

**Note:** Attempt all questions.

- Q.1. Explain how Orwell makes use of personal experience to comment on the human condition at large? 10

**OR**

Recapitulate Lewis's series of reasons for not believing that there is a "Law of nature" which divides the real right and wrong.

- Q.2. In "My Day" by Baker, what was Mrs. Baker's philosophy of life? How did it change in old age? 10

**OR**

Discuss Ross's statement; "Science is empirical, rational, general and cumulative; and it is all four at once."

- Q.3. Write an essay on any ONE of the following topics. 15

- (i) Blessings of Ramzan
- (ii) Social Evils
- (iii) Tourism in Pakistan
- (iv) Indo-Pak relationship, Contemporary Perspectives
- (v) Youth is a Period of Stress and Strain

- Q.4. Correct any FIVE of the following: 5

- 1. The poor is neglected.
- 2. One of the player is injured.
- 3. I am senior than him in service.
- 4. I read the same book which you purchased.
- 5. Lahore is a worth-seeing city.
- 6. He has any books.
- 7. The lion attacked at him.

- Q.5. Translate the following passage into English. 10

مسلمانوں کی تاریخ کے ایک نازک موڑ پر سر سید احمد خان نے قوم کی رہنمائی کا فریضہ سنبھالا۔ انہوں نے مسلمانوں کو جدید تعلیم سے لیس کرنے کے لئے علی گڑھ کالج کی بنیاد رکھی۔ وہ اکثر کہا کرتے تھے کہ قوم کی فلاح تعلیمی ترقی سے ہی ممکن ہے۔ کانگریس وجود میں آئی تو انہوں نے حالات کا جائزہ لے کر مسلمانوں کو مشورہ دیا کہ اس سیاسی جماعت سے الگ رہیں اور اس کے مطالبات کی تائید نہ کریں۔

**Note:** Attempt **Five** questions in all, **Section-A** is compulsory. Attempt **Four** questions from **Section-B**. Draw neat and clean diagrams where necessary. Each question carries 8 marks.

**Section-A**

- Q.1. Write short answer to the following question: 1×8
- i. Enlist five key characteristics of chordates?
  - ii. Differentiate between hagfishes and lampreys?
  - iii. What do you mean by a deme?
  - iv. What do you mean by Gymnophiona?
  - v. What is the function of Jacobson's organ in snake?
  - vi. What do you mean by deuterostome animals?
  - vii. Differentiate between homologues and analogous organs?
  - viii. Define phyletic gradualism?

**Section-B**

- Q. 2. Discuss in detail the nutrition and the digestive system in amphibians? (8)
- Q.3. A) Write a note on sarcopterygian fishes? (5)  
B) Briefly discuss the evidences that prove the common ancestry (evolutionary lineage) of hemichordates and chordates? (3)
- Q.4. A) Write a note on Class Osteichthyes? (4)  
B) Write a note on parental care in amphibians? (4)
- Q.5. Discuss in detail the theory of natural selection? (8)
- Q.6. Write a detail note on order squamata? (8)
- Q.7. Write a note on the life cycle of reptiles? Give evolutionary differences from amphibians? (8)
- Q.8. A) Explain territoriality in mammals? (4)  
B) Explain the role and mechanism of vocalizations in amphibians? (4)
- Q.9. Discuss reproduction in birds? Compare reproduction patterns and their advantages? (8)

**Subject:** Zoology  
(Animal Form & Function)

**B.A/ B.Sc Part-II**

**Time:**03Hrs.

**Paper:** IV

**Annual 2019**

**Max. Marks:**40

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**Note: Section A is compulsory. Attempt any four Questions from Section B.**

**SECTION-A**

**Q1. Write short answers of following Questions. (1×8)**

- i. What are pheromones.
- ii. What is sonar.
- iii. Define tanning
- iv. Differentiate between systolic and diastolic pressure.
- v. Give significance of dietary fiber in digestion.
- vi. Define aestivation.
- vii. Define morphogenesis.
- viii. What is nerve impulse.

**SECTION-B**

- Q.2. (a) Discuss skin of birds. (4)**  
**(b) Describe locomotion in soft bodied animals. (4)**
- Q.3. (a) Write note on vertebrate nervous system. (4)**  
**(b) Describe structure of neuron. (4)**
- Q.4. (a) Write note on phonoreceptors. (4)**  
**(b) Describe structure of human ear. (4)**
- Q.5. (a) Discuss fixed membrane receptor mechanism of hormone action. (4)**  
**(b) Give an account of adrenal gland. (4)**
- Q.6. (a) Describe types of immunities. (4)**  
**(b) Write note on blood cells in invertebrates. (4)**
- Q.7. (a) Discuss role of liver and gall bladder in digestion. (4)**  
**(b) Write note on fluid feeding. (4)**
- Q.8. (a) Describe temperature regulation in birds and mammals. (4)**  
**(b) Give an account of human female reproductive hormones. (4)**
- Q.9. (a) Discuss advantages and disadvantages of asexual reproduction. (4)**  
**(b) Write note on echinoderm embryology. (4)**
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**Note:** Attempt any five questions, three from section-A and two from section-B. Each question carries equally marks.

**Section-A**

- Q.1. a. Find equations of the asymptotes of the curve  $y = \frac{(x-2)^2}{x^2}$ .  
b. Find the relative maxima and minima of  $y$  if  $r = 1 - \cos \theta$ .
- Q.2. a. Find the radius of curvature at any point of the curve  $r^n = a^n \sin n \theta$ .  
b. Verify Euler's Theorem for  $u = \frac{\frac{1}{x^4+y^4}}{\frac{1}{x^5+y^5}}$ .
- Q.3. a. Find an equation of a tangent plane at any point  $P(x_1, y_1, z_1)$  of the elliptic paraboloid  $z = x^2 + 4y^2$ .  
b. Let  $f(x, y) = \sqrt{x^2 + y^2}$ . Find the critical point and relative extrema of  $f$ .
- Q.4. a. Find the volume generated by revolving the arc in the first quadrant bounded by the parabola  $y^2 = 8x$  and its latus rectum about the x-axis.  
b. Find the area of the surface generated by revolving  $r = 2a \sin \theta$  about the polar axis.
- Q.5. a. Evaluate the integral

$$\int_0^4 \int_{\frac{y}{2}}^2 e^{x^2} dx dy.$$

- b. Find the volume of the solid bounded by the coordinate planes and  $\sqrt{\frac{x}{a}} + \sqrt{\frac{y}{b}} + \sqrt{\frac{z}{c}} = 1$ .

**Section-B**

- Q.6. a. Derive the equation of plane in the space.  
b. Find the direction cosines of the coordinate axes.
- Q.7. a. Find the symmetric form for the line  $x + y + z + 1 = 4x + y - 2z + 2$ .  
b. Find the intercept of  $2x^2 - z^2 - xy - 8xy + y - z - 2 = 0$  on the coordinate axes.
- Q.8. a. Show that the lines given below are parallel  
 $L: x + 2y - z - 7 = y + z - 2x - 6$  and  $M: 3x + 6y - 3z - 8 = 2x - y - z$ .  
b. Show that the straight line  $\frac{x}{-1} = \frac{y+1}{2} = \frac{z-2}{-5}$  and the plane  $3x + 4y - 2z = 22$  have a unique point of intersection. Find the point of intersection.



**Note:** Attempt any five questions, two from section-A and three from section-B. Each question carry equal marks.

**Section-A**

- Q.1. a. Determine whether the series  $\sum_{n=1}^{\infty} \frac{(-1)^n n!}{(2n)!}$  absolutely converges or conditional converges.  
b. Apply the Ratio Test to determine whether the series  $\sum_{n=1}^{\infty} \frac{7^n}{n(5^{n+1})}$  converges or diverges.
- Q.2. a. Determine the value of  $x$  for which the series  $\sum_{n=1}^{\infty} \frac{nx^n}{3^n}$   
i) absolutely converges      ii) conditional converges      iii) diverges  
b. Apply Cauchy integral test to determine whether the series  $\sum_{n=1}^{\infty} \frac{\tan^{-1} n}{1+n^2}$  converges or diverges.
- Q.3. a. Use Bisection Method to find solution for  $3x - e^x = 0$ , for  $x \in [1,2]$ .  
b. Use Secant method for  $f(x) = -x^3 - \cos x, x_0 = -1, x_1 = 0$ .

**Section-B**

- Q.4. a. Use the graphical method to maximize  $z = 40x_1 + 50x_2$  subject to conditions  
 $2x_1 + 6x_2 \leq 36; 5x_1 + 3x_2 \leq 30; 8x_1 + 2x_2 \leq 40$ . Where  $x_1, x_2 \geq 0$ .  
b. Solve  $\frac{dy}{dx} = e^{2x} + y - 1$ .
- Q.5. a. Use Simplex method to find the maximum of  $z = 3x_1 + 4x_2$  subject to the constraints  
 $2.5x_1 + x_2 \leq 20; 3x_1 + 3x_2 \leq 30; x_1 + 2x_2 \leq 16$ , where  $x_1, x_2 \geq 0$ .  
b. Find the maximum value of  $z = 5x_1 + 3x_2$  subject to the constraints  
 $6x_1 + 2x_2 \leq 36; 5x_1 + 5x_2 \leq 40; 2x_1 + 4x_2 \leq 28$  where  $x_1, x_2 \geq 0$ .
- Q.6. a. Solve the differential equation  $(6xy + 2y^2 - 5)dx + (x^2 + 4xy - 6)dy = 0$ .  
b. Solve the differential equation  $\frac{dy}{dx} = \frac{y-x+1}{y-x+5}$ .
- Q.7. a. Solve:  $y(1+x)dx + x(1+y)dy = 0$ .  
b. Solve  $(D^2 + 4)y = 4 \sin^2 x$ .
- Q.8. a. Solve by the Method of U.C.  $y'' + 2y' + y = e^x \cos x$ .  
b. Find the orthogonal trajectories of the family of cardioids  $r = a(1 + \cos \theta)$ .
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**Subject:** A-Course of Mathematics  
(Infinite series, Differential Equations  
and Laplace Transforms)

**B.A / B.Sc Part-II**

**Time:** 03 Hrs.

**Paper:** III

**Annual 2019**

**Max. Marks:**50

**Note:** Attempt FIVE questions in all, TWO from Section-A and THREE from Section-B. All questions carry equal marks.

**Section-A**

**Question 1**

- (a) Examine the behavior of the series  $\sum_{n=1}^{\infty} ar^{n-1}$  for different values of  $r$ .  
(b) Use appropriate comparison test to investigate convergence or divergence of the series  $\sum_{n=1}^{\infty} \frac{2}{\sqrt{n+1}}$ .

**Question 2**

- (a) Use the Cauchy's Integral Test to find whether the series  $\sum_{n=1}^{\infty} \frac{\tan^{-1}n}{n^2+1}$  converges or diverges.  
(b) Define conditional convergence of an alternating infinite series.  
Show that the series  $\sum_{n=1}^{\infty} (-1)^{n-1} \frac{\sqrt{n}}{n+1}$  converges conditionally.

**Question 3**

- (a) Find the radius and interval of convergence of the power series given by  $\sum_{n=0}^{\infty} \frac{(-1)^{n+1}(x+1)^{2n}}{5^n(n+1)^2}$ .  
(b) Use power series expansion of  $\ln(1+x)$  and  $\frac{1}{1+x^2}$  and find a power series for  $\frac{\ln(1+x)}{1+x^2}$ . What will be the interval of convergence of this power series?

**Section-B**

**Question 4**

- (a) What is the difference between differential equation and ordinary differential equation?  
(b) Define linear and non-linear ordinary differential equations?

**Question 5**

- (a) Solve the following  $\frac{dy}{dx} = -r \left(1 - \frac{y}{T}\right) y$ ,  $y(0) = y_0$ , where  $r$  and  $T$  are positive constants.  
(b) Solve  $\frac{dy}{dx} = \frac{y \cos x + 2x e^x}{1 - \sin x - x^2 e^y}$

**Question 6**

- (a) What is integrating factor? Find the general solution of  $\frac{dy}{dt} = \frac{1}{\sin y - \frac{t}{y}}$   
(b) Calculate  $L^{-1}\left\{\frac{1}{s^2(s^2-a^2)}\right\}$ .

**Question 7**

- (a) Solve  $xp^2 - 2yp + 4x = 0$  and find its singular solutions.  
(b) Solve  $y'' - y' - 2y = \cosh 2t + 6$ .

**Question 8**

- (a) Use the Laplace transformation to solve the following problem

$$\frac{d^2y}{dt^2} + y = 2u(t-2)\sin\pi t, y(0) = 1, \frac{dy}{dt} = 0 \text{ at } t = 0.$$

- (b) State and prove t-shifting property of Laplace transformation.

**Note:** Attempt FIVE questions in all, THREE from Section-A and TWO from Section-B.

**Section-A**

- Q.1. a) Show that pedal equation of the curve  
 $c^2(x^2 + y^2) = x^2y^2$  is  $\frac{1}{\rho^2} + \frac{3}{r^2} = \frac{1}{c^2}$
- b) Given  $x^y = e^{x-y}$ . Find  $\frac{dy}{dx}$ .
- Q.2. a) Define Pedal equation of a curve. Write down the procedure for finding the Pedal equations.  
b) Find relative maxima and minima if  $r = 1 - \cos\theta$
- Q.3. a) In the cycloid  $x = a(t + \sin t)$ ,  $y = a(1 - \cos t)$  prove that  $\rho = 4a \cos(\frac{t}{2})$  at any point on the curve.  
b) Find the radius of curvature at any point on the curve  
 $x = a(\cos t + t \sin t)$ ,  $y = a(\sin t - t \cos t)$ ,  $a > 0$ .
- Q.4. a) Define horizontal and vertical asymptotes of a plane curve. Find the equations of horizontal and vertical asymptotes of  $y = \frac{(x-2)^2}{x^2}$ .  
b) If  $f(x, y) = \frac{x^2+y^2}{x+y}$  prove that  $(f_x - f_y)^2 = 4(1 - f_x - f_y)$
- Q.5. a) Minimize  $z = 2x_1 + x_2$  subject to  
 $x_1 + x_2 \geq 1$ ,  
 $x_1 + x_2 \geq -1$ ,  
 $x_1 + 2x_2 \leq 4$ ,  
 $x_1, x_2 \geq 0$ .
- b) Minimize  $w = 200y_1 + 255y_2$  subject to  
 $5y_1 + 5y_2 \geq 2$ ,  
 $2y_1 + 3y_2 \geq 1$ ,  
 $y_1, y_2 \geq 0$ .
- Solve the problem by Simplex method.

**Section-B**

- Q.6. a) Evaluate  $\iint (x + 2y) dA$ ,  
where the region is bounded by the parabolas  $y = x^2$  and  $y = 1 + x^2$ .
- b) Find the volume of the solid obtained by rotating the region bounded by  $y = x^3$ ,  $y = 8$  and  $x=0$  about y-axis.
- Q.7. a) State and prove the Second theorem of Pappus.  
b) Use double integrals to find the area inside the circle  $r = 4\sin\theta$  and outside the lemniscates  $r^2 = 8\cos 2\theta$ .
- Q.8. a) Find the volume of the solid obtained by rotating about the x-axis the region under the curve  $y = \sqrt{x}$  from 0 to 1. Illustrate the definition of volume by sketching a typical approximating cylinder.
- b) Show that the volume of a sphere of radius is  $V = \frac{4}{3}\pi r^3$

**Note: Attempt FIVE Questions in all. Section A is Compulsory to attempt. Attempt Two Questions from Section-B and two from Section-C.**

**Section A**

- Q.1. Differentiate Between the following terms: (2 × 4= 8)
- a. Ribosomes and Dictyosomes
  - b. Euploidy and Aneuploidy
  - c. Replication and Transcription
  - d. Mutation and Evolution

**Section B**

- Q.2. What is mitochondria? Give its ultra-structure (with diagram), number and place of occurrence and its functions. (08)
- Q.3. What is Protein? Give structural and chemical composition. Provide types of proteins with examples. (08)
- Q.4. What is Chromosome? Give its Structure and types with diagrams, elaborate its role in the cell. (08)
- Q.5. What is Mitosis? Give its stages with diagram and elucidate its importance in cell. (08)

**Section C**

- Q.6. Who was Mendel? Give his Law of Segregation, with statistical values (08)
- Q.7. What is DNA? Define its mechanism of replication? Provide its chemical structure. (08)
- Q.8. How genetic mechanism occurs in Bacteria, provide its different methods. (08)
- Q.9. What is genetic engineering? Give its process and role in different fields of Science (08)

**Subject:** Botany  
(Physiology and Ecology)  
**Paper:** IV

**B.A / B.Sc Part-II**  
**Annual 2019**

**Time:** 03 Hrs.  
**Max. Marks:** 40

**Note:** Attempt five questions in all. Section A is compulsory, two questions from section B, and two questions from section C.

**SECTION - A**

- Q.1. Write short answers to the following questions 08
- i) How saturated solution is different from super saturated solution?
  - ii) Define Osmotic pressure.
  - iii) What do you mean by callus?
  - iv) Define photoperiodism.
  - v) What is an alluvial soil?
  - vi) Define Xerosere.
  - vii) What is loam?
  - viii) How acid rain develop?

**SECTION - B**

- Q.2. a- How the structure of guard cells respond to the turgor in opening and closing of stomata? 04  
b- Define coenzymes. Describe the role of NADH in cellular metabolism. 04
- Q.3. a- Explain non cyclic flow of electron (Z -Scheme) in light reactions of Photosynthesis 05  
b- Explain the role of auxin and cytokinin in callus morphogenesis 03
- Q.4. a- What are tropic movements? Explain their types in brief. 04  
b- How electron transport chain and chemiosmosis work together to generate ATP 04
- Q.5. a- What are phytochormes? Describe their types. Explain briefly the critical photoperiod 04  
b- What is vernalization? Explain the factors affecting the process of vernalization. 04

**SECTION - C**

- Q.6. a- Describe the role of ecology in water shed management. 04  
b- Write a note on ecophysiological response of plants to temperature. 04
- Q.7. a- Explain different characteristics of a population. 04  
b- All flesh is grass; explain this statement in terms of productivity. 04
- Q.8. a- What is an ecosystem? Explain the components of ecosystem. 04  
b- What is water logging? How it affect the vegetation of an area. 04
- Q.9. a- Describe succession in hydrosere. 05  
b- Explain the green house effect. 03

**Note:** SECTION (A) is compulsory. Attempt two questions from SECTION (B) and two questions from SECTION (C). Every question carries 8 marks.

**SECTION (A)**

Q.1. Define the following terms:

- |                             |                           |                    |
|-----------------------------|---------------------------|--------------------|
| i. Collusion frequency      | ii. Critical pressure     | iii. Mole fraction |
| iv. Eigen function          | v. Dynamic equilibrium    | vi. Free energy    |
| vii. Colligative properties | viii. Azeotropic mixtures |                    |

08

**SECTION (B)**

- Q.2. (a) Explain with examples: i. Logarithm of power ii. Logarithm of root 04  
(b) Elaborate Law of Equipartition of Energies. 04
- Q.3. (a) Give the details of PULFRICH REFRACTOMETER for the measurement of refractive index. 04  
(b) Give the concept of space lattice and unit cell with diagrams. 04
- Q.4. (a) What is wave function ' $\psi$ '? How do you compare ' $\psi$ ' and ' $\psi^2$ ' keeping in view their physical significance? 04  
(b) Calculate the mass of one photon of light having wavelength,  $\lambda = 5894 \text{ \AA}$ . Given that  $c = 3 \times 10^8 \text{ m/sec}$ ,  $h = 6.625 \times 10^{-34} \text{ JS}$ . 04
- Q.5. (a) What are X-rays? Explain diffraction of X-Rays. 04  
(b) Explain molar refraction and write down its units. 04

**SECTION (C)**

- Q.6. (a) What is general gas equation? Derive a relationship between  $K_c$  and  $K_p$ . 04  
(b) Derive the expression for SECOND ORDER reaction with equal concentration of both reactants. 04
- Q.7. (a) Discuss the adiabatic expression of an ideal gas and derive the following relationship:  $PV^\gamma = \text{Constant}$  04  
(b) Differentiate between EBULLIOSCOPY and CRYOSCOPY. 04
- Q.8. (a) How do you explain the phenomenon of FRACTIONAL DISTILLATION by Raoult's Law? 04  
(b) Calculate the half life period in seconds and minutes for a FIRST ORDER reaction, whose specific reaction rate is  $10^{-3} \text{ S}^{-1}$ . 04
- Q.9. (a) Write note on the followings: 4×2  
i. Entropy and Probability  
ii. Collision Theory of reaction rates

**Note:** Attempt five questions in all. Section A is compulsory. Attempt two questions each from section B and section C.

**SECTION-A**

- Q. 1. Answer these questions (any four) 2×4
- i) What do you mean by electron deficient molecule?
  - ii) How would you differentiate between precipitate and co precipitate?
  - iii) Enlist main metallic characters?
  - iv) What is isomerism?
  - v) What is water gas? How is it formed?

**SECTION-B**

- Q. 2. i) Describe main postulates of VSEPR theory? 04  
ii) Describe the electron affinity? Discuss its trends in periods and groups of periodic table? 04
- Q. 3. i) Discuss common features of M.O.T. How M.O.T explain the paramagnetic behavior of O<sub>2</sub>? 04  
ii) What is hybridization? Discuss sp<sup>2</sup>, and sp hybridization, 04
- Q. 4. i) What is Lewis acids and base concept? Explain the term conjugate acids and bases. 04  
ii) What is hard and soft base principle. How it explain the stability of complex. 04
- Q. 5. i) Discuss the separation procedure and sources of inert gasses. 04  
ii) Relate the chemical inertness of inert gases with their electronic configuration? 04

**SECTION-C**

- Q. 6. i) Describe the composition of Portland cement. Discuss the wet process for the manufacturing of cement? 04  
ii) Draw flow sheet diagram and describe various reaction involved in the manufacturing of urea from natural gas? 04
- Q. 7. i) Give the name and formula of any four chief minerals of aluminum? 04  
ii) Give formula of the following 2+2  
a) Potassium hexachloro Platinum (IV)  
b) Tetra cyano diaquoferate (III) ion
- Q. 8. i) How is Tetra thionic acid prepared. Discuss structurally the oxidation of thiosulphat ion to tetrathionate ion. 04  
ii) What is nitrogen cycle? Discuss its importances? 04
- Q. 9. i) What are the postulates of Werner's theory? 04  
ii) How would you classify the chelates? What factors give stability to chelate compounds? Discuss in details? 04
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**Note:** Attempt five questions. Question no. Part I is compulsory, select any four from Part-II.

**Part-I**

- Q.1. Explain the following in brief. (5x2=10)
- a. Define data model?
  - b. What are attributes? Give examples.
  - c. What is relationship? Give example.
  - d. Who is DBA?
  - e. Define an Entity.

**Part-II**

- Q.2. What are the different components of DBMS. (7.5)
- Q.3. Define Normalization. Explain the various normal forms with examples. (7.5)
- Q.4. Explain data anomalies. (7.5)
- Q.5. Explain data abstraction. (7.5)
- Q.6. Explain database integrity rules. (7.5)
- Q.7. What is the difference b/w relational algebra and relational calculus? Explain. (7.5)
- Q.8. Explain about deadlocks. (7.5)
- Q.9. Discuss in detail about database recovery concepts. (7.5)
- Q.10. What do you mean by decomposition and dependency preservation? Explain. (7.5)



**Note:** Attempt five questions. Part-I is compulsory, select any four from Part-II.

**Part-I**

- Q.1. Give short answers to the following (5x2=10)
- a. What is the Kernel?
  - b. Define data communication?
  - c. What are batch systems?
  - d. Define network.
  - e. Define Switch.

**Part-II**

- Q.2. What is a process Scheduler? State the characteristics of a good scheduler. (7.5)
- Q.3. Discuss in detail about file allocation methods. (7.5)
- Q.4. Define Operating System also explain the major parts of an Operating System? (7.5)
- Q.5. Narrate different network topologies. (7.5)
- Q.6. Write a note on Process Control block. (7.5)
- Q.7. How direct access is implemented in Files. Narrate. (7.5)
- Q.8. State the advantages of Virtual machines. (7.5)
- Q.9. What are the different types of networks? Explain in detail. (7.5)
- Q.10. Define IP address. What are the different classes of IP addresses? (7.5)

Note: Attempt Five questions in all. Section A is compulsory. Attempt Two questions from section B, and Two questions from section C.

**SECTION-A**

- Q.1. Attempt any **FOUR** parts. (2,2,2,2)
- i) Why a charged insulator is discharged by just passing it over a flame?
  - ii) Does an electric dipole experience an electric force in a non-uniform electric field. ?
  - iii) There is a constant electric potential in a region. What is about electric field there?
  - iv) How does the relation  $V = IR$  apply to resistors that do not obey the Ohm's law?
  - v) Give one analogy and one difference between Coulomb's law and Biot-Savart's law?

**SECTION-B**

- Q.2. Define ELECTRIC FIELD INTENSITY. Find expression of electric field along the axis passing perpendicularly through the center, with charge  $q$  and radius  $R$ , in case of (1,3,4)
- i) Uniformly charged circular ring. ii) Uniformly charged circular disk.
- Q.3. Define Biot-Savart's law. Apply it to derive relation for magnetic flux density  $B$  at the line passing through the center of a circular current loop. (2,6)
- Q.4. What is the REACTANCE? Find a relation for reactance in a RLC- series circuit and thus express the resonance frequency. (2,4,2)

**SECTION-C**

- Q.5. What is CAPACITANCE? Derive the relation for capacitance in case of a
- i) Cylindrical Capacitor. ii) Spherical Capacitor. (2,3,3)
- Q.6. a) Two free charges  $+q$  and  $+4q$  are at a distance  $L$  apart. A third charge is so placed that the entire system is in equilibrium. Find the sign, magnitude and location of the third charge.
- (b) An infinite sheet of charge has a charge density  $\sigma = 0.12 \mu C/m^2$ . How far apart are equipotential surfaces whose potentials differ by  $48V$ . (4,4)
- Q.7. (a) A parallel-plate air capacitor has a capacitance of  $51.3 pF$ . If its plates each have an area of  $0.350 m^2$ . What is their separation?
- (b) When  $115V$  is applied across a  $9.66 m$  long wire, the current density is  $1.42 A/m^2$ . Calculate the conductivity of the wire material. (4,4)
- Q.8. (a) At what angular frequency would a  $6.23 mH$  inductor and a  $11.4 \mu F$  have the same reactance?
- (b) Two long parallel wires are  $8.10 cm$  apart. What equal currents must flow in the wires if the magnetic field halfway between them is to have a magnitude of  $296 \mu T$ ? (4,4)

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**Note: Attempt five questions in all. Section-A is compulsory. Attempt Two questions from Section-B and Two from Section-C.**

**SECTION-A**

- Q.1 Attempt any four of the following. (2×4)
- (i) In Bohr's model mass of electron of an atom is taken as constant. Is it correct?
  - (ii) What are important characteristics of semiconductor?
  - (iii) What is the wave function?
  - (iv) Distinguish between body centered and face centered cubic structure.
  - (v) State Pauli Exclusion Principle?

**SECTION-B**

- Q. 2 (a) What is transistor? Explain its construction and draw its circuit diagram. (4)
- (b) How does the concept of energy band in solid explain good conductivity of conductor, poor for insulator and electrical behavior of semiconductor? (4)
- Q.3 (a) What is natural radioactivity? Determine an expression for half-life relating to decay constant? (5)
- (b) Explain the mass defect and binding energy of the nucleus. (3)
- Q.4 (a) What is step Potential? Solve time independent Schrodinger wave equation? (5)
- (b) State and calculate probability density of a wave function. (3)

**SECTION-C**

- Q.5 If the De Broglie wavelength of electron 0.01 pm.
- (a) What is speed of proton (b) Through what electrical potential would the proton have to be accelerated from rest to acquire this speed? (8)
- Q.6 Show that the energy released when three particles fuse to form  ${}^4_2\text{He}$  is 7.27 MeV. The atomic mass of  ${}^2_2\text{He}$  is 4.002603 and  ${}^{12}_6\text{C}$  is 12.0 u. (8)
- Q.7 A ruby laser emit a light at wavelength 694.4nm. If a laser pulse is emitted for 12ps and energy released per pulse is 150mJ. What is the length of the pulse. How many photons are in each pulse (8)
- Q.8 What is NOR Gate? Describe its symbol, Boolean expression, truth table and circuit diagram.(8)

**Note:** Attempt FIVE questions in all, selecting TWO questions from Section-I and THREE from Section-II

### Section-I

- Q.1. a) Under what condition do the vectors  $5\mathbf{i} - y\mathbf{j} + z\mathbf{k}$  and  $x\mathbf{i} - 6\mathbf{j} + \mathbf{k}$  have same magnitude?  
 b) If  $\mathbf{a} = 2\mathbf{i} - 3\mathbf{j} + \mathbf{k}$ ,  $\mathbf{b} = -\mathbf{i} + \mathbf{k}$ ,  $\mathbf{c} = 2\mathbf{j} - \mathbf{k}$  then find the area of parallelogram whose diagonals are  $\mathbf{a} + \mathbf{b}$  and  $\mathbf{b} + \mathbf{c}$ .
- Q.2. a) Find the value of  $\lambda$  for which the vectors  $\mathbf{i} + \mathbf{j} - \mathbf{k}$ ,  $\mathbf{i} - 2\mathbf{j} + \mathbf{k}$  and  $\lambda\mathbf{i} + \mathbf{j} - \lambda\mathbf{k}$  are coplanar.  
 b) Find a scalar function  $\phi$  such that  $\vec{F} = \nabla\phi$  where  $\vec{F} = e^x \sin y \mathbf{i} + e^x \cos y \mathbf{j}$
- Q.3. a) Find the vector equation on the line through  $5\mathbf{i} + \mathbf{j} - 7\mathbf{k}$  and parallel to  $2\mathbf{i} - \mathbf{j} + 2\mathbf{k}$ .  
 b) Evaluate the directional derivative of a function  $\phi = x^2 - y^2 + 2z^2$  at the point  $P(1,2,3)$  in the direction of  $\vec{PQ}$  where  $Q$  has coordinates  $(5,0,4)$ .

### Section-II

- Q.4. a) Three forces act perpendicularly to the sides of triangle at their middle points and are proportional to the sides. Prove that they are in equilibrium.  
 b) Forces  $2\vec{BC}$ ,  $\vec{CA}$ ,  $\vec{BA}$  acts along the sides of triangle. Show that their resultant is  $6\vec{DE}$ , where  $D$  bisect  $BC$  and  $E$  is the point on  $CA$  such that  $CE = \frac{1}{3}CA$ .
- Q.5. a) A couple of moment  $G$  acts on a square board  $ABCD$  of side 'a'. Replace the couple by the force acting  $AB$ ,  $BD$  and  $CA$ .  
 b) The resultant of two forces  $P$  and  $Q$  is  $R$ . If  $Q$  is doubled  $R$  is doubled, if  $Q$  is reversed  $R$  is again doubled, show that  $P^2 : Q^2 : R^2 :: 2 : 3 : 2$ .
- Q.6. a) State and prove principle of virtual work for a single particle and for a set of particle  
 b) The smallest force which can support a body of weight  $W$  on a smooth inclined plane is of magnitude  $P$ . Show that the horizontal force necessary to support the same body on the same plane is of magnitude  $\frac{PW}{\sqrt{P^2 + W^2}}$
- Q.7. a) Show that the centre of gravity of the lamina bounded by the loop of the lemniscate  $r^2 = a^2 \cos 2\theta$  is on the initial line at a distance  $\frac{\pi a}{4\sqrt{2}}$  from the pole.  
 b) The density at any point in the sector of circular lamina varies as the distance from the centre. Find the centre of gravity of the sector.
- Q.8. a) A uniform ladder rest in limiting equilibrium with one end on the rough floor whose coefficient of friction is  $\mu$  and with other against a smooth vertical wall. Show that its inclination to the vertical is  $\tan^{-1} 2\mu$ .  
 b) Find the minimum force required just to support a heavy particle on an inclined plane of inclination  $\alpha$ .

Note: Attempt FIVE questions in all, selecting TWO questions from Section-I and THREE from Section-II

Section-I

- Q.1. a) Use Newton Raphson method to find the positive real root of  $\log x = 1 + \frac{1}{x^2}$  correct up to three decimal places.  
b) Find to 4 decimal places the root near 3 of the equation  $e^x - \log_e x = 20$  using simple iteration method.
- Q.2. a) Solve the system of linear equations by Jacobi's method
- $$\begin{aligned}8x_1 + x_2 - x_3 &= 8 \\2x_1 + x_2 + 9x_3 &= 12 \\x_1 - 7x_2 + 2x_3 &= -4.\end{aligned}$$
- b) Solve the cubic equation  $x^3 - 12x^2 + 39x - 28 = 0$ , if the roots are in A.P.
- Q.3. a) Evaluate the integral  $\int_1^2 \frac{1}{1+x^4} dx$  using 7 point Trapezoidal rule and compare your answer with the exact value.  
b) Apply Simpson's rule to evaluate the integral  $\int_0^1 \frac{1}{1+x^2} dx$  for  $h = 0.25$  and compare your result with exact value.

Section-II

- Q.4. a) Determine the radial and transverse components of velocity and acceleration of a particle moving along a circle  $x^2 + y^2 = a^2$  with constant angular velocity  $c$ .  
b) Define principle of angular momentum and prove that the rate of change of angular momentum of a particle is equal to the torque of the forces acting on the particle.
- Q.5. a) A particle starts with a velocity  $u$  and moves in a straight line. If it suffers a retardation equal to square of velocity, find the distance travelled by the particle in a time  $t$ .  
b) A particle describing simple harmonic motion has velocities 5 feet per second and 4 feet per second. When its distances from the centre are 12 feet and 13 feet respectively. Find the time period of motion.
- Q.6. a) What is the maximum range possible for a projectile fired from a cannon having muzzle velocity 1 mile per second and what is the height reached in this case?  
b) Determine the maximum possible range for projectile fired from a cannon having muzzle velocity  $v_0$  and prove that the height reached in this case is  $\frac{v_0^2}{4g}$ .
- Q.7. a) Write the dimension of physical quantities  
(i) Momentum (ii) Power (iii) Angular velocity (iv) Density (v) Torque  
b) Define motion under a central force and prove that the orbit of particle moving under a central force is necessarily a plane curve.
- Q.8. a) A particle describe the following curves  $\frac{a}{r} = e^{n\theta}$ ,  $n\theta$ ,  $\cosh n\theta$  under force  $F$  to the pole, show that the force is stated as  $F \propto \frac{1}{r^3}$ .  
b) A particle falls under gravity in a medium which opposes the motion with a force proportional to the velocity of the body. The limiting velocity acquired by the particle is such that it would be attain in time  $T$  if the body were falling in vacuum. Show that the medium being present, the body acquires half the limiting velocity in a time  $0.693T$ .

Note: Attempt five questions in all. Section-A is compulsory. Select any Four Questions from Section-B.  
Use of calculator is allowed.

SECTION-A

- Q.1. Attempt any eight parts from the following. (08)
- What is meant by population?
  - What do you know about non-sampling errors?
  - Write down two basic purposes of sampling?
  - Define estimation of parameters?
  - What is test statistic?
  - Define sufficiency?
  - What do you know about level of significance?
  - What is analysis of variance?
  - When we use paired sample t test?
  - Discuss two tailed test?

SECTION-B

- Q.2. A population consist of numbers 2, 4, 8, 8, 10, 10. Draw all possible samples of size 2 without replacement and verify the results.

$$\mu_{\bar{x}} = \mu \quad \text{and} \quad \sigma_{\bar{x}}^2 = \frac{\sigma^2}{n} \left( \frac{N-n}{N-1} \right) \quad (08)$$

- Q.3. A population consist of numbers 0, 3, 4, 6, 9 and 15. Draw all possible samples of size 3 without replacement, make sampling distribution of sample proportion for even numbers in the sample and hence verify the following results:

$$\mu_{\hat{p}} = p \quad \text{and} \quad \sigma_{\hat{p}} = \sqrt{\frac{pq}{n} \left( \frac{N-n}{N-1} \right)} \quad (08)$$

- Q.4. Five coins are tossed 1000 times and the number of heads were observed as given below: (08)

Number of heads	0	1	2	3	4	5
Frequencies	38	144	342	287	164	25

Test whether a binomial distribution gives a satisfactory fit to these data.

- Q.5. The means and variances of the weekly incomes in rupees of the workers employed in the different factories, from the samples are given below: (08)

Factory	Sample Size	Mean	Variance
A	160	12.80	64
B	220	11.25	47

- What is the maximum likelihood estimate of the difference in mean income?
  - Compute the 90% confidence interval estimate for the real differences in the incomes of the workers from the two factories.
- Q.6. A machine puts out 16 imperfect articles in a sample of 500. After the machine is overhauled, it puts out 3 imperfect articles in a batch of 100. Has the machine been improved? (08)
- Q.7. A manufacturer claims that his light bulbs have an average lifetime of 1500 hours. A purchaser decides to check this claim and finds that for six bulbs the lifetimes are 1472, 1486, 1401, 1350, 1610, 1590 hours. Does this evidence support the manufacturer's claim? Assume that the lifetimes of the light bulbs are normally distributed.
- Q.8. Two independent random samples of sizes  $n_1=10$  and  $n_2=7$  were observed to have sample variances  $s_1^2=16$  and  $s_2^2=3$ . Test at 10% level of significance, the hypothesis is  $H_0: \sigma_1^2 = \sigma_2^2$  against the Alternative  $H_1: \sigma_1^2 \neq \sigma_2^2$ . (08)

**Note:** Attempt five Questions in all. Section- A is compulsory. Select any four Questions from Section- B. Use of Calculator is allowed

**Section- A**

- Q.1. Attempt all parts.
- What is the  $X^2$ -statistic?
  - Difference between regression and correlation
  - Difference between vital rates and ratios
  - Gross and net reproduction rates
  - Coefficient of contingency and Independence
  - Relative efficiency of Latin square design as compare to RCB design
  - Assumptions of error term.
  - Non-parametric and parametric methods?

**Section- B**

- Q.2. The following data relate the traffic density, described in the number of automobiles per mile, to the average speed of traffic on a moderately large city thoroughfare. The data were collected at the same location at 10 different times within a span of 3 months .i) Which variable is the input and which is the response? ii) Draw a scatter diagram. iii) Does a simple linear regression model appear to be reasonable? (08)

Density	69	56	62	119	84	74	73	90	38	22
Speed	25.4	32.5	28.6	11.3	21.3	22.1	22.3	18.5	37.2	44.6

- Q.3. i) Explain the assumptions on which non-parametric test are based? (04)  
 ii) The average summer temperatures in degrees Fahrenheit for 20 successive years from 1971 to 1990 in a given west coast city are 72,71,70,82,80,77,71,85,75,80,82,81,83,82,85,86,83,81, 82, 84. Test the hypothesis that the data constitute a random sample. (04)
- Q.4. i) A randomly chosen group of 20,000 non-smokers and one of 10,000 smokers were followed over a 10-year period. The following data relate the numbers developing lung cancer in that period. Test the hypothesis that smoking and lung cancer are independent. Use the 1 percent level of significance. (04)

	Smokers	Nonsmokers	Total
Lung Cancer	62	14	76
No Lung Cancer	9,938	19,986	29,924
Total	10,000	20,000	30,000

- ii) State chi-Squared goodness-of-fit test procedure. (04)
- Q.5. i) What are different sources of demographic data? (03)  
 ii) State short comings of vital statistics? (05)
- Q.6. i) What are the requirements of a good experimental design? (03)  
 ii) A nutrition expert claims that the amount of running a person does relates to that person's blood cholesterol level. Six runners from each of three running categories were randomly chosen to have their blood cholesterol levels checked. The sample means and sample variances were given in the following table. Do these data prove the nutritionist's claim? Use the 5 percent level of significance. Test whether the treatments means are equal. (05)

Weekly miles run	$\bar{X}$	$S^2$
Less than 15	188	190
Between 15 and 30	181	211
More than 30	174	202

- Q.7. i) What assumptions and hypotheses we usually make in one-way ANOVA. (03)  
 ii) Prove that

$$\sum_{i=1}^k \sum_{j=1}^n (y_{ij} - \bar{y}_{..})^2 = n \sum_{i=1}^k (\bar{y}_{i.} - \bar{y}_{..})^2 + \sum_{i=1}^k \sum_{j=1}^n (y_{ij} - \bar{y}_{i.})^2$$

$$\text{where } y_{ij} = \mu + \alpha_i + \epsilon_{ij}$$

- Q.8. i) What is a residual for an RCB design? (03)  
 ii) Explain the basic principle of experimental design. (05)