ag(NH_3)_2]Cl$
   (iii) $K_3[Al(C_2O_4)_3]$
(b) Explain the 18-electron rule, giving a suitable example.   2

D. Give the name, symbol and electronic configuration of the first five elements of the second series of transition elements.   5

E. (a) Explain, the solution containing hydrated Ti^{3+} ion is purple in colour.   3
(b) Calculate the magnetic moment for V^{3+} ion.   2

P.T.O.

Q3. Attempt **any three** of the following:

A. What is diazotization ? Explain the mechanism involved.   5

B. a) Explain the aromaticity in furan.   3

   b) What is Chichibabin reaction?   2

C. a) Give the synthesis of p – bromoaniline from aniline.   3

   b) How is aniline prepared from benzamide ? Name the reaction involved.   2

D. a) Give the Hantzsch synthesis of pyridine.   3

   b) Explain why thiophene is reactive towards electrophilic reagents ?   2

E. a) Give the reaction involved in :   3

      i) Conversion of furan to furfural.

      ii) action of $SO_2 Cl_2$ on pyrrole.

      iii) Friedel – Crafts acylation of thiophene.

   b) How is 2 – aminobenzoic acid converted 2 – chlorobenzoicacid ?   2

Q4. Attempt **any five** of the following:

a. Write a note on phosphorescence and fluorescence.   3

b. Explain the term Mass Defect.   3

c. Explain the term wave function. Calculate kinetic energy of electron when a metal
Is irradiated with light of wavelength 500×10^{-9}m.
(Given h = 6.626 X 10^{-34}Js. C = 3 X 10^8 m/s, Me = 0.00055, Mn = 1.00866, Mp = 1.00727)   3

d. Give the classification of ligands with suitable examples.   3

e. Give the name and formula of any three oxides of vanadium.   3

f. (i) Give a balanced reaction for the action of H_2 on TiO_2.   1

   (ii) Complete and balance the following reaction: 1

      $TiCl_4 + H_2O \longrightarrow$

   (iii) Give any one test for the detection of Cu^{2+} ions qualitatively.   1

g. Explain N – Methylation in aniline.   3

h. Write the resonating structures of pyridine and explain why sulphonation of pyridine takes place at position 3.   3

i. Discuss the relative basic strengths of aniline, p – toluidine and p –nitroaniline.   3

DAY: WEDNESDAY   TIME: 11:00 am TO 1:00pm

DATE: 15/05/2019   MAX MARKS: 60

N.B. 1. Figures to the right indicate full marks
          2. Use of non-programmable calculator is permitted

All questions are compulsory

Q. 1 **A** Attempt **ANY FOUR.**   16M
i. A light of wavelength 4000.0 Angstroms illuminates a narrow rectangular slit placed at a distance of 0.4 m from a straight edge. Find the separation between the first and second bright band when observed on a screen at a distance of 0.6 m from the edge.
ii. A thin narrow vertical slit is illuminated with monochromatic light of wavelength 4000.0 Angstroms and casts a shadow of a vertical steel wire of radius 1.1 mm and 1.3 m away on a screen 250.0 cm away from the wire. Find the fringewidth and width of the geometrical shadow. Also obtain the total number of bands that are observed in the shadow.
iii. A narrow slit is illuminated by light of wavelength λ placed at a distance of 0.1 m from a straight edge. If the distance between dark bands 6.0 and 5.0 is 0.432 mm determine the wavelength of the source if the screen is at a distance 0.5 m from the edge.
iv. Determine the number of lines in 1 cm of the grating surface when a plane transmission grating diffracts order 1.0 through 30.0 degrees for incident light of wavelength 5000.0 Angstroms.
v. A fabric with 600.0 threads/cm is illuminated by a light of wavelength 4000.0 Angstroms. Find the angle between the central image of a light and its order 2.0 diffracted image. For the same fabric find the angle for light of wavelength 6000.0 Angstroms.
vi. A plane transmission grating has 12000.0 lines / inch. What is the angular separation of the 5500.0 Angstroms and 5467.0 Angstroms lines of helium in the order 2.0 spectrum?

B Attempt **ANY ONE.**   04M
i. Explain using diagram Fresnel's diffraction due to a slit with wide aperture.
ii. With illustrations, explain Fraunhoffer diffraction at a single slit.
iii. How are transmission gratings made?

Q. 2 **A** Attempt **ANY ONE.**   08M
i. Explain the phenomena of polarization of light. Mention various methods of production of linearly polarized light waves. With a neat diagram explain how light waves can be polarized by a wire grid polarizer.
ii. What are retarders? Explain construction of Quarter wave plate. Obtain the equation of the thickness of the quarter wave plate.

B Attempt **ANY THREE.**   12M
i. Calculate the thickness of thinnest plate of quartz quarter-wave plate for sodium light of wavelength 589.3 nm, given that the index of refraction at the given wavelength for quartz for ordinary and extra ordinary light are 1.5442 and 1.5533 respectively.
ii. How is circularly polarized light produced?

iii. Explain polarization by scattering.

iv. How will you analyze a mixture of unpolarized and circularly polarized light?

v. Explain double refraction phenomenon. Draw wave surfaces for a positive and a negative crystal.

Q. 3   A   Attempt **ANY ONE**.   08M

i. Describe the principle, construction and working of Michelson's interferometer.

ii. Explain and derive the resolving power of prism

B   Attempt **ANY THREE**.   12M

i. The monochromatic light is incident at an angle of 62° on a surface of thin transparent film of refractive index 1.33,if 6th fringe corresponds to wavelength of 600nm, find the thickness of the thin transparent film?

ii. If after obtaining fringes in Michelson's interferometer with white light, the white light is replaced by Na light, the fringes are found, to disappear, when one mirror is moved through 0.289mm. Find the wavelength of longer wavelength's component when the shorter one has the value 5890Å.

iii. Calculate the useful magnifying power of a telescope of 10 cm objective. Assuming that the limit of resolution of the eye is 2 minutes of an arc. Wavelength of light used is 600nm.

iv. Calculate the minimum thickness of the base of a prism which will just resolve the D_1 and D_2 lines of Na. The refractive index of glass is 1.6545 for $\lambda=5270$Å and 1.6635 for $\lambda=6563$Å.also justify the result?

v. Light is incident normally on a grating of total ruled width 5mm with 2500 lines in all. Calculate the separation of the two sodium lines in the first order spectrum. Can they be distinct? (given: $\lambda_1 =5890$Å, $\lambda_2=5896$Å)

******Best of Luck******

DAY: WEDNESDAY   TIME: 11:00 am TO 1:00pm

DATE: 15/05/2019   MAX MARKS: 60

NOTE: 1. All question are compulsory
      2. Figures to the right indicate full marks
      3. Draw neat and labeled diagram wherever necessary.

Q1 Answer the following

a)Explain the types of Endoplasmic Reticulum and add a note on its functions.   (08)

b)Explain the structure of Nuclear pore and Pore complex.   (07)

OR

Q1 Write notes on

a) Origin occurrence and morphology of Golgi complex   (05)

b) Functions of Mitochondria   (05)

c) Facilitated diffusion in plasma membrane   (05)

Q2 Answer the following

a)Describe the structure of heart of amphibian.   (08)

b)Give an account on formation of pseudopodia in amoeba.   (07)

OR

Q2. Write notes on

a)Neurogenic and Myogenic heart   (05)

b)Amoeboid movement.   (05)

c)Sensitivity and irritability.   (05)

Q.3 Describe the following

a) Digestive system of Cockroach   (08)

b) Circulatory system of Cockroach   (07)

OR

Q3. Write notes on

a) Abdomen of cockroach   (05)

b) Mouthparts of cockroach   (05)

c) Excretion in cockroach   (05)

Q4. Write short notes on

a)Protein asymmetry of plasma membrane   OR   a)Endocytosis.   (05)

b) chemical or hormonal co- ordination OR   b)Water as circulating fluid.   (05)

c) Peripheral nervous system of cockroach OR c) Systemic position of cockroach.   (05)

DAY: WEDNESDAY   TIME: 11:00 am TO 1:00pm

DATE: 15/05/2019   MAX MARKS: 60

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

1   Attempt any TWO of the following.   20

(i) Obtain M.G.F. of a random variable (r. v.) X which follows   10
     Uniform distribution over (a, b). Also obtain an expression for
     r^{th} raw moment μ_r'. Hence obtain mean and variance.

(ii) Obtain M.G.F. & Cumulant Generating Function (C.G.F.) of a   10
     random variable (r. v.) X which follows Exponential distribution
     with parameter θ. Also obtain mean and variance.

(iii) Obtain M.G.F. of a r.v. X~ Triangular distribution in the interval   10
      (a,b) with peak at X = c.

2   Attempt any TWO of the following.   20

(i) If a r.v. X follows Normal distribution with parameters (μ, σ^2),   10
     obtain median.

(ii) If a r.v. X follows Normal distribution with parameters (μ, σ^2),   10
     obtain mean deviation from mean.

(iii) If a random variable $X \sim N(\mu, \sigma^2)$,   10
      prove that $\mu_{2r+1} = 0$ for all r.
                   $\mu_{2r} = [1.3.5\ldots\ldots(2r-1)]\, \sigma^{2r}$ for r = 1, 2, 3…

3   Attempt any TWO of the following.   20

(i) A r.v. X follows Chi-square distribution with n_1 degrees of   10
     freedom. Another r.v. Y follows Chi-square distribution with n_2
     degrees of freedom. X & Y are independent. Obtain p.d.f. of
     X / (X + Y).

(ii) If a r.v. X follows Student's t distribution , obtain mean deviation   10
     from mean.

(iii) If a r.v. follows F distribution with (f_1 , f_2) degrees of freedom,   10
      show that its reciprocal follows F distribution with (f_2 , f_1)
      degrees of freedom.

DAY: THURSDAY   TIME: 11:00 am TO 1:00pm

DATE: 16/05/2019   MAX MARKS: 60

1. All questions are compulsory.
2. Draw neat diagrams wherever necessary.
3. Use of logtables and nonprogrammable calculator is allowed.
4. Symbols have their usual meaning unless stated otherwise.
5. Number to the right indicate maximum marks.
(Given: Mass of electron = 9.11 x 10^{-31} kg, mass of proton = 1.67 x 10^{-27} kg,
Planck's constant = 6.67 x 10^{-34} Js, charge on electron = 1.6 x 10^{-19} C)

Q1 A   Attempt any one   10
    (i)   Show that when the potential energy is a function of position alone,
          Schrödinger's time dependent equation reduces to Schrödinger's time in-
          dependent equation. Express it in three dimensional form.
    (ii) What is meant by superposition of wave functions? Show that wavefunc-
          tions obey the principle of superposition but the corresponding probability
          densities do not follow it. What are the requirements of well behaved wave-
          function?

    B   Attempt any one   6
    (i)   Show that $\psi(x) = \exp(-\frac{x^2}{2})$ is an eigenfunction of the operator

$$\hat{A} = \frac{\partial^2}{\partial x^2} - x^2.$$

          What is its eigenvalue.
    (ii) A particle is limited to the x axis and has the wavefunction

$$\psi(x) = \begin{cases} ax & \text{when } 0 \leq x \leq 1. \\ 0 & \text{elsewhere.} \end{cases}$$

          Find the probability that the particle can be found between $x = 0.2$ and 0.4.

    C   Attempt any one   4
    (i)   Find the expectation value of the momentum for a wavefunction

$$\psi(x) = \sqrt{\frac{2}{L}} \sin(\frac{\pi x}{L})$$

          for $0 < x < L$.
    (ii) The energy operator $\hat{E}$ operates on the wavefunction

$$\psi(x, t) = 2x^3 e^{-i\omega t}.$$

          Obtain the result.

[P.T.O.]

Q2 **A** Attempt any two 10

(i) Find the reflection and transmission coefficient for an electron with energy 2 eV when it is incident on a potential step of height 1 eV.

(ii) Set up the Schrödinger's equation in three dimensional cubic potential and obtain the general solution using the method of seperation of variables. (No need to apply the boundary conditions)

(iii) Consider the finite potential step in which $U(x) = 0$ for $x < 0$ and $U(x) = V_0$ for $x \geq 0$. For the case $E < V_0$, the wave function in the region I ($x < 0$) is given by $\psi_I(x) = Ae^{ikx} + Be^{-ikx}$ and in region II ($x > 0$) $\psi_{II}(x) = ce^{-\alpha x}$ where $k = \sqrt{2mE\hbar^{-2}}$ and $\alpha = \sqrt{2m(V_0 - E)\hbar^{-2}}$. Apply the boundary conditions and obtain the coefficient of reflection and hence the coefficient of transmission.

B Attempt any one 5

(i) Find the degeneracy of a state of the three dimensional cubic potential box having energy $\frac{29\pi\hbar^2}{2mL^2}$.

(ii) Find the ground state energy of a proton confined to move in a one dimensional infinite potential well of length 1 A°.

C Attempt any one 5

(i) Consider an infinite potential well from $-L$ to L (instead of 0 to L). Write down the Schrödinger's equation inside the well and its general solution. Apply the boundary conditions to determine one of the constants.

(ii) Consider a double step potential, that is, $U(x) = 0$ for $x < 0$, $U(x) = V_0$ for $0 \leq x < L$ and $U(x) = 2V_0$ for $x \geq L$. Sketch this potential. If $E = 3V_0/2$, write the Schrödinger equations in different regions and sketch the solutions.

Q3 **A** Attempt any two 10

(i) What is the correspondence principle? Explain with examples.

(ii) Describe in detail how the tunnelling effect explains the decay of α-particles from radioactive nuclei.

(iii) Consider the potential barrier of width L and height V_0. Write the Schrodinger equations in three different regions and their general solutions. Apply the boundary conditions and obtain the relations between various constants.

B Attempt any one 5

(i) Sketch and compare the energy level diagrams of the infinite potential well, harmonic oscillator and the Bohr model.

(ii) With the help of neat diagram describe the principle behind the scanning tunnelling microscope (STM).

C Attempt any one 5

(i) Consider a potential defined as follows. $U(x) = 0$ for $x < 0$, $U(x) = 2V_0$ for $0 \leq x < L$ and $U(x) = V_0$ for $x \geq L$. For $E > V_0$, write down the Schrödinger equations in different regions and sketch the solutions.

(ii) Consider a potential defined as follows. $U(x) = 0$ for $x < 0$ and $x > 2L$, $U(x) = V_0$ for $0 \leq x < L$ and $U(x) = 2V_0$ for $L \leq x \leq 2L$. Sketch this potential and write down the Schrödinger equations in different regions for $E < V_0$. Also state the boundary conditions.

All the Best!

DAY: THURSDAY   TIME: 11:00 am TO 1:00pm

DATE: 16/05/2019   MAX MARKS: 60

N.B. 1. Attempt all questions.
2. Figures to the right indicate full marks.
3. Use of log tables or non-programmable calculator is allowed. ·

Q1.   Answer **any three** of the following.   [15]

A   a) Draw FCC structure and calculate the number of atoms per unit cell.
         b) Anhydrous CaF_2 (molecular weight 78×10^{-3} Kg.m^{-3}) crystallizes in
         FCC lattice with an edge length 546 pm. Its density is 3.18×10^3 Kg.m^{-3}.
         Calculate the Avogadro's number.

B   a) Show that the path difference is integral multiple of wavelength for
         peaks in X– ray diffraction.
         b) Define catalyst support with a suitable example.

C.   Explain the plane and axis of symmetry with the help of diagrams
         for cubic crystal.

D.   Give characteristic features of catalysis.

E.   Derive the kinetics of Michaelis – Menten enzyme catalytic reactions.

Q.2.   Answer **any three** of the following.   [15]

A.   What is hydration energy? With a neat diagram explain the
         hydration of cation in aqueous medium.

B.   What is meant by predominance diagram? Explain it with reference
         to Cr^{3+} ion and its hydrolytic products in aqueous medium.

C.   Explain how are monoatomic anions classified on the basis of their
         basicity, giving examples. Also give the predominance diagram for
         each type.

D.   Write any five general properties of oxo acids.

E.   Mention any five uses of sulphuric acid.

Q.3.   Answer **any three** of the following.   [15]

A   Complete the following reaction and suggest suitable mechanism. Give one
         example of crossed Claisen condensation reaction.

$$2\ CH_3COOC_2H_5 \xrightarrow{\ NaOC_2H_5\ } ?$$
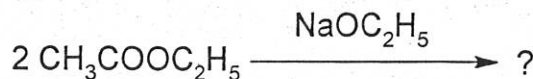
B   a) How will you prepare benzoic acid using
         i) Grignard reagent   ii) an aromatic alcohol.
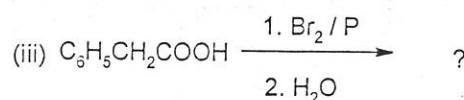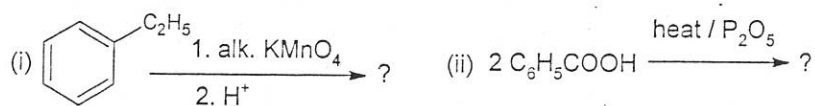   b) Explain why p-chlorobenzoic acid is stronger acid than p-toluic acid.

                                                                    [P.T.O.]

C   a) Give the preparation of picric acid through sulfonic acid route by ipso attack.

          b) Give the action of $LiAlH_4$ on phenylacetic acid.

D   What is sulfonation? Give sulfonation of naphthalene at $80°C$. Discuss the mechanism of action of conc. H_2SO_4 on benzene.

E   a) How will you convert

          i) salicylic acid to methyl salicylate

          ii) benzoic acid to benzamide

          b) Give the action of carbonyl chloride on benzoic acid.

Q4.   Answer **any five** of the following.   **[15]**

a)   Name any two methods for preparation of nanoparticles and describe one of them in detail.

b)   What is crystal system? Explain with examples.

c)   What is the effect of pH on the rate of acid and base catalyzed reactions? Show graphically.

d)   Give Latimer equation and explain how it is used to calculate the hydration energy for cations in aqueous medium.

e)   Show the relationship between acidity, pKa and charge to radius ratio of cations, graphically.

f)   Mention any three oxy acids of nitrogen with their chemical formula and give the oxidation number of nitrogen in those oxy acids.

g)   Complete the following reactions.

(i) [benzene ring with C_2H_5 substituent] $\xrightarrow[\text{2. H}^+]{\text{1. alk. KMnO}_4}$?   (ii) $2\ C_6H_5COOH \xrightarrow{\text{heat / P}_2O_5}$?

(iii) $C_6H_5CH_2COOH \xrightarrow[\text{2. H}_2O]{\text{1. Br}_2 / P}$?

h)   Give one example each of decarboxylation and desulfonation reaction.

i)   Benzene sulfonic acid is more acidic than benzoic acid. Justify.

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RAMNIRANJAN JHUNJHUNWALA COLLEGE (AUTONOMOUS) GHATKOPAR – 86
SYBSc   ADDITIONAL CUM SUPPLEMENTARY EXAMINATION MAY 2019
SEM IV   SUBJECT: BOTANY II

DAY: THURSDAY   TIME: 11:00 am TO 1:00pm

DATE: 16/05/2019   MAX MARKS: 60

N.B.: 1) All questions are compulsory.
2) Draw neat and labelled diagrams wherever necessary.
3) All questions carry equal marks.

Q.1) Answer any <u>TWO</u> Of the following.   (15)
   a) With the help of neat labelled diagram, explain the secondary growth in Monocot stem.
   b) Explain in detail the structure and functions of I. girders in *Coleus* stem
   c) Give detailed account on Inflexibilty and Incompresibilty in plants.
   d) Describe the various arrangements of vascular tissues in stems.

Q.2) Answer any <u>TWO</u> Of the following.   (15)
   a) With suitable diagram, explain Soil profile.
   b) Describe in brief the process of soil formation.
   c) With reference to plant community, explain Spatial stratification and Temporal stratification.
   d) Explain the following:
     (i) Life forms   (ii) Frequency

Q.3) Answer any <u>TWO</u> Of the following.   (15)
   a) What are secondary metabolites? Discuss the botanical sources and uses of volatile oils.
   b) Discuss the functions and properties of tannins.
   c) What are resins? Give botanical sources and uses of resins.
   d) Discuss the functions and properties of glycosides.

Q.4) Write short notes on any <u>THREE</u> Of the following.   (15)
   a) I-girders for shearing stress
   b) Xylem tissue in plant body
   c) Types of soil
   d) Any five classes of pesticides in relation to the type of pests
   e) Concept of Pharmacopeia.
   f) Properties of alkaloids

········ Best of Luck ·········

DAY: THURSDAY   TIME: 11:00 am TO 1:00pm

DATE: 16/05/2019   MAX MARKS: 60

Instructions: All questions are compulsory.
            Figures to the right indicate full marks of the question.

Q.1 A   Attempt ANY ONE from the following: [08]
     (i)   Derive the group of symmetries of a square using permutations.
     (ii) If $n (\geq 2)$ is a positive integer and $.$ is a multiplication modulo n in $\mathbb{Z}_n$,
           then prove that $(U(n), .)$ is a group.

     B   Attempt ANY TWO from the following: [12]
     (i)   Prove that $G = \left\{ \begin{pmatrix} a & a \\ a & a \end{pmatrix} : a \in \mathbb{Q}, \ a \neq 0 \right\}$ under multiplication of
           2×2 matrices is a group.
     (ii) Prove that Intersection of two subgroups of a group is also a subgroup.
           Is it true for union of two subgroups? Justify.
     (iii) Let $G = S_4$, then prove that $H = \{ \ I, (1\,2)(3\,4), (1\,3)(2\,4), (1\,4)(2\,3) \ \}$
           is a subgroup of G
     (iv) Find order of every element in a group $G = \left\{ \ \overline{5}, \overline{15}, \overline{25}, \overline{35} \right\} \ mod \ 40$
           under multiplication of residue classes modulo 40.

Q.2 A   Attempt ANY ONE from the following: [08]
     (i)   Define a cyclic Group. Prove that every subgroup of a cyclic group is
           cyclic.
     (ii) Prove that a finite group G is cyclic if and only if there exists an element
           $a \in G$ such that $o(a) = o(G)$

     B   Attempt ANY TWO from the following: [12]
     (i)   Are the following groups cyclic? Give reasons.
           (i) $(\mathbb{Z}_6, +)$
           (ii) $(U(12), .)$
           (iii) $(\mathbb{R}^*, .)$
     (ii) (a) Show that a non-trivial finite cyclic group with exactly one generator
               has utmost 2 elements.
           (b) List all the elements of subgroup $< \overline{6} >$ in group $(\mathbb{Z}_{36}, +)$

(iii) Find all the generators of the cyclic group $U(19)(= \mathbb{Z}_{19}^*)$ under multiplication modulo 19.

(iv) Find all subgroups of $(\mathbb{Z}_{15}, +)$

Q.3 A   Attempt ANY ONE from the following: [03]
(i)   State and prove lagranges theorem.
(ii) (a)Define Group Homomorphism.
      (b)Let G_1 and G_2 be two groups and $f: G_1 \to G_2$ be a group homomorphism, then prove that f is injective if and only if $Ker\, f = \{e\}$.

     B   Attempt ANY TWO from the following: [12]
(i)   Find all the distinct left cosets of subgroup $H = <\bar{9}>$ of group $G = U(14)$
(ii) Let a and b be non-identity elements of different orders in a group of order 155. Prove that the only subgroup of G that contains both a and b is G itself.
(iii) Show that the map $f: GL_n(\mathbb{R}) \to GL_n(\mathbb{R})$ defined by $f(A) = (A^t)^{-1}$ is a group homomorphism. Is it an automorphism?. Justify your answer.
(iv) Let $f: \mathbb{Z} \to \mathbb{Z}_{11}$ be a group homomorphism with $f(1) = \bar{6}$. Find $f(31)$ and $ker f$.

***** *End* *****

DAY: FRIDAY   TIME: 11:00 am TO 1:00pm
DATE: 17/05/2019   MAX MARKS: 60

1. All questions are compulsory.
2. Draw neat diagrams wherever necessary.
3. Use of logtables and nonprogrammable calculator is allowed.
4. Symbols have their usual meaning unless stated otherwise.
5. Number to the right indicate maximum marks.
(Given: Mass of electron = 9.11 x 10^{-31} kg. mass of proton = 1.67 x 10^{-27} kg.
Planck's constant = 6.67 x 10^{-34} Js. charge on electron = 1.6 x 10^{-19} C)

Q1 A Attempt any one   10
(i) Show that when the potential energy is a function of position alone,
     Schrödinger's time dependent equation reduces to Schrödinger's time in-
     dependent equation. Express it in three dimensional form.
(ii) Discuss Max Born's interpretation of wave function. What is meant by nor-
     malisation of wavefunction and write the requirements of a well behaved
     wave function.

B Attempt any one   6
(i) The wavefunction for a particle confined to move in a line of length L is given
     by

$$\psi = A\sin(\frac{n\pi x}{L}).$$

     Find the required value of A to normalise this function given A is real and n
     is a whole number.
(ii) If $\psi_1(x,t)$ and $\psi_2(x,t)$ are both solutions of Scrödinger's equation for a given
     potential $U(x)$ show that the linear combination $\psi = a_1\psi_1 + a_2\psi_2$ is also a
     solution where a_1 and a_2 are constants.

C Attempt any one   4
(i) The energy operator $\hat{E}$ operates on the wavefunction

$$\psi(x,t) = 3x^2 e^{-i\omega t}.$$

     Obtain the result.
(ii) Show that $sin(x)$ is not an eigenfunction of the operator $\frac{d}{dx}$, but is an eigen-
     function of $\frac{d^2}{dx^2}$

Q2 A Attempt any one   10
(i) Find the ground state energy of an electron confined to move in a three
     dimensional cubic infinite potential well of side 1 nm.
(ii) Set up the Schrödinger's equation for an infinite potential well in one dimen-
     sion, write its general solution and using the boundary condition show that
     the energy is quantised.

[P.T.O.]

(iii) Consider the finite potential step in which $U(x) = 0$ for $x < 0$ and $U(x) = V_0$ for $x \geq 0$. For the case $E > V_0$, the wave function in the region I ($x < 0$) is given by $\psi_I(x) = Ae^{ikx} + Be^{-ikx}$ and in region II ($x > 0$) $\psi_{II}(x) = ce^{ik'x}$ where $k = \sqrt{2mE\hbar^{-2}}$ and $k' = \sqrt{2m(E - V_0)\hbar^{-2}}$. Apply the boundary conditions and obtain the coefficient of reflection and hence the coefficient of transmission.

B   Attempt any one   5

(i) Sketch the solutions of the Schrödinger's equation for a finitely deep potential well when the energy of the particle is less than V_0 and also greater than V_0 where V_0 is the depth of the potential well (potential inside the well is taken as 0).

(ii) Find the degeneracy of a state of the three dimensional cubic potential box having energy $\frac{14\pi\hbar^2}{2mL^2}$.

C   Attempt any one   5

(i) Consider a double step potential, that is, $U(x) = 0$ for $x < 0$, $U(x) = V_0$ for $0 \leq x < L$ and $U(x) = 2V_0$ for $x \geq L$. Sketch this potential. If $E = 3V_0/2$, write the Schrödinger equations in different regions and their general solutions. Also state the boundary conditions.

(ii) Consider a three dimensional potential well which has different sides (not cubic) in different directions, say, L_x, L_y and L_z in x, y and z directions respectively. Write the Schrödinger equation and state the boundary conditions.

Q3 A   Attempt any two   10

(i) A proton with energy 1 eV is incident on a potential barrier of height 10 eV and width 1 A^0. Find the transmission coefficient.

(ii) With the help of neat diagram describe the principle behind the scanning tunnelling microscope (STM).

(iii) Sketch the first three wave functions and the corresponding probability densities of a harmonic oscillator.

B   Attempt any one   5

(i) Describe in detail how the tunnelling effect explains the decay of α-particles from radioactive nuclei.

(ii) Consider the potential barrier of width L and height V_0. Write the Schrodinger equations in three different regions and sketch the solutions.

C   Attempt any one   5

(i) Consider a potential defined as follows. $U(x) = 0$ for $x < 0$ and $x > 2L$, $U(x) = V_0$ for $0 \leq x < L$ and $U(x) = 2V_0$ for $L \leq x \leq 2L$. Sketch this potential and write down the Schrödinger equations in different regions for $E < V_0$. Also sketch the solutions in different regions.

(ii) Consider a potential defined as follows. $U(x) = 0$ for $x < 0$, $U(x) = 2V_0$ for $0 \leq x < L$ and $U(x) = V_0$ for $x \geq L$. For $E > V_0$, write down the Schrödinger equations in different regions and state the boundary conditions.

All the Best!

DAY: FRIDAY   TIME: 11:00 am TO 1:00pm
DATE: 17/05/2019   MAX MARKS: 60

N.B.   1. Attempt all questions.
       2. Figures to the right indicate full marks.
       3. Use of log tables or non-programmable calculator is allowed.

Q1.   Answer any three of the following.   [15]

A   a) Show the following in cubic crystal
       i) Axis of symmetry
       ii) plane of symmetry
       iii) centre of symmetry
       b) What is interplanar spacing in crystallography? Write the
          formula for calculation of interplanar spacing for different planes
          in simple cubic lattice in terms of Miller indices and edge length.
B   a) Draw simple cubic structure and calculate the number of atoms per
          unit cell.
       b) The first order diffraction peaks for (100), (110) and (111)
          planes of a substance are observed at $13°24'$, $9°32'$ and $23°50'$
          respectively. Identify the type of cubic crystal lattice.
C   a) Define catalyst support with a suitable examples.
       b) Calculate the density of crystalline substance (in $Kg.m^{-3}$) crystallizing
          in FCC having atomic mass 195.09×10^{-3} $Kg.mol^{-1}$. It has edge
          length(a) 392.36 pm. Given- Avogadro's number 6.023×10^{23}.
D   a) Enzyme catalysis belongs to which type of catalysis?
       b) Derive the formula of "Mishaelis constant" in enzyme catalytic
          reaction.
E   Derive the kinetics of acid catalyzed reaction
$$HA + S \underset{k_1}{\overset{k_{-1}}{\leftrightarrows}} [SH] + A^- \overset{k_2}{\rightarrow} P + HA$$
       What is the effect of pH on rate of this reaction? Show from rate law.

Q.2.   Answer any three of the following.   [15]

A.   Explain in detail, the hydration and hydrolysis of mono atomic anion
       in aqueous medium.
B.   Explain how are monoatomic cations classified on the basis of their
       acidity, giving examples. Also give the predominanace diagram for
       each type.
C.   Give the hydrolysis reactions of chromium ion in aqueous medium
       and explain them with their predominance diagram.

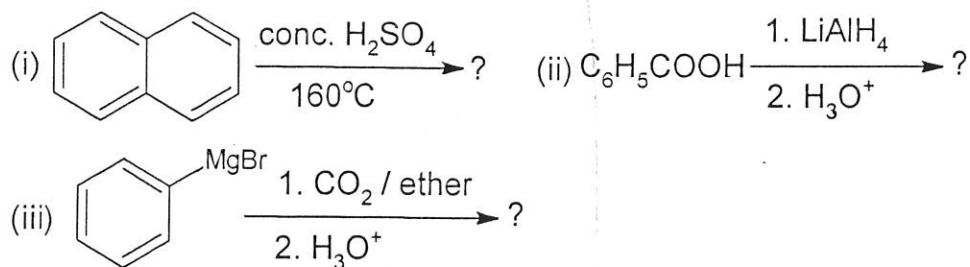   [P.T.O.]

D.   Mention any five uses of nitric acid.

E.   Write any five physical properties of oxy acid of sulphur.

Q.3.   Answer **any three** of the following.   [15]

A.   What is Dieckmann condensation reaction? Give one example and discuss its mechanism.

B.   What is sulfonation? Write different sulfonating agents. Give the mechanism of sulfonation of benzene using suitable sulfonating agent.

C.   Write one method of preparation of benzoic acid and give the action of following reagents on it.
     i) SO_2 ii) soda lime / heat   iii) $NaHCO_3$

D.   a) Give the preparation of ethylbenzene sulfonate
     b) How will you convert sodium benzoate to ethyl benzoate.

E.   a) Explain why p-toluic acid is weaker than benzoic acid.
     b) Give the mechanism of HVZ reaction of α-halogenation of carboxylic acids.

Q4.   Answer **any five** of the following.   [15]

a)   Explain heterogeneous catalytic reactions with suitable examples.

b)   Which radiations are used instead of visible radiations for structure determination of solids by diffraction technique? Explain.

c)   What are nanocatalysts? Give their any two applications.

d)   What is hydration energy? How is it calculated for monoatomic anions in aqueous medium.?

e)   Mention any three oxy acids of phosphorus with their chemical formula and give the oxidation number of phosphorus in those oxy acids.

f)   Draw the predominance diagram for moderately basic and strongly basic anions.

g)   What is ipso substitution? Explain with suitable example.

h)   How will you convert
     (i) benzoyl chloride to benzoic anhydride
     (ii) ortho-xylene to phthalic acid

i)   Complete the following reactions.

(i) [naphthalene] $\xrightarrow[160°C]{\text{conc. } H_2SO_4}$?   (ii) $C_6H_5COOH \xrightarrow[2.\ H_3O^+]{1.\ LiAlH_4}$?

(iii) [benzene-MgBr] $\xrightarrow[2.\ H_3O^+]{1.\ CO_2\ /\ ether}$?

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DAY: FRIDAY   TIME: 11:00 am TO 1:00pm
DATE: 17/05/2019   MAX MARKS: 60

N.B. All questions are compulsory.

Q1   Attempt any two sub questions :-

a.   In one way classification, write mathematical model and assumptions. Also verify,   (10)

   i) $E(S_{Tr}^2) = \sum_{i=1}^{k} n_i a_i^2 + (K - 1) \sigma^2$

   ii) $E(S_T^2) = \sum_{i=1}^{k} n_i a_i^2 + (N - 1) \sigma^2$

b.   Show that for one way classification, in usual notations,   (10)

   i) $E(\hat{\mu}) = \mu$ ii) $V(\hat{\mu}) = \frac{\sigma^2}{N}$ iii) $E(\hat{a_i}) = a_i$ iv) $V(\hat{a_i}) = \frac{\sigma^2}{n_i}$

c.   Stating clearly the mathematical model and assumptions in two way classification. derive the formulae for the least square estimates of the parameters μ, a and β, in terms of sample observations.   (10)

Q2   Attempt any two sub questions :-

a.   Describe three basic principles of designs of experiments. Name the different designs of experiments you know. When do we use these designs? Which are the basic principles of designs of experiments followed in these designs?   (10)

b.   Describe completely randomised design in usual notations. Explain its layout using suitable example. Also explain its advantages and disadvantages.   (10)

c.   Explain randomized block design with m treatments. Give its layout and complete analysis using ANOVA table.   (10)

Q3   Attempt any two sub questions :-

a.   Obtain an estimate of a missing observation in latin square design. Further explain the adjustment in degrees of freedom in Analysis of variance table in the same.   (10)

b.   Describe the factorial experiment. State the formulae for factorial effect totals [A], [B] and [AB] in terms of treatment combination totals and present a detailed ANOVA table for 2^2 factorial experiment to test the relevant hypotheses.   (10)

c.   In 2^3 factorial experiment, obtain four possible simple effects of A and using them, derive formulae for main effects of A, interaction effect AB and interaction effect ABC.   (10)

RAMNIRANJAN JHUNJHUNWALA COLLEGE (AUTONOMOUS) GHATKOPAR – 86
SYBSc ADDITIONAL CUM SUPPLEMENTARY EXAMINATION MAY 2019
SEM IV   SUBJECT: ZOOLOGY II

DAY: FRIDAY   TIME: 11:00 am TO 1:00pm
DATE: 17/05/2019   MAX MARKS: 60

NOTE: 1. All questions are compulsory and carry equal marks.
2. Figures to the right indicate full marks.
3. Draw neat and labeled diagram wherever necessary.

Q.1 Answer of the following.

a) Describe β- oxidation of fatty acids.   (08)

b) Give a brief account of protein metabolism.   (07)
                OR

a) Describe the process of digestion of lipids.   (05)

b) Draw a labelled diagram of urea cycle and add a note on its regulation. (05)

c) Write a note on Diabetic ketoacidosis.   (05)

Q.2 Answer of the following.

a) Describe the Genic Balance theory of sex determination in *Drosophila.* (08)

b) With an appropriate example, explain X-linked inheritance in man.   (07)

                OR

a) Write a note on parthenogenesis.   (05)

b) Describe the Lyon hypothesis.   (05)

c) Write a note on lampbrush chromosome.   (05)

P. T. O.

Q.3 Answer the following.

    a) Explain the theory of chemical evolution.   (08)

    b) Give an account of Miller-Urey experiment   (07)

                  OR

    a) Explain the concept of ecological niche.   (05)

    b) Explain the concept and limitations of natural selection theory.   (05)

    c) Write a note on Mesozoic era.   (05)

Q.5 Write notes on

    a) Transamination   (05)

                  OR

    a) Triacylglycerol   (05)

    b) Z-linked inheritance.   (05)

                  OR

    b) Sex determination in Bonellia.   (05)

    c) Lamarckism   (05)

                  OR

    c) Reproductive isolation   (05)

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DAY: MONDAY   TIME: 11:00 am TO 1:00pm

DATE: 20/05/2019   MAX MARKS: 60

N.B.

1) All questions are compulsory.

2) Figures to the right indicate full marks

3) Use of log table or non- programmable calculators is allowed.

Q.1. Answer any three questions of the following.   **(15)**

A. What is chromatography? Discuss the classification of chromatographic methods on the basis of phases involved.

B. An ore of Mn was analysed for its Mn content. It was found to be 9.56 % as the mean for a set of 4 observations with the standard deviation $\pm$ 0.12. Calculate the confidence interval around themean at 95 % probability level. (t = 3.182)

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

D. Explain Q test and 4 d rule used for rejection of doubtful result.

E. Explain the different methods used for locating the separated components inpaper chromatography.

Q.2. Answer any three questions of the following.   **(15)**

A. Explain the principle of conductometric titration with suitable example.

B. 100 cm^3 of an aqueous solution is extracted twice with 40 cm^3 portions of an organic phase. If the percentage extraction is 99%, calculate the value of distribution ratio in favour of organic phase.

C. Lanthanum is extracted from 100 cm^3 of an aqueous solution which contains 0.01 mole of lanthanum. Three extractions are to be carried out. Calculate the minimum volume of solvent required per single extraction so as to reduce the concentration of lanthanum in the aqueous phase to 10^{-5} mole. Given $D_{O/W}$= 370.

D. Discuss following graphical methods for detection of equivalence point in potentiometric titration.

    i.   E Vs V, and

    ii. $\Delta E/\Delta V$ Vs V

E. Mention any two factors to be considered for selection of solvent in the solvent extraction. Derive a mathematical expression for percentage extraction for single step extraction in the method of solvent extraction.

P.T.O.

Q.3. Answer any three questions of the following. (15)

A. Discuss the different methods used for concentration of ores.

B. What is hydrometallurgy ? Explain the operations involved in hydrometallurgy.

C. With reference to pyrometallurgy of copper , write a note on :

(i) Smelting and (ii) Refining.

D. Discuss different sources and toxic effects of hydrocarbons as an air pollutant.

E. Give the different sources and their consequences of following air pollutants:

i) Oxides of nitrogen and ii) Oxides of carbon.

Q.4 Answer any five questions of the following. (15)

a. Explain the criteria used for the selection of solvent system in paper chromatography.

b. Explain the criteria used for qualitative analysis w.r.t. thin layer chromatography.

c. In the analysis of a sample for its lead content, the following values were reported 4.6, 4.7, 4.5 and 4.9. On the basis of 2.5 d rule and 4 d rule, find whether the value 4.9 can berejected or retained.

d. Explain reference electrode and indicator electrode, giving one example of each, w.r.t. potentiometric titration.

e. Mention any three advantages of conductometric titrations.

f. Discuss the nature of conductometric titration curve for the titration of acetic acid against sodium hydroxide.

g. Discuss in brief carbon credit.

h. Write a note on "Bhopal gas tragedy".

i. Explain the term "carbon offsetting" .

DAY: MONDAY   TIME: 11:00 am TO 1:00pm

DATE: 20/05/2019   MAX MARKS: 60

Instructions: 1. All questions are compulsory.

2. Figures to the right indicate full marks of the question.

3. Use of a scientific calculator is allowed.

Q.1. A)   Attempt any one.   [08]

(i) Let $M(x,y)$ and $N(x,y)$ be two real valued C^1 functions on $\mathbb{R}^2$. Prove that $Mdx + Ndy = 0$ is an exact differential equation iff $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$.

(ii) State existence-uniqueness theorem for the first order ordinary differential equations. Show that $\frac{dy}{dx} = 3x + \sin y$ where $(x,y) \in [-1, 1] \times \mathbb{R}$ with the initial condition $y(0) = 1$, has unique solution. Also give an example of a differential equation with an initial condition such that it has more than one solution. Does it contradict the existence-uniqueness theorem? Justify your answer.

Q.1. B)   Attempt any two.   [12]

(i) Solve: $(x^4 + y^4)dx - xy^3 dy = 0$.

(ii) Solve: $\frac{dy}{dx} = \frac{3x+y-7}{6x+2y+9}$.

(iii) A 12-volt battery is connected to a series circuit in which the inductance is 0.5H and the resistance is 10 ohms. Determine the current i after 10 seconds if the initial current is zero. Also determine the current as time tends to infinity.

(iv) The population of a town grows at a rate proportional to the population present at time t. The initial population of 500 increases by 15% in 10 years. What will be the population in 30 years? How fast is the population growing at t = 30?

Q.2. A)   Attempt any one.   [08]

(i) (a) Prove that solution set of $y'' + P(x)y' + Q(x)y = 0$ on $[a, b]$ forms a subspace of $C[a, b]$.
    (b) If y_1 and y_2 are solutions of $y'' + P(x)y' + Q(x)y = 0$ on $[a, b]$ then prove that the Wronskian $W(y_1, y_2)$ is either identically zero or never zero on $[a, b]$

(ii) Let y_1 be a nonzero solution of $y'' + P(x)y' + Q(x)y = 0$ on $[a, b]$. Find another linearly independent solution of the differential equation.

Q.2. B) Attempt any two. [12]

(i) Define linearly independent functions and show that 1, $\log x$, and $\log(1+x)$ are linearly independent on $(0, \infty)$.

(ii) Solve: $y'' - 5y' + 6y = 0$ with initial conditions $y(1) = e^2, y'(1) = 3e^2$.

(iii) Solve: $y^{(4)} + 12y'' + 27y = 0$.

(iv) Solve Cauchy-Euler equation: $4x^2 y'' + 8xy' + y = 0$.

Q.3. A) Attempt any one. [08]

(i) Let y be a nontrivial solution of $y'' + P(x)y' + Q(x)y = 0$ on an interval $[a, b]$ then prove that the number of zeros of y in $[a, b]$ is finite. Also prove that if $y(x) = 0$ for some x in $[a, b]$ then $y'(x) \neq 0$.

(ii) State and prove the Sturm Comparison Theorem.

Q.3. B) Attempt any two. [12]

(i) Using the method of undetermined coefficients, solve: $y'' + 3y' + 2y = x + e^{-x}$.

(ii) Using the method of variation of parameters, solve: $4y'' + 36y = \operatorname{cosec}(3x)$.

(iii) Prove that any nontrivial solution of Bessel's equation has infinitely many zeros on the positive X-axis.

(iv) Prove that a standard form, $y'' + P(x)y' + Q(x)y = 0$, is oscillatory iff its normal form is oscillatory.

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DAY: MONDAY   TIME: 11:00 am TO 1:00pm

DATE: 20/05/2019   MAX MARKS: 60

N.B.: 1) All questions are compulsory.
      2) Draw neat and labelled diagrams wherever necessary.
      3) All questions carry equal marks.

Q.1) Answer any TWO Of the following.   (15)
    a. Give a concise account of different components of plant tissue culture medum
    b. With reference to plant tissue culture explain i) meristem ii) pollen culture
    c. What are restriction endonucleases? Explain the functioning of the same
    d. What are vectors? Explain the construction of pUC18 vector

Q.2) Answer any TWO Of the following.   (15)
    a. Define horticulture. With respect to horticulture explain Ornamental horticulture and Nursery.
    b. Define Garden. With respect to its location explain edges. Add a note on suitable plants for edges.
    c. Explain the following garden features, a) Arches and Pergolas b) Topiary.
    d. With respect to horticulture explain focal point.

Q.3) Answer any TWO Of the following.   (15)
    a. The rainfall and wheat production for different farms under an agricultural institute is as given in the table-

Rainfall (in cms)	40	20	32	35	40	45	43	30	25	50
Wheat Production (in Quintal)	120	120	145	150	100	120	120	135	130	140

Find the coefficient of correlation and Comment on the results.

    b. In pea seeds, yellow colour is dominant over green colour. In a cross between yellow seeded and green seeded plants, F_2 generation segregated into the following types-

Yellow seed	4400
Green seed	1624

Does the data fit the Mendelian's typical ratio of 3:1?
Given tabulated X^2 =3.84 at DOF 1 and 5% significance.

    c. What are software tools? Highlight the various software tools used in bioinformatics related to biotechnology.

P.T.O.

d. Define correlation? Enlist different methods to study correlation. What are the steps involved in calculating coefficient of correlation?

Q.4) Write short notes on any <u>THREE</u> Of the following. (15)
   a. Wet sterilization
   b. Ti plasmid
   c. Hedges
   d. Objectives of horticulture
   e. Critical Acceptance/Rejection region and Level of significance.
   f. www and its different components.

·········· *Best of Luck* ··········

DAY: TUESDAY   TIME: 11:00 am TO 1:00pm

DATE: 21/05/2019   MAX MARKS: 60

N.B.

- All questions are compulsory.
- Figures to the right indicate full marks.
- Symbols have usual meaning unless otherwise stated.
- Draw a neat diagram wherever necessary.
- Use of log table or non-programmable calculator is allowed.

Q.1   Attempt any Four of the following   20 M

i   Carry out the following subtraction using binary number system

$$(CO)_{16} - (7A)_{16}$$

ii   Explain the working of JK flip-flop with neat diagram. Give its truth table and logic symbol?

iii   Write a short note on register and it types?

iv   Explain construction of binary mod-5 counter with diagram, truth table and waveforms?

v   Explain the operation of clocked RS flip-flop with neat diagram. Give its truth table and logic symbol.

vi   Explain operation of asynchronous 3 bit counter waveform and truth table.

Q.2   A   Attempt any Four of the following   20 M

i   Explain the elements of communication system, in short, with the help of its block diagram.

ii   Discuss the various types of internal noise sources in receivers.

iii   Draw and explain diagram to generate PAM and PWM waveforms.

iv   A modulating signal $15 \, Sin(2\pi \times 10^4 t)$ is used to modulate a carrier signal $30 Sin (2\pi \times 10^5 t)$. Find the modulation index, frequencies of the side band components and their amplitudes. What is the bandwidth of the modulated signal.

Also draw the spectrum of AM wave.

v   Explain with diagram ASK and FSK, the digital modulation techniques.

vi Explain elementary Hertzian antenna with its antenna radiation pattern. Define dipole antenna directive gain.

Q.3 A   Attempt any Four of the following   20 M
i   What is the difference between Geophysics and Geology?

ii   Explain the method of Annular Rock Layering to determine the age of the Earth

iii What is gravity anomaly?

iv   What is Earth's magnetic field? With the help of neat diagram, explain the angle of magnetic inclination.

v   What is Seismology? What are seismic waves and their types?
     Explain body waves.

vi   Explain formation of our Solar system using Laplace's Nebula theory.

******Best of Luck******

DAY: TUESDAY   TIME: 11:00 am TO 1:00pm
DATE: 21/05/2019   MAX MARKS: 60

N . B . --   1) All questions are compulsory .
             2) Attempt any TWO sub-questions from each question .
             3) Figures to the right indicate marks .

Q. 1.   a)   i) Define the terms ---- Total float , Free float , Independent float .   10
             ii) Define the terms ---- An activity , An event .

        b)   Draw the network , identify the critical path and calculate free float   10
             and independent float for the following data -----

             Activity ---- 1 – 2   1 – 3   1 – 4   2 – 5   2 - 6   3 – 6   4 – 7   5 – 7   6 - 7
             Time   ----   8   20   33   18   20   9   10   8   4 .

        c)   Draw the network , calculate expected time and variance of each   10
             activity and identify the critical path for the following data -----

Activity	10-20	10-30	20-40	20-50	30-70	40-60	50-60	60-80	70-80
t_O	5	2	7	3	4	6	4	2	5
t_M	8	6	13	6	10	12	7	5	20
t_P	17	16	31	9	28	18	16	8	29 .

Q. 2.   a)   i) Define --- Pure and Mixed strategy , Two Person Zero Sum game ,   10
             Saddle point , Value of the game .
             ii) Explain the principle of dominance used in Game theory .

        b)   For a 2 x 2 game problem without saddle point , derive the   10
             expressions for the optimum strategies for players A and B . Also
             obtain an expression for the value of the game .

P.T.O.

c) i) Solve the following game problem whose pay-off matrix is as follows: 10

player B

player A	2	-5	0	7
	6	5	4	8
	0	4	2	-3

ii) Solve the following game problem graphically ----

player B

Player A	- 2	5
	- 5	3
	0	- 2
	- 3	0
	1	- 4

Q. 3. a) Explain the following terms used in decision theory :   10
Decision maker , Course of action , States of Nature , Pay – off table ,
Regret table , EMV , EOL .

b) A certain output is manufactured at Rs. 80 and sold at Rs. 100 per   10
unit. The product, if it is produced but not sold is worthless. The
daily sales records in the past are as follows -----

Sales per day -----	30	40	50	60
Probability -----	0.2	0.3	0.4	0.1

Find the optimum sales per day. Also calculate EVPI.

c) For the following pay-off matrix, obtain best decision using   10
(i) Max-Min (ii) Max-Max (iii) Laplace (iv) Hurwicz ($\alpha = 0.6$) and
(v) Min-Max Regret criterion.

course of action

Event	A_1	A_2	A_3	A_4
S_1	15	3	1	7
S_2	10	14	5	19
S_3	0	8	14	10 .

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DAY: TUESDAY   TIME: 11:00 am TO 1:00pm

DATE: 21/05/2019   MAX MARKS: 60

N.B.

1) All questions are compulsory.

2) Figures to the right indicate full marks

3) Use of log table or non- programmable calculators is allowed.

Q.1. Answer any three questions of the following.   **(15)**

A. Name the various tests used for rejection of doubtful result. Explain any two of them.

B. Two independent methods were employed to analyze the sample for its calcium content. The results were as follows:

Method I	Method II
% of Ca	% of Ca
7.84	7.55
8.01	7.59
7.88	7.32

The combined standard deviation was 0.031. Determine whether the two methods differ statistically or only numerically? (Given: t_{table}= 2.78 at 95% probability level)

C. Explain the classification of chromatographic methods based on phases involved, giving examples of each type.

D. Write a note on " Gaussian distribution curve"

E. What are the applications of TLC?

Q.2. Answer any three questions of the following.   **(15)**

A. Discuss following graphical methods of determination of equivalence point in the potentiometric titration :

i) $\Delta^2 E/\Delta^2 V$ against V , and

ii) E against V

B. The distribution ratio is 8 in favour of organic solvent, in certain solvent extraction system. Calculate the percentage extraction for single extraction, using a volume ratio V_O/V_w of :

i) 1, and ii) 5

C. 100 cm^3 of an aqueous phase containing 0.05 mole of Fe^{2+} is to be equilibrated with 10 cm^3 portions of ether. Calculate how many extractions are necessary so as to bring the concentration of Fe^{2+} in the aqueous phase to 10^{-6} mole. Given D=17.6.

P.T.O.

D. Discuss the nature of conductometric titration curve in the titration of:
   i) CH_3COOH against $NaOH$, and
   ii) CH_3COOH against NH_4OH
E. Discuss continuous solvent extraction method, for extractant heavier than water, with a neat labelled diagram.

Q.3. Answer any three questions of the following. (15)
   A. What is metallurgy? Explain the terms i) Calcination and ii) Roasting?
   B. Explain the term flux. Discuss the smelting of copper ore.
   C. What is anode effect ? Write the electrode reactions during electrolysis of alumina.
   D. Discuss the different methods used for concentration of ores.
   E. What is toxicology? Discuss following air pollutants:
      i. Oxides of sulphur. and ii. Oxides of nitrogen.

Q.4. Answer any five questions of the following. (15)
   a. Mention different techniquesof development w.r.t. paper chromatography. Explain any one, in brief.
   b. What are the advantages of TLC over paper chromatography?
   c. Following are the results obtained for the spectrophotometric determination of sodium. Using the method of averages, obtain the equation of best fitting line in the form $y = mx$.

Concentration of Na in ppm	0.2	0.4	0.6	1.0
Absorbance	0.15	0.32	0.43	0.78

   d. Mention any three advantages of potentiometric titrations.
   e. Discuss principle of conductometric titrations.
   f. Mention any three limitations of conductometric titration.
   g. Discuss in brief carbon offsetting.
   h. What do you mean by carbon foot print? How does buying carbon credit reduce pollution?
   i. Write a note on "Bhopal gas tragedy".

DAY: TUESDAY   TIME: 11:00 am TO 1:00pm
DATE: 21/05/2019   MAX MARKS: 60

NOTE: 1. All question are compulsory and carry equal marks.
2. Figures to the right indicate full marks
3. Draw neat and labeled diagram wherever necessary.

Q.1 Attempt the following   15M
a. Describe life cycle of *Leshmania donovani* .   8M
b. Discuss parasitic adaptations in endoparasites.   7M
                        OR
Q.1 Attempt the following   15M
˙. Give a brief account on pathogenicity of *Wuchereria bancrofti*. 5M
b. Describe the different types of hosts.   5M
c. With the help of a flow chart explain life cycle of *Entamoeba histolytica.* 5M

Q2. Answer the following.   15M
a. Give an account of composition of milk.   8M
b. Describe characteristics of normal and abnormal egg.   7M
                        OR
Q2. Answer the following.   15M
a. Give an account of artificial hatching.   5M
b. Explain clarification and homogenization of milk.   5M
c. Give an account of milch breeds of cattle.   5M

Q3. Answer the following.   15M
a. What is imprinting? Discuss its types with suitable examples.   8M
b. Give an account on chemical communication in animals.   7M
                        OR
Q.3 Describe the following: 15M
a. Innate releasing mechanism.   5M
b. Auditory communication.   5M
c. Significance of instincts.   5M

Q4. Write short notes on.   15M
a. Cysticercosis
                        OR
a. Pathogenicity, control measures and treatment in *Fasciola hepatica* infection

b. Murrah buffalo
                        OR
b. Leghorn

c. Waggle dance in bees.
                        OR
c. Displacement behaviour
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