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V Semester B.Sc. (NEP) Degree Examination, December/January - 2024-25

MATHEMATICS

Vector Calculus and Analytical Geometry

Paper : II (DSC)

(Regular/Repeater)

Time : 2 Hours **Maximum Marks : 60**

Instructions to Candidates :

1. Answer any **Six** questions from Q.No.**1**.
2. Answer any **Three** questions from Q.No's **2,3,4,** and **5**.

Answer any **Six** of the following questions. **(6×2=12)**

1. a) Find the unit tangent vector to the curve

$\bar{r} = (\cos 2t)i + (\sin 2t)j + tk$

b) Find *grad* ϕ if $\phi = x^2yz^2$ at $(-1,2,3)$

c) If $\bar{f} = x^2zi - 2y^3z^2j + xy^2zk$ find *divf at* $(1,-1,1)$.

d) State Stoke's theorem.

e) Show that the planes $2x - 4y + 3z = 0$ *and* $10x + 11y + 8z - 17 = 0$ are perpendicular.

f) Find the equation of sphere whose centre is $(3,2,-1)$ and radius is 2 units.

g) Define cone and write the general equation of cone.

h) Find the equation of cylinder whose generators intersect the curve $ax^2 + by^2 = 2z, lx + my = p$

Answer any **Three** of the following questions. **(3×4=12)**

2. a) Find the binormal vector for $\bar{r}(t) = ti + (3\sin t)j + (3\cos t)k$.

b) Find the directional derivative of $\phi = x^2yz + 4xz^2$ at $(1,-2,-1)$ along 2i-j-2k.

c) Prove that $div(A + B) = divA + divB$.

d) If ϕ is a scalar field then prove that $curl(grad\phi) = 0$

P.T.O.

Answer any **Three** of the following questions. **(3×4=12)**

3. a) If $f=(5xy-6x^2)i+(2y-4x)j$, Evaluate $\int_C f.dr$, where C is the curve $y=x^3$ from the point (1,1) to the point (2,8).

   b) Evaluate $\iint_S (yzi+zxj+xy).n\,ds$, where S is the surface of the Sphere $x^2+y^2+z^2=a^2$ in the first octant.

   c) State and prove Green's theorem.

   d) If $\vec{F}=2xzi-xj+y^2k$ Evaluate $\int_V \vec{F}dV$, where V if the Volume of the region bounded by the surface $x=0$, & $x=2$, $y=0$ & $y=6$, $z=x^2$ & $z=4$.

Answer any Three of the following questions. **(3×4=12)**

4. a) Find the equation of the plane through the intersection of the planes $2x-y=0$ and $3z-y=0$ and perpendicular to the plane $4x+5y-3z=8$.

   b) Find the equation of the plane which bisects the acute angle between the planes $2x-y+2z+3=0$ and $3x-2y+6z+8=0$.

   c) Find the equation of the sphere through the points $(0,0,0),(a,0,0),(0,b,0)$ *and* $(0,0,c)$.

   d) Derive the condition of orthogonality of two spheres $x^2+y^2+z^2+2u_1x+2v_1y+2w_1z+d_1=0$ and $x^2+y^2+z^2+2u_2x+2v_2y+2w_2z+d_2=0$

Answer any **Three** of the following questions. **(3×4=12)**

5. a) Find the equation to the cone with vertex at the origin which passes through the curve $x^2+y^2+z^2-x-1=0$ and $x^2+y^2+z^2+y-2=0$.

   b) Find the equation of the cone with vertex at $(0,0,0)$ and passing through the circle given by $x^2+y^2+z^2+x-2y+3z-4=0$, $x-y+z=2$.

   c) Find the equation of the cylinder whose generators are parallel to the line $\frac{x}{1}=\frac{y}{2}=\frac{z}{3}$ and passes through the curve $x^2+y^2=16$, $z=0$.

   d) Find the equation of the quadratic cylinder whose generators intersect the curve $ax^2+by^2+cz^2=1$, $lx+my+nz=p$.

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V Semester B.Sc. 6 (NEP) Degree Examination, December/January - 2024-2025

MATHEMATICS

Real Analysis - II and Complex Analysis

Paper : I

(Regular/Repeater)

Time : 2 Hours **Maximum Marks : 60**

Instructions to Candidates :

1) Answer **any Six** questions from Q.No.1
2) Answer **any Three** questions from Q.No's 2,3,4, and 5

Answer any Six of the following. **(6×2=12)**

1. a) Define upper and Lower sums.

b) Find $U(p,f)$ & $L(p,f)$ for the function $f(x)=x\ in[0,1]$ and Partition $P=\left\{0,\frac{1}{3},\frac{2}{3},1\right\}$

c) State Fundamental theorem of integral Calculus.

d) Evaluate $\int_0^1 x^8(1-x)^7\,dx$.

e) Define analytic function.

f) Prove that $\int_C \frac{dz}{z-a}=2\pi i$, where C is a circle.

g) State Cauchy's inequality.

h) Define bilinear transformation.

Answer any Three of the following. **(3×4=12)**

2. a) State and prove the necessary and sufficient condition for integrability of bounded function.

b) Let $f,g:[a,b]\to R$ are bounded functions and R-integrable over $[a,b]$, $f(x)\le g(x)$ then prove that $\int_a^b f(x)\,dx\le\int_a^b g(x)\,dx$.

P.T.O.

c) Show that $f(x) = 2x+1$ is integrable on $[1,2]$ and $\int_1^2 (2x+1)dx = 4$.

d) Using Mean Value theorem, prove that $\frac{\pi^2}{9} \le \int_{\pi/6}^{\pi/2} \frac{x}{\sin x} dx \le \frac{2\pi^2}{9}$.

Answer any Three of the following. **(3×4=12)**

3. a) State and Prove Dirichlet's test for the convergence of the integral of a product of two functions.

b) Examine the convergence of $\int_0^\infty e^{-ax} \cdot \cos bx \, dx$.

c) Prove that $B(m,n) = \int_0^1 \frac{x^{m-1} + x^{n-1}}{(1+x)^{m+n}} dx$.

d) Prove that $\int_0^\infty x^2 e^{-x^4} dx . \int_0^\infty e^{-x^4} dx = \frac{\pi}{8\sqrt{2}}$

Answer any Three of the following. **(3×4=12)**

4. a) State and prove necessary condition for Cauchy's -Reimann equations.

b) Prove that an analytic function with constant modulus is constant.

c) Prove that $3x^2y + 2x^2 - y^3 - 2y^2$ is harmonic. Find the harmonic conjugate.

d) If $f(z) = u + iv$ is analytic and $u - v = e^x(\cos y - \sin y)$ then find $f(z)$ in terms of z.

Answer any Three of the following. **(3×4=12)**

5. a) State and Prove Cauchy's Integral theorem.

b) Evaluate $\int_C \frac{z}{(z^2+1)(z^2-9)} dz$, where C is the circle $|z| = 2$.

c) Prove that a bilinear transformation preserves the cross-ratio of four points.

d) Find the bilinear transformation which maps z=0,i,-1 onto w=i,1,0 respectively.

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V Semester B.Sc.6 (NEP) Degree Examination, December/January - 2024-25

PHYSICS (OPTIONAL)

Elements of Atomic, Molecular and Laser Physics

Paper : II

(Regular)

Time : 2 Hours **Maximum Marks : 60**

Instructions to Candidates :

1. Calculators may be allowed for solving problems.
2. Write intermediate steps.

Answer any Six of the following questions. **(6×2=12)**

1. a) Who discovered the nucleus?

b) Mention an important outcome of Rutherford's alpha Patrick scattering experiment.

c) What is stark effect?

d) Calculate Lande's 'g' factor for $^2P_{\frac{3}{2}}$ state.

e) Mention the types of molecules based on their moment of inertia.

f) What are stoke's and antistoke's lines.

g) Give two examples of macroscopic properties of a system.

h) Give an example of fermion.

Answer 'a' and 'b' OR 'c' and 'd' of the following questions.

2. a) Derive expression for radius of an atom using Bohr's theory of hydrogen atom.

b) Write a note an spectral series of hydrogen atom. **(8+4)**

(OR)

c) Describe Frank and Hertz experiment to determine excitation potential.

d) The wavelength of first line in Balmer series is 656.3nm . What is the wavelength of second line in Balmer series. **(8+4)**

[P.T.O.

Answer 'a'and 'b' OR 'c' and 'd' of the following questions.

3. a) Derive an expression for magnetic dipole moment of an electron due to orbital motion. Hence define gyromagnetic ratio.

   b) Explain L-S and J-J Coupling. **(8+4)**

(OR)

   c) What is Zeeman effect ? Describe the experimental arrangement to study Zeeman effect.

   d) Calculate Zeeman shift observed in normal Zeeman effect when a spectral line of wavelength 5600 Angstrom is subjected to magnetic field of 0.8 T.

   Given : $\frac{e}{m} = 1.76 \times 10^{11}$ ekg^{-1} **(8+4)**

Answer 'a' and 'b' OR 'c' and 'd' of the following questions.

4. a) Explain the theory of a vibrating molecule as a simple harmonic oscillator. Draw the energy level diagram.

   b) The force constant of the bond in CO molecule 187Nm^{-1}. Its reduced mass is 1.14×10^{-26} kg. Compute the frequency of vibration of CO molecule and spacing between its vibrational energy levels (Given: h = 6.63×10^{-34} Js) **(8+4)**

(OR)

   c) With a neat diagram,explain the construction and working of a Ruby laser.

   d) Explain the processes (i) Absorption (ii) Spontaneous emission (iii) Stimulated emission. **(8+4)**

Answer 'a' and 'b' OR 'c' and 'd' of the following questions.

5. a) Derive an expression for Maxwell-Boltzmann distribution function.

   b) Explain different types of ensemble with the help of a neat diagrams. **(8+4)**

(OR)

   c) Differentiate between Maxwell - Boltzmann , Fermi - Dirac and Bose-Einstein Statistics.

   d) Define thermo dynamic probability. Give the expression for thermo dynamic Probability for distinguishable Patrick and explain the terms. **(8+4)**

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V Semester B.Sc. (NEP) Degree Examination, December/January - 2024-25

CHEMISTRY(DSC)

Paper : I

(Regular/Repeater)

Time : 2 Hours **Maximum Marks : 60**

Instructions to Candidates :

1. **All questions are compulsory.**
2. **Draw neat diagrams and give equations wherever necessary.**

1. Answer any Six questions. **(6×2=12)**

a) What is ligand? Give an example of polydendate ligand.

b) What are ionization isomers? Give example.

c) Write the nitration reaction of Furan and pyridine.

d) Which is more basic between pyridine and piperidine and why?

e) What is zero-point energy? Give its equation.

f) Calculate the vibrational degrees of freedom of H_2O molecule.

g) What type of polymer is Nylon 66? Mention the monomers of it.

h) What are conducting polymers? Give example.

2. Answer any Three questions. **(3×4=12)**

a) Explain the colour property of transition elements.

b) What are lanthanides? Write about the lanthanide contraction and its cause.

c) Discuss the hybridization, geometry and magnetic property of $[CoF_6]^{-3}$ ion by VBT.

d) Write the IUPAC name of following complexes.

i) $K_3[Fe(CN)_6]$

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

iii) $[Co(NH_3)_6]cl_3$

iv) $K_3[Cr(C_2O_4)_3]$

P.T.O.

3. **Answer any Three questions.** **(3×4=12)**

a) Explain the molecular orbital picture and aromaticity of Furan.

b) Discuss the constitution of coniine.

c) Give the reactions to show the following in Nicotine

i) Presence of pyridine ring with a sidechain at position-3

ii) Presence of pyrrole /pyrrole derivative

iii) N-methyl pyrrolidinering bonded to pyridine through position-2

d) What is Green Chemistry? Mention the principles of Green chemistry.

4. **Answer any Three questions.** **(3×4=12)**

a) Derive an expression for rotational energy of a rigid diatomic molecule.

b) Give the potential energy curve for bonding molecular orbital and write the characteristics of bonding molecular orbitals.

c) State Frank-Condon principle and explain it with a potential energy curve.

d) The pure rotational spectrum of HCl molecule contains a series of equally spaced lines separated by $20.8cm^{-1}$. Calculate the bond length of the molecule.

(Given $M = 1.63\times10^{-27}\ kg$, $h = 6.626\times10^{-34}\ Js$, $c = 3\times10^{10}\ cms^{-1}$)

5. **Answer any Three questions.** **(3×4=12)**

a) Write the preparation, properties and applications of polytetrafluoro ethene polymer.

b) Give the preparation, properties and application of polystyrene.

c) What are silicones? Write the differences between inorganic and organic polymers.

d) What are nanomaterials? How they are classified based on composition.

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V Semester B.Sc. (NEP) Degree Examination, December/January - 2024-25

CHEMISTRY(DSC)

Paper : II

(Regular/Repeater)

Time : 2 Hours **Maximum Marks : 60**

Instructions to Candidates :

1. All questions are compulsory.
2. Draw neat diagrams and give equations wherever necessary.

1. Answer any Six questions. **(6×2=12)**

a) What are alloys? Mention the types of alloys.

b) What are abrasives? Give examples.

c) Write the structure and a use of NBS reagent.

d) Write two requirements of a dye.

e) Mention two applications of salt bridge.

f) Give two examples of metal - insoluble salt-anion electrode.

g) What is chromophore ? Give example.

h) What is Base peak in Mass spectrometry?

2. Answer any Three questions. **(3×4=12)**

a) Explain the manufacture of glass using tank furnace.

b) Write about the following

i) Setting of cement

ii) Annealing of glass.

c) What are fuels? Write their characteristics.

d) Explain the manufacture of Biogas.

3. Answer any Three questions. **(3×4=12)**

a) Write the mechanism of aromatisation of tetralin using DDQ.

b) Discuss the mechanism of oxidation of 1,2-diol to aldehyde using lead tetra acetate.

c) What are Azodyes? Write the synthesis of Congo red.

d) What type of dye is indigo? Write its synthesis.

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4. Answer any Three questions. **(3×4=12)**

a) Write a note on weston standard cell.

b) Derive the Nernst's equation for EMF of a cell.

c) How pH of solution is determined using glass electrode?

d) Mention the type of below cell and calculate its EMF at 25°C

$$Ag \mid AgNO_3(0.01m) \parallel AgNO_3(0.1M) \mid Ag$$

5. Answer any Three questions. **(3×4=12)**

a) Explain the variation in stretching frequency of $\backslash C = O$ **IR** absorption band in organic compounds.

b) Explain in brief the types of electronic transitions.

c) Write about the following with example

i) Alexochromes

ii) Hypochromic shift

d) What is McLafferty rearrangement? Explain it with respect to hexenoic acid.

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V Semester B.Sc.6 (NEP) Degree Examination, December/January - 2024-25

PHYSICS

Classical Machanics and Quantum Mechanics - I

Paper : I

(Regular)

Time : 2 Hours **Maximum Marks : 60**

Instructions to Candidates :

1. Use calculators for calculations.
2. Write intermediate steps in solving problems.

1. Answer any SIX of the following questions. **(6×2=12)**

a) What is non inertial frame of reference? Give an example.

b) State the Principle of virtual work.

c) State the Newtonian principle of relativity.

d) What are massless particles? Give an example.

e) What is Compton effect?

f) What are De Broglie Waves? Mention expression for their Wavelenght.

g) What is normalization of a wave function?

h) What is the principle of scanning tunneling microscope?

2. Answer 'a' and 'b' OR 'c' and 'd' of the following questions.

a) Establish the relation between (i) Workdone by a force and kinetic energy (ii) Workdone and potential energy for a conservative force. Hence prove the law of conservation of energy.

b) State and prove the law of conservation of angular momentum. **(8+4)**

(OR)

c) Derive Lagrange's equation of motion from D Alembert's principle.

d) Explain the different types of Constraints. **(8+4)**

3. Answer 'a'and 'b' OR 'c' and 'd' of the following questions.

a) Derive Lorentz transformation equations.

[P.T.O.

b) How fast would a rocket has to go relative to an observer at rest for its length to be contracted to 99% of its Length at rest. (Given $c=3\times10^8\ ms^{-1}$) **(8+4)**

(OR)

c) With a neat diagram, explain relativistic Doppler effect. Obtain expression for relativistic transformation of frequency. What are transverse and Longitudinal Doppler effect.

d) What is mass energy equivalence. Derive $E = mc^2$. **(8+4)**

4. **Answer 'a' and 'b' OR 'c' and 'd' of the following questions.**

a) Derive an expression for the Compton Shift.

b) X-rays of wavelength 4 A.U.fall on electron and are scattered at an angle of 60^0 Determine the compton shift.

Given : Plank's constant $h = 6.625\times10^{-34}$ JS

Rest mass of electron $m_0 = 9.11\times10^{-31}$ Kg

Speed of light in air $c = 3\times10^8\ m\ s^{-1}$ **(8+4)**

(OR)

c) Give an illustration of Heisenberg uncertainty Principle by gamma ray microscope thought experiment.

d) Give brief explanation of G.P Thomson's experiment and its significance. **(8+4)**

5. **Answer 'a' and 'b' OR 'c' and 'd' of the following questions.**

a) Obtain an expression for time independant Schrodinger wave equation.

b) What are the Postulates of quantum mechanics. **(8+4)**

(OR)

c) Derive Schrodinger wave equation for a linear harmonic oscillator.

d) An electron is confined in a box of length 1 angstrom. Calculate the lowest energy of the system. Given :Mass of electron $=9.1\times10^{-31}$ kg, $h = 6.625\times10^{-34}$ JS. **(8+4)**
