

# **PANDIT DEENDAYAL ENERGY UNIVERSITY**

NAAC Accredited with 'A++' grade with CGPA of 3.52 out of 4.00



**Admission Rules 2024-2025**

**for**

**Master of Science (M. Sc.)**

**(in Physics/Chemistry/Mathematics and Computing)**

**Pandit Deendayal Energy University**

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### 1. Seats Available for Admission:

For the purpose of admission to the first semester of the M. Sc. (Physics, Chemistry, and Mathematics and Computing) program, available seats are as follows;

Sr. No.	Subject offered	Department	Number of Seats
1	M. Sc. (Physics)	Department of Physics	25
2	M. Sc. (Chemistry)	Department of Chemistry	25
3	M. Sc. (Mathematics and Computing)	Department of Mathematics	25

### 2. Eligibility for Admission:

For the purpose of admission, a candidate shall have passed the qualifying examination of graduation in Science or Technology with a minimum 50% marks aggregate of all semesters/years or CPI 5.5 on 10 point scale or equivalent score from a recognized University/Institute. The candidate must have credited a core (major) course(s) in a relevant subject (for which he/she is seeking admission) during graduation.

### 3. Selection Procedure and Merit List Preparation:

The selection procedure is comprised of three components as follows;

Sr. No.	Components	Weightage
1	UG final Exam Performance* <sup>1</sup>	50%
2	Written Test† <sup>2</sup>	25%
3	Personal Interview‡ <sup>3</sup>	25%
<b>Total</b>		<b>100%</b>

Final Merit list will be prepared on total marks.

Written Admission Test (WAT) and Personal Interview (PI) will be conducted in three phases 7<sup>th</sup> May 2024 onwards on campus (offline mode). The complete details of the schedule are given in the important date section.

\*<sup>1</sup> During the selection process, if the final semester/year result is pending, then the previous semester/year CPI or Percentage will be considered, and provisional admission will be offered. In this case admission confirmation will be subjected to submission of the final semester/year mark sheet within 10 days of a declaration of the result from the respective university.

†<sup>2</sup> The details are mentioned in Sections 8 – 10.

‡<sup>3</sup> Personal interview may be based upon discussions related to scientific & research aptitude, overall learning approach and conceptual understanding, professional ethics and values.

### 4. Admission Procedure:

The admission procedure shall be on campus in the following manner, namely-

- 4.1. The Admission Committee shall prepare merit lists of the eligible candidates who has applied for respective programs, and appear for the selection procedure on the basis of performance in selection criteria's as mentioned in selection procedure.
- 4.2. The merit lists shall be displayed on the university website.
- 4.3. The candidate shall be required to pay the fee, as may be determined by University. The candidate will pay the course fees through an online process.
- 4.4. International students who are interested to apply, may contact the Office of International Relations of PDEU and go through the website of office ([http://pdp.ac.in/International- Students.html](http://pdp.ac.in/International-Students.html)) for more information.

## 5. Fee Structure:

Fees Structure for Two Years M. Sc. Program								
Sr. No.	Particulars	Amount of Fees	No. of Terms Per Year	(In Indian Rupees)				Total Fees
				Total Fees During Year				
				First Year		Second Year		
				1st Semester	2nd Semester	3rd Semester	4th Semester	
<b>Fees (Per Semester)</b>								
1	Tuition Fee**	75,000	2	75,000	75,000	75,000	75,000	3,00,000
2	University Enrolment	3,000	1	3,000	-	-	-	3,000
	Fee & Examination Fees							
3	Semester Enrolment Fee & Examination Fees	3,000	2	-	3,000	3,000	3,000	9,000
<b>Total Fees (A)</b>				<b>78,000</b>	<b>78,000</b>	<b>78,000</b>	<b>78,000</b>	<b>3,12,000</b>
<b>Deposit (Refundable / Adjustable)</b>								
4	Security Deposit	10,000	-	10,000	-	-	-	10,000
5	Library Deposit	3,000	-	3,000	-	-	-	3,000
<b>Total Deposit (B)</b>				<b>13,000</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>13,000</b>
<b>Total (A + B)</b>				<b>91,000</b>	<b>78,000</b>	<b>78,000</b>	<b>78,000</b>	<b>3,25,000</b>

## Research-based Assistantship:

Research-based assistantship of Rs. 25,000/- per semester will be given to all enrolled

students for all the semesters and will be paid at the end of the respective semester. The student has to maintain a CPI of 6.5 or above throughout the course duration (all 4 semesters) to be eligible for the research assistantship.

### **Cancellation of Admission and Fee Refund:**

If, at any stage, the information provided by the candidate is found to be false, his / her admission shall be cancelled, and fees shall be refunded.

Refunds for withdrawal of admission will be as per the provisions of the University. If the admission is withdrawn by a candidate before the commencement of the First Semester, and if the seat there upon becoming vacant is filled up with the other candidate, the fees will be refunded by 15<sup>th</sup> November 2024 after a deduction of Rs.1,000/-.

If on account of withdrawal, consequential vacancy is not filled, and the seat remains finally unfilled, only the Caution Money Deposit (i.e. Rs.10,000/-) and Library Deposit (i.e. Rs.3,000/-), i.e., a total of a sum of Rs.13,000/- will be refunded.

For withdrawal of admission and application seeking a refund, a candidate must submit the fee receipt, admission letter and the letter of request for withdrawal duly signed by him/her, countersigned by the parent/guardian.

### **Hostel & Mess Facilities:**

Hostel accommodation will be offered subject to its availability and as per its rules. Hostel Fees (FY 2024-25):

- Hostel Fees: Rs.96,000/- per academic year (Non-refundable)
- Hostel Deposit (Refundable): Rs.5,000/-

Hostel Accommodation shall be subject to the availability of seats as per the norms.

- Electricity charges would be levied (calculated) extra on an actual consumption basis.
- Mess Charges:
  - i) Rs. 52,000/- per year for breakfast, lunch, dinner and snacks as per the canteen schedule. This is compulsory for candidates opting for the hostel facility of the University.
  - ii) Rs. 34,250/- per year for breakfast, lunch and snacks for day scholars as per the canteen schedule. (Monday to Friday)

**Note:** Hostel and Mess fees are subject to upward revision from time-to-time.

### **6. Documents to be uploaded with the application:**

- Recent Passport size photograph
- B. Sc. Final Semester / Year mark sheet (in case of result “awaiting” status previous semester mark sheet)

- Migration Certificate (Within One Month)
- D.O.B. Proof (10<sup>th</sup> Passing Certificate or School Leaving Certificate)
- 12<sup>th</sup> Mark sheet.
- Any other certificates.

## 7. Important Dates:

Sr. No.	Particulars		Date
1	Online applications start		01-02-2024
2	Early admission (Phase-I)	Written admission Test and Personal Interview	07-05-2024
		Announcement of Provisional Merit List (1 <sup>st</sup> Phase)	14-05-2024
		Last Date for fees payment (1 <sup>st</sup> Phase)	21-05-2024
3	Phase-II**	Written admission Test and Personal Interview	07-06-2024
		Announcement of Provisional Merit List (2 <sup>nd</sup> Phase)	12-06-2024
		Last Date for fees payment (2 <sup>nd</sup> Phase)	20-06-2024
4	Phase-III**	Written admission Test and Personal Interview	05-07-2024
		Announcement of Provisional Merit List (3 <sup>rd</sup> Phase)	10-07-2024
		Last Date for fees payment (3 <sup>rd</sup> Phase)	16-07-2024
5	Last date for Online Application		03-07-2024
6	Orientation of the M.Sc. Batch 2024		19-07-2024
7	Commencement of the first semester		22-07-2024

\*\* Phase –II and III will be conducted in case of the vacant seats only.

## 8. Written Admission Test (WAT) Syllabus:

### a. Physics

**Mathematical Methods:** Calculus of single and multiple variables, partial derivatives, Taylor expansion, Fourier series. Vector algebra, Vector Calculus, Multiple integrals, Divergence theorem, Green's theorem, Stokes' theorem. First order equations and linear second order differential equations with constant coefficients. Matrices and determinants, Algebra of complex numbers.

**Mechanics and General Properties of Matter:** Newton's laws of motion and applications, Velocity and acceleration in Cartesian, polar and cylindrical coordinate systems, uniformly rotating frame, centrifugal and Coriolis forces, Motion under a central force, Kepler's laws, Gravitational Law and field, Conservative and non-conservative forces. System of particles, Centre of mass, equation of motion of the CM, conservation of linear and angular momentum, conservation of energy, variable mass systems. Elastic and inelastic collisions. Rigid body motion, fixed axis rotations, rotation and translation, moments of Inertia and products of Inertia, parallel and perpendicular axes theorem.

**Oscillations, Waves and Optics:** Differential equation for simple harmonic oscillator and its general solution. Superposition of two or more simple harmonic oscillators. Damped and forced oscillators, resonance. Wave equation, traveling and standing waves in one dimension. Energy density and energy transmission in waves. Group velocity and phase velocity. Doppler Effect. Fermat's Principle. Thick lens, thin lens and lens combinations. Interference of light, optical

path retardation. Fraunhofer diffraction. Rayleigh criterion and resolving power. Diffraction gratings. Polarization.

**Electricity and Magnetism:** Coulomb's law, Gauss's law. Electric field and potential. Electrostatic boundary conditions, Solution of Laplace's equation for simple cases. Conductors, capacitors, dielectrics, dielectric polarization, volume and surface charges, electrostatic energy. Biot-Savart law, Ampere's law, Faraday's law of electromagnetic induction, self and mutual inductance. Alternating currents. Simple DC and AC circuits with R, L and C components. Displacement current, Maxwell's equations and plane electromagnetic waves.

**Kinetic Theory, Thermodynamics:** Elements of Kinetic theory of gases. Velocity distribution and Equipartition of energy. Ideal gas, van-der-Waals gas and equation of state. Mean free path. Laws of thermodynamics. Isothermal and adiabatic processes. Reversible, irreversible and quasi-static processes. Carnot cycle. Maxwell's thermodynamic relations and simple applications. Thermodynamic potentials and their applications. Phase transitions and Clausius-Clapeyron equation. Ideas of ensembles, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein distributions.

**Modern Physics:** Inertial frames and Galilean invariance. Theory of special relativity. Blackbody radiation, photoelectric effect, Compton Effect, Bohr's atomic model, X-rays. Wave-particle duality, Uncertainty principle, the superposition principle, calculation of expectation values, Schrödinger equation and its solution for one, two and three dimensional boxes. Solution of Schrödinger equation for the one dimensional harmonic oscillator. Reflection and transmission at a step potential, Pauli Exclusion Principle. Structure of atomic nucleus, mass and binding energy. Laws of radioactive decay.

**Solid State Physics, Devices and Electronics:** Crystal structure, Bravais lattices and basis. Miller indices. X-ray diffraction and Bragg's law; Intrinsic and extrinsic semiconductors, variation of resistivity with temperature. Fermi level. p-n junction diode, I-V characteristics, Zener diode and its applications, BJT: characteristics in CB, CE, CC modes. Single stage amplifier, two stage R-C coupled amplifiers. Boolean algebra: Binary number systems; conversion from one system to another system; binary addition and subtraction. Logic Gates AND, OR, NOT, NAND, NOR exclusive OR; combination of gates.

## b. Chemistry

Basic Concepts in Organic Chemistry: Electronic effects (resonance, inductive, hyper conjugation) and steric effects and its applications (acid/base property).

Stereochemistry-I: Optical isomerism in compounds with and without any stereocenters (allenes, biphenyls).

Stereochemistry-II: Conformation of acyclic systems (substituted ethane/n-propane/n-butane) and cyclic systems (mono- and di-substituted cyclohexanes).

Reaction Intermediates: Chemistry of reactive intermediates (carbocations, carbanions, free radicals, carbenes, nitrenes, benzyne etc...).

Organic Reaction Mechanism and Synthetic Applications-I: Simmons-Smith reaction, Reimer-Tiemann reaction, Michael reaction, Darzens reaction, Wittig reaction and McMurry reaction; Baeyer-Villiger reaction; oxidation and reduction reactions in organic chemistry; Diels-Alder, electrocyclic and sigmatropic reactions; functional group inter-conversions and structural problems using chemical reactions.

Organic Reaction Mechanism and Synthetic Applications-II: Hofmann-Curtius-Lossen rearrangement, Wolff rearrangement, Pinacol-pinacolone, Favorskii, benzylic acid rearrangement, dienone-phenol rearrangement.

Reagents in Organic Synthesis: Organometallic reagents in organic synthesis (Grignard, organolithium and organocopper);

Qualitative Organic Analysis: Identification of functional groups by chemical tests; elementary UV, IR and  $^1\text{H}$  NMR spectroscopic techniques as tools for structural elucidation.

Natural Products Chemistry: Classification, Chemistry and applications of alkaloids, steroids, terpenes and terpenoids.

Chemistry of Carbohydrates: occurrence, classification and their biological importance, monosaccharides - constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures, interconversions of aldoses and ketoses, disaccharides (maltose, lactose and sucrose).

Chemistry of Amino Acids, Protein and Enzymes: Amino acids, peptides and their classification, alpha amino acids - synthesis, ionic properties and reactions, zwitterions, pKa values, isoelectric point, protein denaturation/renaturation. Enzymes: classification and characteristics of enzymes, salient features of active site of enzymes, mechanism of enzyme action, coenzymes and their role in biological reactions.

Aromatic Chemistry: Monocyclic, bicyclic and tricyclic aromatic hydrocarbons: synthesis, reactivity and properties.

Heterocyclic Chemistry: Monocyclic compounds with one hetero atom: synthesis, reactivity and properties.

Periodic Table: Periodic classification of elements and periodicity in properties; general methods of isolation and purification of elements.

Chemical Bonding: Types of bonding; VSEPR theory and shapes of molecules; hybridization; dipole moment.

Acids and bases: Brønsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, Lewis acid-base concept, hard and soft acids and bases, application of HSAB principle. Non-aqueous solvents.

Ionic Solids: Ionic solids; structure of NaCl, CsCl, diamond and graphite; lattice energy.

Main Group Elements (s and p blocks): General concepts on group relationships and gradation in properties; structure of electron deficient compounds involving main group elements.

Transition Metals (d block): Characteristics of 3d elements; oxide, hydroxide and salts of first row metals; coordination complexes: structure, isomerism, reaction mechanism and electronic spectra.

Bonding theories of Coordination complexes: VBT, MOT and Crystal Field theoretical approaches for structure, color and magnetic properties of metal complexes.

Organometallic chemistry: Organometallic compounds having ligands with back bonding capabilities such as metal carbonyls, carbenes, nitrosyls and metallocenes; homogenous catalysis.

Bioinorganic Chemistry-I: Essentials and trace elements of life; basic reactions in the biological systems and the role of metal ions, especially  $\text{Fe}^{2+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Cu}^{2+}$  and  $\text{Zn}^{2+}$ , Structure and function of haemoglobin and myoglobin and carbonic anhydrase.

Bioinorganic Chemistry-II: Structure and function of hemoglobin and myoglobin and carbonic



anhydrase.

Instrumental Methods of Analysis-I: Basic principles; instrumentations and simple applications of conductometry, potentiometry and UV-vis spectrophotometry.

Instrumental Methods of Analysis-II: Analysis of water, air and soil samples.

Spectroscopy: Beer-Lambert law; fundamental concepts of rotational, vibrational, electronic and magnetic resonance spectroscopy.

Analytical Chemistry-I: Principles of qualitative and quantitative analysis; acid-base, oxidation-reduction and complexometric titrations using EDTA.

Analytical Chemistry-II: Precipitation reactions; use of indicators; use of organic reagents in inorganic analysis.

### **c. Mathematics and Computing**

#### **Real Analysis**

Sequences and Series of real numbers, Convergence of sequences, Bounded and Monotone sequences, Cauchy sequences, Bolzano-Weierstrass theorem, Absolute convergence, Tests of convergence for series – comparison test, ratio test, root test; Power series (of one real variable), Radius and interval of convergence, Term-wise differentiation and integration of power series.

Functions of One Real Variable: limit, continuity, intermediate value property, differentiation; Rolle's theorem, Mean value theorem, L'Hospital rule, Taylor's theorem, Taylor's series, Maxima and Minima, Riemann integration (definite integrals and their properties), Fundamental theorem of calculus.

Metric spaces, Compactness, Connectedness

#### **Multivariable Calculus**

Functions of Two Real Variables: limit, continuity, partial derivatives, total derivative, maxima and minima.

Double and triple integrals, Change of order of integration, Calculating surface areas and volumes using double integrals, Calculating volumes using triple integrals.

#### **Complex Analysis**

Algebra of complex numbers, The complex plane, Functions of a complex variable, Continuity, Differentiability, Analytic functions, Harmonic functions, Cauchy-Riemann equations.

Contour integral, Cauchy's theorem, Cauchy's integral formula, Taylor series, Laurent series, Calculus of residues.

#### **Linear Algebra and Abstract Algebra**

Algebra of matrices, Types of matrices, Determinant, Inverse, Rank of matrices, Systems of linear equations, Eigenvalues, Eigenvectors, Cayley-Hamilton theorem.

Vector spaces, Subspaces, Linear dependence/independence, Basis, Linear transformations and their matrix representations, Range space, Null space, Rank-Nullity theorem.

Groups, Subgroups, Normal subgroups, Quotient groups, Lagrange's theorem, Homomorphisms, Cyclic groups, Permutation groups, Cayley's theorem.

#### **Differential Equations**

First-order ordinary differential equations, linear ordinary differential equations of higher order with constant coefficients; Second order linear ordinary differential equations with variable coefficients, method of variation of parameters.

### Numerical Analysis

Numerical solutions of algebraic equations, Bisection method, Iteration method, False-position method, Newton-Raphson method, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences.

## 9. Written Admission Test (WAT) Pattern:

A 100 Marks Off-line Test will be conducted on the PDEU Campus. It will comprise 50 multiple-choice questions, each carrying 2 Marks. There is no negative marking.

## 10. Sample Questions:

### a. Physics

1. Two gases separated by an impermeable but movable partition are allowed to freely exchange energy. At equilibrium, the two sides will have the same:
  - a. **pressure and temperature**
  - b. volume and temperature
  - c. pressure and volume
  - d. volume and energy
  
2. For which of these substances, the gas laws can be used with minimum error:
  - a. dry steam
  - b. wet steam
  - c. saturated steam
  - d. **superheated steam**
  
3. An engine operates between temperatures 900 K and  $T_2$  and another engine operates between  $T_2$  and 400 K. For both to do equal work, value of  $T_2$  =
  - a. 750 K
  - b. 730 K
  - c. 700 K
  - d. **650 K**
  
4. The line integral of the tangential component of magnetic field intensity (H) around a closed path is the same as:
  - a. the net distance of the conductor from the center of the path
  - b. the net length of the conductor enclosed by the path
  - c. **the net current enclosed by the path**
  - d. none of the above
  
5. The magnetic field intensity due to straight current carrying filamentary conductor of finite length is:
  - a. directly proportional to distance from the conductor
  - b. **inversely proportional to distance from the conductor**
  - c. does not depend on the distance from the conductor

- d. none of the above
6. The torque on the current loop always tends to turn the loop so as to align the magnetic field produced by the loop:
- perpendicular to the applied magnetic field that is causing the torque
  - with the applied magnetic field that is causing the torque**
  - at an angle of 45 degree to the applied magnetic field that is causing the torque
  - none of the above
7. The velocity of a longitudinal wave depends on:
- the inelastic force of the medium and on the mass density
  - the elastic restoring force of the medium and on the mass density**
  - the elastic restoring force of the medium and on the charge density
  - none of the above
8. The energy transported by wave is proportional to the:
- square of the frequency and to the square of the amplitude**
  - cube of the frequency and to the square of the amplitude
  - square of the frequency and to the cube of the amplitude
  - none of the above
9. The diffraction of light achieved when the source and the screen are at infinite distances from the aperture is known as:
- Fresnel's diffraction
  - Fraunhofer diffraction**
  - Single-slit interference
  - None of the above
10. Two data taken during gravitational acceleration experiment are given as: (1)  $t = 3$  s,  $v = 29.4$  m/s; (2)  $t = 5$  s,  $v = 49$  m/s. Using  $v = u + gt$ , the value of  $g$  can be approximately calculated as:
- $0.98$  m/s<sup>2</sup>
  - $9.8$  m/s<sup>2</sup>**
  - $98$  m/s<sup>2</sup>
  - None of these
11. The electric power consumed by an ohmic resistance device can be calculated by using following equation:
- $I * R * R$
  - $I * V * R$
  - $I * I * R$**
  - None of the above
12. The specific heat of water is given by:
- $4.18$  kJ/(kg, K)**
  - $4.18$  (kJ. kg)/ K
  - $4.18$  kJ. kg. K
  - None of the above

13. In a simple linear oscillator, the relation between frequency and period of oscillation is:
- T = 1/f**
  - T = f\*f
  - f = T\*T
  - None of the above
14. A block of mass m lies on the floor in static equilibrium condition. Then the magnitude of the frictional force on it from the floor is:
- 8 N
  - 5 N
  - 0 N**
  - None of the above
15. A particle of mass 40 g executes a simple harmonic motion (SHM) of amplitude 2.0 cm. If the time period is 0.2 s, then the total mechanical energy of the system is:
- 7.9 mJ**
  - 4.9 mJ
  - 1.9 mJ
  - 9.9 mJ

## b. Chemistry

- A soap bubble is given a negative charge; then its radius:
  - decreases
  - increases**
  - remains unchanged
  - nothing can be predicted as information is insufficient
- The magnetic resonance imaging MRI is based on the phenomenon of:
  - nuclear magnetic resonance**
  - electron spin resonance
  - Electron paramagnetic resonance
  - diamagnetism of human tissues
- Ozone layer in the atmosphere absorbs:
  - radio waves
  - Infrared waves
  - ultraviolet rays**
  - microwaves
- Which of the following compounds undergoes nitration most readily?
  - Benzene
  - Toluene**
  - Nitrobenzene
  - Benzoic acid
- One cannot see through fog because:
  - fog absorbs light
  - light is scattered by the droplets in the fog**
  - light suffers total reflection at the droplet in the fog
  - the refractive index of the fog is infinity
- The control rods used in nuclear reactor can be made up of:
  - Graphite

- b. **cadmium**
  - c. barium
  - d. lead
7. Which scientist experimentally proved the existence of electromagnetic waves?
- a. Sir J.C Bose
  - b. Maxwell
  - c. Marconi
  - d. Hertz**
8. The bond that exists in a semiconductor is
- a. Covalent bond**
  - b. Ionic bond
  - c. Metallic bond
  - d. Hydrogen bond
9. First atomic energy reactor was designed by
- a. E. Teller
  - b. E. Fermi**
  - c. Otto Hahn
  - d. Rutherford
10. When water is converted into ice, its entropy
- a. Increases
  - b. Decreases**
  - c. Remains unchanged
  - d. First decreases then increases
11. Alkenes show geometrical isomerism due to
- a. Asymmetry
  - b. rotation around single bond
  - c. Resonance
  - d. restricted rotation around a double bond**
12. LPG (house hold cooking gas) is mainly mixture of
- a. Methane + Ethane
  - b. Acetylene + oxygen
  - c. Butane + isobutene**
  - d. Acetylene + hydrogen
13. Baeyer's reagent is
- a. dilute  $\text{KMnO}_4$**
  - b.  $\text{HCl} + \text{ZnCl}_2$
  - c.  $\text{Br}_2$  in  $\text{CCl}_4$
  - d.  $\text{NH}_2\text{NH}_2$
14. Freon-12 is used as
- a. Local anesthetic
  - b. Dry cleaning agent
  - c. Refrigerant**
  - d. Disinfectant

Which of the following poisonous gas is formed when chloroform is exposed to light and air?

- a. Mustard gas
- b. Carbon monoxide
- c. Phosgene**
- d. Chlorine

### c. Mathematics and Computing

1. Let  $G$  be any group and let  $a \in G$  be such that the order of  $a$  is  $n$  and for some integer  $m$ ,  $a^m = e$  then ...

- a) **n is a divisor of m**  
 b) m is a divisor of n  
 c)  $m = n$   
 d) none of the above is true
2. In a group  $(\mathbb{Z}_8, +_8)$  order of an element 2 is ...  
 a) 1  
 b) 2  
 c) 3  
**d) 4**
3. Let  $x = (4,4,0), y = (1, -1,8)$  &  $z = (0, -1,4)$ , then ...  
 a) x, y & z are linearly independent.  
**b) x, y & z are linearly dependent.**  
 c) x, y & z forms a basis for a vector space  $\mathbb{R}^3(\mathbb{R})$ .  
 d) x, y & z spans a vector space  $\mathbb{R}^3(\mathbb{R})$ .
4. Let  $W_1 = \{(x, y) \in \mathbb{R}^2 | x + y = 0\}$  and  $W_2 = \{(x, y) \in \mathbb{R}^2 | x^2 + y^2 \leq 1\}$  be two subsets of vector space  $\mathbb{R}^2(\mathbb{R})$ , then ...  
**a)  $W_1$  is a subspace but  $W_2$  is not a subspace of  $\mathbb{R}^2(\mathbb{R})$ .**  
 b)  $W_1$  is not a subspace but  $W_2$  is a subspace of  $\mathbb{R}^2(\mathbb{R})$ .  
 c) Both  $W_1$  &  $W_2$  are subspaces of  $\mathbb{R}^2(\mathbb{R})$ .  
 d) Neither  $W_1$  nor  $W_2$  is a subspace of  $\mathbb{R}^2(\mathbb{R})$ .
5. Let A be any  $3 \times 3$  upper-triangular matrix and eigen values of A are 3, -4 & 1, then determinant of matrix A is ...  
 a) 0  
 b) 8  
 c) 12  
**d) -12**
6. Order and degree of differential equation  $\left[ \sin x - \left( \frac{dy}{dx} \right)^4 \right] = \frac{d^3y}{dx^3}$  is ... & ... respectively.  
 a) 3 & 1  
 b) 1 & 4  
**c) 3 & 7**  
 d) 3 & degree does not exist
7. Particular Integral of the differential equation  $(D^2 - 4)y = e^{-2x}$  is ...  
 a)  $-\frac{xe^{-2x}}{4}$   
 b)  $\frac{xe^{2x}}{4}$   
 c)  $-\frac{e^{-2x}}{4}$   
 d)  $\frac{e^{2x}}{4}$
8. Let  $z \in \mathbb{C}$  and if  $|z| = |z - i|$ , then ...  
 a)  $Re(z) = \frac{1}{2}$   
 b)  $Re(z) = -\frac{1}{2}$   
 c)  **$Im(z) = \frac{1}{2}$**

d)  $Im(z) = -\frac{1}{2}$

9. Which of the following is singular point of  $\frac{1}{\sin z - \cos z}$

a)  $z = 0$

b)  $z = \frac{\pi}{3}$

c)  $z = \frac{\pi}{4}$

d)  $z = \frac{\pi}{2}$

10. In Gauss elimination method, the given system of linear equations is transformed into an equivalent ... matrix.

a) diagonal

b) lower triangular

c) **upper triangular**

d) identity

11.  $\int_0^1 \int_0^x x e^y dy dx = \underline{\hspace{2cm}}$

a) 0

b)  $\frac{1}{2}$

c) 1

d) 2

12. Let  $f(x) = |x|$ , then ...

a)  **$f$  is continuous at 0.**

b)  $f$  is differentiable at 0.

c) Range of  $f$  is  $\mathbb{R}$ .

d)  $f'(x) = 1$

13.  $\lim_{x \rightarrow 0} \frac{\sin ax}{\sin bx} = \dots$ , where  $(a \neq 0, b \neq 0)$

a)  $\frac{a}{b}$

b)  $\frac{b}{a}$

c)  $ab$

d) Does not exist

14. Which of the following is true for given  $I$  and  $II$

I)  $d(x, y) = |x| + |y|$

II)  $d(x, y) = \max(|x|, |y|)$

a) Only I is metric space on  $\mathbb{R}$ .

- b) Only II is metric space on  $\mathbb{R}$ .
- c) Both I and II are metric space on  $\mathbb{R}$ .
- d) Neither I nor II is metric space on  $\mathbb{R}$ .**

15. The radius of convergence of the power series  $\sum_{i=1}^n \frac{6^n}{n} x^{n-1}$  is ...

- a) 6
- b)  $\frac{1}{6}$
- c) 0
- d)  $\infty$