TDP (Honours) 6th Semester Exam., 2017

PHYSICS

(Honours)

SEVENTH PAPER

Full Marks : 80

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer **eight** questions, taking **two** from each Unit

Used symbols have their usual meanings

UNIT—I

1. *(a)* Plot the graph of the binding energy per nucleon versus mass number (A). Discuss the various facts related to this plot.

(b) Neutron is an electrically neutral particle, still it is associated with a negative magnetic moment. Why?

(c) Write Bethe-Weizsäcker semi-empirical mass formula mentioning each term.

(Turn Over)

(d) An α-particle of energy 5 MeV is scattered through 180° by a fixed uranium nucleus. Calculate the distance of closest approach. (1+2)+2+2+3=10

2. (a) In successive radioactive disintegration $P \rightarrow Q \rightarrow R$, show that the time during which the daughter nucleus (Q) attains a maximum is given by $t_m = \frac{1}{\lambda_1 - \lambda_2} \ln \frac{\lambda_1}{\lambda_2}$.

(b) Explain qualitatively how the neutrino hypothesis solves the apparent breakdown of conservation of momentum and energy in β-decay.

(c) Explain the terms 'internal conversion' and 'electron-positron annihilation'.

3+3+(2+2)=10

3. (a) What are the advantages of using neutrons as projectiles for artificial transmutations? Give an example of artificial transmutation induced by neutron.

(b) Derive an expression for the threshold energy of an endoergic nuclear reaction.

(c) Mention the various conservation laws in a nuclear reaction.

(d) How much energy in joule would be released when 1 gm of U_{235} is fissioned?

(2+1)+3+2+2=10

(Continued)

UNIT—II

4. *(a)* What is ultraviolet catastrophy?

(b) Show that Wien's law and Rayleigh-Jeans law of blackbody radiation are only the special cases of Planck's law.

(c) A particle of mass m and kinetic energy E is incident on a potential step

$$V(x) = 0 \quad \text{for} \quad x < 0$$
$$= V_0 \quad \text{for} \quad x \geq 0$$

Considering $E > V_0$, calculate the reflection and transmission coefficients.

2+3+5=10

5. *(a)* State the physical interpretation of wave function. Why do we normalize the wave function?

(b) Find the solutions of the time independent Schrödinger equation for a particle moving one-dimensionally in a region of zero potential energy between two rigid walls at $x = -\frac{L}{2}$ to $x = +\frac{L}{2}$.

(c) What is an observable? (2+2)+5+1=10

6. *(a)* In a quantum mechanical system, the wave function is

$$\psi(x) = A \exp(ikx) \exp\{(-a^2x^2)/2\}$$

Find the normalization constant A and probability current density.

(b) What is zero point energy in a linear harmonic oscillator?

(c) The energy levels in a harmonic oscillator are equally spaced, but for particle in a box, these are not equally spaced. Explain the reasons.

(d) Consider a wave function

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

Find the value of momentum operator $\langle \hat{p} \rangle$.

(2+3)+1+2+2=10

UNIT—III

7. (a) Define lattice points and basis in a crystal structure.

(b) What is meant by symmetry operation in crystal? Why is it important in study of crystal?

(c) Sketch the crystal planes of (110) and (111) in a cubic lattice.

(d) Calculate the glancing angle for the plane (110) of NaCl crystal. The lattice parameter is 0·28 nm corresponding to second-order Bragg's diffraction of X-rays of wavelength 0·05 nm. 2+(2+1)+2+3=10

8. *(a)* Discuss the van der Waals bonds in solid.

(b) Derive the expression for specific heat capacity of solids using Einstein's theory and compare it with experimental results at both high and low temperatures.

(c) For aluminium, the Debye temperature is 400 K. Calculate its specific heat at constant volume at a temperature 40 K. Assume $R = 2$ calories. 2+(5+1)+2=10

9. *(a)* With necessary diagram, explain Hall effect. How is Hall coefficient used to determine the types of semiconductor?

(b) The Curie temperature of iron is 1043 K and each iron atom has a magnetic moment $2\mu_B$, where μ_B = Bohr magneton. If the saturation magnetization of iron is $1 \cdot 75 \times 10^6$ A/m, calculate the Weiss constant and the Curie constant.

(c) On account of the quantum theory of paramagnetics, discuss the low and high temperature cases. (2+1)+4+3=10

UNIT—IV

10. *(a)* Draw a logic circuit by using NOR gates to implement the Boolean expression $AB + \overline{B}\,\overline{C}$.

(b) Implement *(i)* AND with OR and NOT gates and *(ii)* OR with AND and NOT gates.

(c) Prove the following identities in Boolean algebra :

(i) $A + AB + \overline{A}B = \overline{\overline{A}\,\overline{B}}$

(ii) $(A+B)(A+\overline{B}+C) = (A+B)(A+C)$

3+3+(2+2)=10

11. *(a)* What are the components of DTL?

(b) Draw a logic circuit for adding two binary numbers 1101 and 0011 by using full adder.

(c) Draw a circuit diagram of *S-R* flip-flop. Discuss the operation of the flip-flop and write the truth table of the above flip-flop.

(d) Explain various functions of an operating system.

1+3+3+3=10

(Continued)

12. *(a)* Draw a flowchart to find the largest among N numbers.

(b) Write a program to evaluate the series

$$\frac{1}{1-x} = 1 + x + x^2 + x^3 + \cdots \text{ for } -1 < x < 1$$

to 0·001% accuracy.

(c) Explain the uses of the BASIC statements DIM and TAB. 4+4+2=10

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TDP (Honours) 6th Semester Exam., 2018

PHYSICS

(Honours)

SEVENTH PAPER

Full Marks : 80

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer **eight** questions, taking **two** from each Unit

Used symbols have their usual meanings

UNIT—I

1. *(a)* Discuss betatron with the help of a neat sketch and also explain its working principle.

(b) Explain the construction and working principle of a proportional counter.

(c) There are two GM counters, one has a long and flat plateau and other has a short and steep plateau. Which one would you prefer? Justify. 4+4+2=10

2. *(a)* What is meant by 'packing fraction'? How is it related to the binding energy of a nucleus? How does it vary with the mass number of the nucleus?

(b) Explain how the phenomenon of radioactivity can be applied for the determination of the age of the earth.

(c) Assuming that U-235 and U-238 were created in equal amounts when the earth was born, calculate the age of the earth from the following data :

Half-life of U-235 = $7{\cdot}13\times10^{8}$ yrs
Half-life of U-238 = $4{\cdot}5\times10^{9}$ yrs
Concentration ratio of U-235/U-238 = 1/40

(2+1+1)+3+3=10

3. *(a)* Mention various conservation laws in a nuclear reaction.

(b) Show how neutrino hypothesis explains the discrepancy of continuous β-ray spectrum.

(c) What is meant by the term 'electron-positron annihilation'? 2+5+3=10

UNIT—II

4. *(a)* Discuss Planck's quantum hypothesis and deduce Planck's law of energy distribution for black-body radiation.

(b) For a particle in one dimension, is the function $\psi(x) = x$ acceptable?

(c) In what respect, does the Schrödinger wave equation differ from the classical wave equation? 5+3+2=10

5. (a) Determine the probability and the probability current density for a wave function given by

$$\psi(x) = A\exp\left(-\frac{\alpha^2 x^2}{2}\right)\exp(ikx)$$

(b) A particle is confined in a one-dimensional infinite square well potential where

$$V(x) = 0, \quad -a < x < a$$
$$\infty, \quad |x| \geq a$$

Obtain the energy eigenvalues and the eigenfunction. 5+5=10

6. (a) The radial part of wave function for hydrogen atom in the ground state is given by $R = \frac{2}{a_0^{3/2}} e^{-r/a_0}$. Find an expression for ground state energy of hydrogen atom.

(b) What are degenerate states?

(c) Find the expectation value of momentum for a particle trapped in a one-dimensional box of width L. Give the physical interpretation of this result.

4+2+(3+1)=10

UNIT—III

7. (a) What is unit cell? Explain lattice parameters associated with a unit cell.

(b) What are Miller indices? Find the Miller indices for the planes a, $2b$ and $3c$.

(c) Calculate the atomic packing factor for bcc structure.

(d) A substance with fcc lattice has density 6250 kg/m^3 and molecular weight 60·2. Calculate the lattice constant a. Given Avogadro's number $6{\cdot}02\times10^{26}$ kg/mole.

2+(1+2)+2+3=10

8. (a) Discuss the temperature dependence of lattice heat capacity and compare with experimental observations.

(b) Calculate the Debye frequency and Debye temperature for aluminium from the following data :

Density of atoms = $6{\cdot}02\times10^{28}$/m^3

Velocity of longitudinal wave $v_l = 6374$ m/s

Velocity of transverse wave $v_t = 3111$ m/s

(c) What is meant by Fermi energy E_F? Obtain an expression for Fermi energy for free electron gas in one dimension at absolute zero. Hence show that the average KE in the ground state is one third of Fermi energy. 3+2+5=10

9. (a) What do you mean by effective mass of an electron? Derive its expression and state the significance of it.

(b) What is ferromagnetism? Discuss the Weiss field theory of ferromagnetism and explain how magnetic susceptibility varies with temperature. (1+3+1)+(1+4)=10

UNIT—IV

10. (a) Construct a *J-K* flip-flop using NAND gates where a clock pulsed also be applied and explain its operation. Write down the truth table. Also draw the waveform of such type *J-K* flip-flop.

(b) Implement XOR function by using NAND gates. Why is NAND gate called universal gate?

(c) Define a sequential system. How does sequential system differ from a combinational system?

(2+1+1)+(2+1)+(2+1)=10

11. *(a)* Write down De Morgan's theorems.

(b) What are multiplexer and demultiplexer?

(c) Simplify the following Boolean expressions :

(i) $\overline{\overline{A}B\overline{C}} + \overline{A\overline{B}C}$

(ii) $\overline{(\overline{A} \cdot B)(B \cdot C)(C \cdot \overline{D})}$

(d) Distinguish between combinational and sequential logic circuits. 2+2+4+2=10

12. *(a)* Draw a flowchart to solve a quadratic equation.

(b) Write a program in BASIC to find all the prime numbers from 1 to 50.

(c) Explain the operation of the command PRINT USING and READ-DATA. 3+3+(2+2)=10

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TDP (Honours) 6th Semester Exam., 2019

PHYSICS

(Honours)

SEVENTH PAPER

Full Marks : 80

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer **eight** questions, taking **two** from each Unit

UNIT—I

1. *(a)* What are mirror nuclei? Give one such pair of nuclei.

   (b) In which shape of nuclei, electric quadrupole moment is observed?

   (c) Write down the semi-empirical nuclear binding energy formula for a nucleus of mass number A, containing Z protons and N neutrons as proposed by Weizsacker.

(d) Use semi-empirical nuclear binding energy formula for finding the atomic number of the most stable nucleus for a given mass number A.

(e) What are the magic numbers?

(f) Write the expression for nuclear magneton. 2+1+2+3+1+1=10

2. (a) Explain the neutrino theory of β-decay.

(b) What is meant by range of an alpha particle? How is this quantity related to the disintegration constant of the radioactive element?

(c) What are the different processes of interaction of γ-rays with matter? Mention the energy ranges of γ-rays required for occurring these different interaction processes.

(d) What is meant by nuclear reaction cross-section? What is its unit?

3+(1+1)+(1½+1½)+(1+1)=10

3. (a) Explain the terms (i) internal conversion and (ii) electron-positron annihilation.

(b) Compute the Q-value and the threshold energy for the reaction $^{19}F(n, p)\ ^{19}O$. Atomic masses are $^{19}F = 18 \cdot 998404$ u, $H = 1 \cdot 007825$ u, $^{19}O = 19 \cdot 003577$ u and $n = 1 \cdot 008665$ u.

(c) Describe the construction and principle of operation of an ionization chamber.

(1½+1½)+3+4=10

UNIT—II

4. (a) Show that Wien's law and Rayleigh-Jeans law of black-body radiation are only the special cases of Planck's law.

(b) A wave packet of matter wave associated with a moving particle has group velocity V_p. If velocity of moving particle is v, what will be the relation between V_p and v?

(c) Show how one can arrive at Bohr's quantization condition on the basis of de Broglie's hypothesis of matter waves.

(d) What are meant by probability and probability current density for a quantum mechanical system? 4+1+2+(1½+1½)=10

5. (a) A particle of mass m is free to move in a force-free region in one dimension between two rigid walls situated at $x = -L/2$ and $x = +L/2$.

(i) Find the eigenfunction and eigenvalues of the Hamiltonian.

(ii) Sketch the wave function of the ground state and the 1st excited state.

(iii) Find the ratio of the energy eigenvalues corresponding to the first excited state and the ground state.

(b) A particle having zero potential energy is confined between two rigid walls at $x = 0$ and $x = L$. Show that for a very large quantum number the probability of finding the particle in any small interval Δx between x and $x + \Delta x$ is independent of x. (2+2+2)+4=10

6. (a) The potential energy of a harmonic oscillator of mass m is given by

$$V(x) = \frac{1}{2} m\omega^2 x^2$$

where ω is the angular frequency.

(i) Write the time independent Schrödinger's equation for a simple harmonic oscillator.

(ii) Calculate the energy eigenvalue in the ground state. Given

$$\Psi_0 = \left(\frac{\alpha}{\pi}\right)^{1/4} \exp\left(-\frac{\alpha x^2}{2}\right)$$

where $x = \frac{m\omega}{\hbar}$.

(b) Write Schrödinger's time independent equation for hydrogen atom. Hence solve $\Theta(\theta)$ equation. (1+4)+(1+4)=10

UNIT—III

7. (a) What is meant by 'Miller indices' of a crystal plane? Show that in a cubic crystal the spacing between consecutive parallel planes of Miller indices ($h\ k\ l$) is given by

$$d_{h\,k\,l} = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$$

(b) Obtain Laue's equations for X-ray diffraction by crystals. Show that these are consistent with Bragg's law.

(c) Write the Bragg's law in vector form and give meaning of each term.

(1+3)+(2+2)+(1+1)=10

8. (a) Why do X-rays get diffracted by crystals?

(b) What is Madelung constant?

(c) What is a phonon? Give an evidence for the existence of phonons. Write the expression of average number of phonons in a mode of lattice vibration at temperature T.

(d) What is Einstein temperature? Give drawbacks of the Debye model.

2+2+(1+1+1)+(1+2)=10

9. (a) "All substances exhibit diamagnetism". Comment on the statement.

(b) Using Langevin's classical theory, derive an expression for susceptibility of a paramagnetic substance.

(c) Describe the behaviour of magnetic substances with reference to their Curie points.

(d) What is 'hysteresis'? 2+4+3+1=10

UNIT—IV

10. (a) Draw a logic circuit using only 2-input NAND gates to implement the Boolean expression $Y = AB + BC + CA$.

(b) What is the advantage of *J-K* flip-flop over *S-R* flip-flop? Explain the function of 'preset' and 'clear' inputs in *J-K* flip-flop.

(c) Realize a full subtractor using two half-subtractors. 3+(2+3)+2=10

11. *(a)* Design a 4 : 1 multiplexer using basic gates.

(b) Discuss the working of a NOT gate.

(c) Construct a digital half-adder circuit using logic gates and explain its action.

3+3+4=10

12. *(a)* Write a basic program to find the largest number among three given numbers.

(b) What is meant by MS-DOS?

(c) Explain how to add, delete or modify a statement in BASIC program.

(d) Compare the functions of the STOP and END statements and KILL and DELETE commands. 3+1+3+3=10

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S–6/PHSH/07/20

TDP (Honours) 6th Semester Exam., 2020

PHYSICS
(Honours)

SEVENTH PAPER

Full Marks : 80

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer **eight** questions, taking **two** from each Unit

UNIT—I

1. *(a)* Explain the spin dependancy of nuclear force.

(b) What is the ratio of gravitational interaction to the strong nuclear interaction?

(c) Why a deuteron nucleus is considered for the study of nuclear force? Which types of statistics is followed by deuteron?

(d) Point out the names of four important nuclear models. Discuss the successes and failures of liquid drop model of nucleus. 2+1+(1+1)+(2+3)=10

2. *(a)* A radioactive substance disintegrates for a time equal to its average life. Calculate the fraction of the original substance disintegrated.

(b) What is the condition between decay constants for occurring secular equilibrium in successive radioactive disintegration?

(c) Give the graphical presentation of Coulomb potential barrier for α-disintegration.

(d) What is meant by range of α-particles? Name four factors on which range of α-particles in a gas depends on.

(e) Both neutrino and antineutrino have the same properties zero (rest) mass, zero change and spin $\frac{1}{2}$. Then, how are they distinguished? 2+1+2+(1+2)+2=10

3. *(a)* If we increase the γ-ray energy, then mention whether probability of occurring the following phenomena will increase or decrease :

(i) Photoelectric effect

(ii) Compton effect

(iii) Pair production

(b) What is meant by nuclear reaction? Name two physical quantities which are not conserved in nuclear reaction.

(c) What was the Bohr's independent hypothesis regarding compound nuclear reaction?

(d) Distinguish among a cyclotron, synchrotron and synchro-cyclotron.

3+(1+2)+1+3=10

UNIT—II

4. (a) Why does classical theory fail to account the distribution of energy in the spectrum of blackbody radiation?

(b) Show that the expectation value of the position coordinate in a quantum state $\psi(x)$ can be given by $\langle x \rangle = \int_{-\infty}^{+\infty} \psi^*(x)\, \hat{x}\psi(x)\, dx$.

(c) The solution of a time-independent Schrödinger equation is given by $\psi(x) = \left(\frac{x}{x_0}\right)^a e^{-x/x_0}$, find potential $V(x)$ and energy E, where a, x_0 are constants. Assume $V(x) \to 0$ as $x \to \infty$. 2+4+4=10

5. (a) Establish the law of conservation of probability density in quantum mechanics.

(b) An electron with kinetic energy of 10 eV at $x = \infty$ is moving from left to right along the x-axis. The potential energy is $V = 0$ for $x < 0$ and $V = 20$ eV for $x > 0$. Considering the electron as a one-dimensional plane wave, answer the following :

(i) Write the Schrödinger equation for $x < 0$ and $x > 0$.

(ii) What is the wavelength for $x < 0$?

(iii) What are the boundary conditions at $x = 0$?

(iv) Make a general statement about the possibility of finding the electron at some positive value of x.

5+(2+1+1+1)=10

6. (a) Draw the energy level diagram for a particle confined in a three-dimensional cubical box and hence explain degeneracy.

(b) The normalized ground state wave function of hydrogen atom is given by $\psi(r, \theta, \varphi) = 1/\sqrt{\pi a_0{}^3}\, e^{-r/a_0}$. Find the distance from the nucleus at which the electron is most likely to be found.

(c) Show that the existence of zero point energy in a quantum harmonic oscillator is consistent with the uncertainty principle.

3+4+3=10

UNIT—III

7. *(a)* What is the difference between a primitive cell and a unit cell? Show that all primitive cells are unit cells but all unit cells may or may not be primitive cell.

(b) Show that FCC structure is more closely-packed compared to SC and BCC structure.

(c) The distance d_{100} between (100)-planes in BCC structure is 0·232 nm. What is the size of the unit cell? What is the radius of the atom? 3+3+(2+2)=10

8. *(a)* What are primary bonds?

(b) State Wiedemann-Franz law.

(c) Establish Boltzmann transport equations.

(d) State Bloch theorem. 2+1+5+2=10

9. *(a)* What is meant by effective mass of an electron? What is its significance?

(b) Show that the effective mass of an electron is inversely proportional to the second derivative of the $(E-k)$ curve.

(c) Discuss the condition when the effective mass of an electron becomes positive, negative and infinity.

(d) Write the significance of Hall coefficient.

(1+1)+3+3+2=10

UNIT—IV

10. (a) Implement a NOR gate using NAND only.

(b) Draw the circuit diagram of a NAND gate using DTL. Explain its operation.

(c) Simplify : $\overline{A}BC + A\overline{B}C + AB\overline{C} + ABC$

3+(2+3)+2=10

11. (a) Why is flip-flop called a sequential circuit?

(b) Construct a three input AND gate using two input NAND gates only.

(c) What is operating system? Discuss the primary objectives of an operating system.

(d) What is programming language? How does computer language differ from natural language? 2+3+2+3=10

12. *(a)* Draw a flowchart to find the solution of a quadratic equation, $ax^2 + bx + c = 0$. You must also consider the case, when $a = 0$.

(b) What is a compiler? What types of error are detected in a compiler?

(c) Write a program in BASIC to find the sum of the series $S = 1 + 3 + 5 + \ldots$.

4+(2+1)+3=10

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TDP (Honours) 6th Semester Exam., 2021

PHYSICS

(Honours)

SEVENTH PAPER

Full Marks : 80

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer **eight** questions, taking **two** from each Unit

UNIT—I

1. *(a)* Mention the names of four chief forces of nature.

(b) On what factors does the stability of a nucleus depend?

(c) What is the basic cause of nuclear magnetic moment?

(d) What important conclusions may be drawn from binding energy per nucleon vs. mass number curve?

(e) Show that the nuclear magneton is 1836 times smaller than the Bohr magneton. 2+2+2+2+2=10

2. *(a)* State the factors on which the range of particles depends.

(b) Mention some of the important properties of neutrino. Show how neutrino hypothesis explains the discrepancy and accounts for the continuous β-ray spectrum.

(c) Derive an expression for α-disintegration energy. 2+(2+3)+3=10

3. *(a)* State Geiger-Nuttall law. What is the importance of the law?

(b) Distinguish between internal conversion and photoelectric effect.

(c) Write Bethe-Weizsacker semi-empirical mass formula.

(d) Give idea about *(i)* pair-production and *(ii)* electron-positron annihilation. 2+2+2+(2+2)=10

UNIT—II

4. *(a)* Show that de Broglie wavelength associated with electron accelerated through a potential difference V in non-relativistic case is given by $\lambda = \frac{12 \cdot 28}{\sqrt{V}}$ Å.

(b) Show that the de Broglie wave velocity for a free particle is greater than the velocity of light *c*. How was this difficulty resolved by Schrodinger?

(c) What is meant by operator? Find the quantum mechanical operators of the observable energy and momentum.

2+(2+1)+(1+2+2)=10

5. (a) Explain the physical interpretation of the wave function ψ. Write the wave function for a free particle.

(b) What is meant by expectation values of dynamical quantities?

(c) Show that if the expectation values of dynamical quantities for a particle are considered, then quantum mechanics gives the same equation of classical mechanics. (2+1)+2+5=10

6. (a) Does the concept of Bohr orbits violate the uncertainty principle?

(b) A particle of mass *m* moves in the three-dimensional box of dimensions *a*, *b*, *c*. If the potential is zero inside and infinity outside the box, find the energy eigen- values and eigenfunctions. What is zero point energy of the system? What is degeneracy of the first and second excited states?

(c) Draw the *(i)* energy levels and wave functions of the lowest four states of the linear harmonic oscillator and *(ii)* probability density of the lowest four states. 2+(3+2)+3=10

UNIT—III

7. (a) Consider a cubic crystal system. With necessary diagram, discuss all the crystallographic symmetry elements available with this structure.

(b) Draw the crystal planes a, $b/2$, $c/3$ and hence find the Miller indices of the plane.

(c) Calculate the lattice constant for iron belonging to bcc structure. Take the density of iron as 7·65 g/cm^3 and atomic weight of iron as 55·85. 4+(1+2)+3=10

8. (a) What is meant by lattice vibration?

(b) What is a phonon? Which statistics is obeyed by a phonon?

(c) What are the main assumptions of Einstein's theory of lattice heat capacity?

(d) What are the basic assumptions of classical free electron theory of metals?

(e) Mention the merits and demerits of free electron theory. 2+2+2+2+2=10

9. *(a)* Give an account of Weiss theory of ferromagnetism. On the basis of this theory, how will you explain hysteresis and Curie point?

(b) Explain with examples soft and hard magnetic materials.

(c) A paramagnetic salt contains ions/m^3 with magnetic moment of one Bohr magneton. Calculate the paramagnetic susceptibility and magnetization produced in a uniform magnetic field of 10^6 amperes/meter when the temperature is 27 °C. (3+2)+2+3=10

UNIT—IV

10. *(a)* Why is binary number system preferred to the decimal system for use in computer system?

(b) Convert 0·85 to its binary equivalent number.

(c) Draw the circuit diagram of a NAND gate using DTL. Explain its operation.

(d) Why is NAND gate called universal gate? Explain. 2+2+(2+2)+2=10

11. *(a)* What are half-adder and full-adder? Explain their operations by using the necessary truth table, Boolean expression and logic circuits.

(b) What is an *S-R* flip-flop? Give its circuit symbol.

(c) Show how an *S-R* flip-flop can be converted into *J-K* flip-flop. (2+3)+2+3=10

12. *(a)* Write a program in BASIC to solve a quadratic equation.

(b) Briefly describe the functions of an operating system.

(c) Discuss the meaning of the commands LET, READ and INPUT in BASIC programming. 4+3+3=10

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