4 MSc PROGRAMMES

TU offers following MSc programmes of two years duration (4 Semesters):

(i) MSc (Biotechnology)
(ii) MSc (Chemistry)
(iii) MSc (Mathematics and Computing)
(iv) MSc (Physics)

4.1 MSc (BIOTECHNOLOGY)

4.1.1 Eligibility

(*a*) For Open Merit and SC/ST Candidates

Candidates with bachelor's degree under 10+2+3 pattern of education in Physical, Biological, Agricultural, Veterinary, and Fishery Sciences, Pharmacy, Engineering Technology, 4-Years BS (Physician Assistant) Course, Medicine (MBBS) or BDS with at least 50% marks.

4.1.2 NUMBER OF SEATS:

The total number of seats is 30 (+ 5 FN/NRI seats. Refer section 8 for eligibility & other conditions). (Gen-21, SC/ST-8, PH-1).

4.1.3 ENTRANCE EXAMINATION

A candidate is required to appear in the TU conducted Entrance Examination.

4.1.4 CENTRES FOR EXAMINATION:

The **Entrance Test** will be held at TU, Patiala and Delhi only. In addition, we may have examination centres at Mumbai, Kolkata, Jammu and Chennai based on sufficient number of options for various centres by the candidates. Highest preferred Entrance Test Centre available shall be allocated.

4.2 MSc (CHEMISTRY)

4.2.1 Eligibility:
Recognised Bachelors degree in Science of minimum 3 years duration with 50% marks in aggregate and **Chemistry as one of the subject at the graduation level and** each candidate has to qualify in the entrance test to be conducted by the University.

4.2.2 Mode of Selection: Admission will be made on the merit of the entrance test only.

4.2.3 No. of seats of each programme: 30 (Gen-21, SC/ST-8, PH-1) + (5 FN/NRI seats. Refer section 8 for eligibility & other conditions)

4.3 MSc (MATHEMATICS AND COMPUTING)

4.3.1 Eligibility:
Recognised Bachelors degree of minimum 3 years duration with 50% marks in aggregate and **Mathematics as one of the subject at the graduation level and** each candidate has to qualify in the entrance test to be conducted by the University.

4.3.2 Mode of Selection: Admission will be made on the merit of the entrance test only.

4.3.3 No. of seats of each programme: 30 (Gen-21, SC/ST-8, PH-1) + (5 FN/NRI seats. Refer section 8 for eligibility & other conditions)

4.4 MSc (PHYSICS)

4.4.1 Eligibility:

Recognised Bachelors degree in Science of minimum 3 years duration with 50% marks in aggregate and **Physics as one of the subject at the graduation level and** each candidate has to qualify in the entrance test to be conducted by the University.

4.4.2 Mode of Selection: Admission will be made on the merit of the entrance **test** only.

4.4.3 No. of seats of each programme: 30(Gen-21, SC/ST-8, PH-1) + (5 FN/NRI seats. Refer section 8 for eligibility & other conditions)

4.5 Centre of Examination(for 4.2, 4.3 & 4.4) : TU, Patiala

4.6 Time of Entrance Test

a) MSc (Chemistry) 9.30 AM -1100 AM
b) MSc(Physics) 12.00 Noon-1.30 PM
c) MSc (Mathematics and Computing) 3.00 PM to 5.00 PM

GENERAL INFORMATION REGARDING MSc ENTRANCE TESTS

I MSc (BIOTECHNOLOGY) ENTRANCE TEST

The entrance examination will consist of two papers of a total of two hours duration carrying a total of 120 marks as given below:

Paper-I will have questions at the level of 10+2 (CBSE) carrying 60 marks. This paper consists of 90 multiple-choice questions subdivided into Sections I, II, III. While section I will have 30 questions from Physics and Chemistry and must be answered by all the candidates, section II will have 30 questions from mathematics and section III will have 30 questions from Biology. The candidates have the option to answer questions from either Section II or Section III. Each question will carry 1 mark and $1/4^{th}$ mark will be deducted for each wrong/blank answers.

Paper-II will have multiple choice questions of the level of B.Sc carrying 60 marks. This paper consists of 90 multiple-choice questions subdivided into Section I, II, III. Section I will have 30 questions from Chemistry and must be answered by all candidates. Section-II will have 30 Questions from Mathematics and physics and Section III will have 30 questions from Biology and other branches of the life sciences. The candidates have the option to answer questions from either Section II or III. Each question will carry 1 mark and $1/4^{th}$ mark will be deducted for each wrong/blank answers.

SAMPLE QUESTIONS FOR PAPER-I &II

Section I

1. Small drops of water assume spherical shapes because of
   (a) water having low density (b) surface tension
   (c) viscosity (d) density

2. Chemical reaction taking place at the anode is
   (a) reduction (b) oxidation
   (c) ionization (d) hydrolysis

3. Which of the following compounds will give a hydrocarbon on treatment with Grignard reagent?
   (a) Ethyl alcohol (b) Formaldehyde
   (c) Acetaldehyde (d) Acetone

4. The resistance that must be placed in parallel with 12 ohms to reduce the combined resistance to 4 ohms is

(a) 6 ohms (b) 16 ohms
(c) 8 ohms (d) 3 ohms

Section II

1. If b<d and a=2b and c=2d then

(a) a<c (b) b=d
(c) a=c (d) a>c

2. If the side of a square is increased by 10% then its area is increased by

(a) 20% (b) 12%
(c) 121% (d) 21%

3. In a triangle ABC, $\sin^2 A + \sin^2 B = \sin^2 C$. The triangle is

(a) equilateral (b) isosceles
(c) scalene (d) right angled

4. The equation $(x-1) - 2 / (x-1) = - 2 / (x-1)$ has

(a) one root (b) a double root
(c) no roots (d) a root with a nonzero imaginary part

Section III

1. Extrachromosomal DNA is found in

(a) ribosomes (b) lysosomes
(c) mitochondria (d) Golgi body

2. Sickle-cell anaemia is caused by

(a) viral infection of red blood cels (b) amino acid substitution in the hemoglobin molecule
(c) excessive diphosphoglycerate (d) deficiency of biotin

3. Which of the following peptide hormones is produced by posterior pituitary ?

(a) Insulin (b) Glucagon
(c) ACTH (d) Vasopressin

4. Which one of the following is not associated with protein synthesis ?

(a) Ribosomes (b) proteosomes
(c) mRNA (d) tRNA

II Syllabus for MSc (Chemistry) Entrance Examination

Paper will consists of 90 objective type questions. Each question will carry 1 mark and $1/4^{th}$ mark will be deducted for each wrong/blank answers.

Syllabus

Periodic Table: Periodic classification of elements and periodicity in properties; general properties of s, p, d and f block elements.

Hard and Soft Acids and Bases : Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, theoretical basis of. hardness and softness, electronegativity and hardness and softness.

Metal-ligand Bonding in Transition Metal Complexes: Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.

Magnetic Properties of Transition Metal Complexes: Types of magnetic behavior, methods of determining magnetic susceptibility, spin-only formula. L-S coupling, correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.

Electron Spectra of Transition Metal Complexes: Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series. Orgel-energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion.

Thermodynamic and Kinetic Aspects of Metal Complexes: A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes.

Organometallic Chemistry: Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn and Ti, metal-ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls. Organomagnesium compounds: the Grignard reagents - formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions.

Spectroscopy: Electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom.

UV-Visible Spectroscopy: Beer-Lambert's law, molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones.

Infrared absorption spectroscopy: molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds.

Nuclear magnetic resonance (NMR) spectroscopy: ^1H NMR spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules.

Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

Stereochemistry of Organic Compounds: Concept of isomerism. Types of isomerism, Optical isomerism - elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral

molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometric isomerism - determination of configuration of geometric isomers. E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism - conformational analysis of ethane and n-butane, conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives. Newman projection and Sawhorse formulae, Fischer and flying wedge formulae.

Heterocyclic Compounds: Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Synthesis, properties and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

Organic Synthesis *via* Enolates: Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1,3-dithianes. Alkylation and acylation of enamines.

Carbohydrates: Classification and nomenclature. Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D-(+)-glucose. Mechanism of mutarotation. Structures of ribose and deoxyribose.

Amino Acids, Peptides, Proteins and Nucleic Acids: Classification, structure and stereochemistry of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation and reactions of α-amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, and group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Structures of peptides and proteins. Levels of protein structure. Protein denaturation/renaturation. Nucleic acids: introduction. Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

Synthetic Polymers: Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers.

Atomic Structure: De Broglie hypothesis, the Heisenberg's uncertainty principle, Significance of ψ and ψ^2, quantum numbers, Schrödinger wave equation and its importance, physical interpretation of the wave function. Hund’s rule and electronic configuration of elements.

Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus - Drapper law, Stark -

Einstein law, Jablonski diagram, fluorescence, phosphorescence, non-radiative processes, quantum yield, photosensitized reactions – energy transfer processes.

Solutions, Dilute Solutions and Colligative Properties: Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point,

Chemical Thermodynamics: Reversible and irreversible processes; First law and its application to ideal and nonideal gases; Thermochemistry ; Second law; Entropy and free energy, Criteria for spontaneity.

Chemical and Phase Equilibria: Law of mass action; Kp , Kc, Kx and Kn ; Effect of temperature on K; Ionic equilibria in solutions; pH and buffer solutions; Hydrolysis; Solubility product; Phase equilibria–Phase rule and its application to one-component and two-component systems; Colligative properties.

Electrochemistry: Conductance and its applications; Transport number; Galvanic cells; EMF and Free energy; Concentration cells with and without transport.

Chemical Kinetics: Reactions of various order, Arrhenius equation, Collision theory; Theory of absolute reaction rate; Chain reactions – Normal and branched chain reactions; Photophysical and photochemical processes; Catalysis.

Model questions

1. The decreasing order of the first ionization energy of the following elements is
   (A) He > H > Be > B
   (B) Be > B > H > He
   (C) H > He > Be > B
   (D) B > Be > He > H

2. The solubility products (Ksp) for three salts MX, MY_2 and MZ_3 are 1×10^{-8}, 4×10^{-9} and 27×10^{-8}, respectively. The solubilities of these salts follow the order
   (A) MX > MY_2 > MZ_3
   (B) MZ_3 > MY_2 > MX
   (C) MZ_3 > MX > MY_2
   (D) MY_2 > MX > MZ_3

3. The rate of nitration of following aromatic compounds decreases in the order
   (i) benzene (ii) pyridine (iii) thiophene (iv) toluene
   (A) (iv) > (i) > (iii) > (ii)
   (B) (iii) > (iv) > (i) > (ii)
   (C) (iii) > (ii) > (i) > (iv)
   (D) (ii) > (i) > (iv) > (iii)

III Syllabus for MSc (Mathematics and Computing) Entrance Examination

Paper will consists of 100 objective type questions.Each question will carry 1 mark and $1/4^{th}$ mark will be deducted for wrong/blank answers.

Syllabus

Algebra: Set theory, Relations, Mapping and its applications, Permutations and combinations, Types of matrices, Rank and inverse of a matrix, Linear independence and linear dependence, Solution of system of linear equations, Eigen values and Eigen vectors of a matrix, Cayley Hamilton theorem.

Calculus: Limits, Continuity and Differentiability, Rolle's and Mean value theorems, Successive differentiation, Partial differentiation, Maxima and Minima of function of one and two variables, Maclaurin's and Taylor's theorem for functions of one and two variables, Definite integral and its applications, Beta and gamma function, Double integral and its applications, Laplace and inverse Laplace transform and their properties, Convolution theorem.

Differential Equation: Ordinary differential equations of first order and their solutions, Linear differential equations of higher order with constant coefficients, Classification of partial differential equations, Partial differential equations of first order, Lagrange's solution, Charpit's method.

Analysis: Riemann integral, Integrability of continuous and monotonic functions, Mean value theorems of integral calculus, Infinite series and their

convergence, Demoivre's theorem and its applications, Functions of complex variables, Analytic function, C-R equations.

Abstract Algebra: Groups, Subgroups and their properties, Lagrange's theorem, Rings, Subrings, Integral domain and Field, Vector spaces, Subspaces and their properties, Inner product spaces, Orthogonal vectors.

Numerical Analysis: Solution of non linear equations using iterative methods, Interpolation for equally and unequally spaced data, Trapezoidal and Simpson's rules for integration.

Statistics, Probability and Linear Programming: Measures of central tendency, Dispersion, Skewness and kurtosis, Correlation and regression, Basic concepts of probability, Conditional probability, Baye's theorem, Discrete and continuous distributions (Binomial , Poisson and Normal), Fundamentals of linear programming problems, Graphical solution, Simplex method and its variants.

Computing Fundamentals: Organization of a computer, Central processing unit(CPU), Input/Output devices, Computer memory, Memory organization, Back-up devices, Representation of character, integers and fractions, Binary and hexadecimal representation, Binary arithmetic: addition, subtraction, division and multiplication, Floating point representation of numbers, Normalized floating point representation.

MODEL QUESTIONS

1. A root of the equation $\begin{vmatrix} 3-x & -6 & 3 \\ -6 & 3-x & 3 \\ 3 & 3 & -6-x \end{vmatrix} = 0$ is

(A) 6 (B) 3 (C) 0 (D) -3

2. Which statement characterizes standard form of a linear programming problem?

(A) Constraints are given by inequalities of any type
(B) Constraints are given by a set of linear equations
(C) Constraints are given only by inequalities of >= type
(D) Constraints are given only by inequalities of <= type

3. The coefficient of correlation

(A) Cannot be negative (B) Cannot be positive
(C) Is always positive (D) Can be positive as well as negative

4. If the two regression coefficients are b_1 and b_2 then the correlation coefficient is

(A) $\frac{b_1}{b_2}$ (B) $b_1 b_2$

(C) $\sqrt{b_1 b_2}$ (D) $\frac{b_2}{b_1}$

5. Machine language instructions are executed in a part of the computer called:

(A) Arithmetic/logic unit (B) Video display unit
(C) Volatile memory (D) Central processing unit

6. The process of writing the computer instructions is called

(A) Coding (B) Compiling (C) Debugging (D) Interpreting

IV Syllabus for MSc (Physics) Entrance Examination

Paper will consists of 90 objective type questions.Each question will carry 1 mark and 1/4th mark will be deducted for wrong/blank answers.

Syllabus:

1. Mechanics and Waves

Newton's laws of motion and applications, variable mass systems, projectiles. Rotational dynamics-kinetic energy, angular momentum, theorems of moment of intertia. Conservative forces, frictional forces. Gravitaional potential and intensity due to spherical objects. Central forces, Kepler's problem, escape velocity and artificial satellites. Streamline motion, viscosity, Applications of Bernoulli's equation and Stokes' law. Special relativity, length contraction, time dilation, mass-energy relation. Simple harmonic motion, Lissajous figures. Damped oscillation, forced oscillation and resonance. Beats, Phase and group velocities. longitudinal waves in solids. Doppler effect, Ultrasonic and their applications.

2.Geometrical and Physical Optics.

Laws of reflection and refraction from Fermat's principle. Matrix method in paraxial optics- thin lens formula, nodal planes, system of two thin lenses. Chromatic and spherical aberrations. Huygens' principle-reflection and refraction of waves. Interference of light-Young's experiment, Newton's rings, interference by thin films, Michelson interferometer. Fraunhofer diffraction-single slit, double slit, diffraction grating, resolving power. Production and detection of linearly, circularly and elliptically polarised light. Double refraction, quarter-waves plates and half-wave plates. Optical activity and applications. Elements of fibre optics-attenuation; pulse dispersion in step index and parabolic index fibres; material dispersion. Lasers, characteristics of laser light-spatial and temporal coherence.

3. Heat and Thermodynamics

Thermal equilibrium and temperature. The zeroth law of thermodynamics. Heat and the first law of thermodynamics. Efficiency of Carnot engines. Entropy and the second law of

thermodynamics. Kinetic theory and the equation of state of an ideal gas. Mean free path, distribution of molecular speeds and energies. Trasport phenomena. Andrew's experiements-van der Waals equation and applications. Joule-Kelvin effect and applications. Brownian motion. Thermodynamic potentials-Maxwell relations. Phase transitions. Kirchhoff's laws. Black-body radiation-Stefan-Boltzmann law, spectral radiancy, Wien displacement law, application to the cosmic microwave background radiation, Planck radiation law.

4. Electricity and Magnetism

Electric charge, Coulomb's law, electric field, Gauss' law. Electric potential, van de Graff accelerator. Capacitors, dielectrics and polarization. Ohm's law, Kirchhoff's first and second rules, resistors in series and parallel, applications to two-loop circuits. Magnietic field-Gauss'law for magnetism, atomic and nuclear magnetism, magnetic susceptibility, classification of magnetic materials. Cirulating charges, cyclotron, synchrotron. Hall effect. Biot-Savart law, Ampere's law, Faraday's law of induction., Lenz's law. Inductance. Alternating current circuits-RC, LR, single-loop LRC circuits, impedance, resonance, power in AC circuits.
Displacement current, Maxwell's equations.

5. Atomic and Nuclear Physics

Photoelectric effect, Einstein's photon theory. Bohr's theory of hydrogen atom. Stern-Gerlach experiment, quantisation of angular momentum, electron spin. Pauli exclusion principle and applications. Zeeman effect. X-ray spectrum. Compton effect, Compton wavelength. Wave nature of matter, de Broglie wavelength, wave-particle duality. Heisenberg's uncertainty relationships. Schroedinger's equation-eigenvalues and eigenfunctions of (i) particle in a box, (ii) simple harmonic oscillator and (iii) hydrogen atom. Natural and artificial radioactivity. Binding energy of nuclei, nuclear fission and fusion. Classification of elementary particles.

6. Solid State Physics

Crystal structure, x-ray diffraction, Bragg’s law, Bonding, covalent, ionic, metallic, Van der Walls bonding,
Magnetism, Dia, Para and Ferromagnetism, Hysteresis. Thermal properties, lattice vibrations, Debye model.
Band structure, energy band, energy gap, metals, insulators and semiconductors.

7. Electronics

Diodes in half-waves and full-wave rectification, qualitative ideas of semiconductors, p type and n type semiconductors, junction diode, Zener diode, transistors, Field Effect transistor. binary numbers, Logic gates and truth table.

Sample Questions:

1. The minimum value of angular momentum by coupling three angular momenta 1, 3/2 and 5/2 is

(a) -5 (b) 0.5 (c) 0 (d) 1

2. The mechanical equivalence of an LCR series circuit with voltage source is a

   (a) damped harmonic oscillator (b) forced harmonic oscillator

   (c) free linear harmonic oscillator (d) damped and forced harmonic oscillator

Note: There will be negative marking for wrong answers. Penalty for wrong answers will be adopted as under :
The total marks to be awarded to a candidate in a paper after imposing the penalty will be calculated by the following formula (assuming that each question carries 1 mark).
For each correct answer to a question, one mark will be awarded. However, if the answer is wrong 1/4 mark will be deducted. For examples this will be computed as under.
Let R = number of correct answers
W = number of wrong answers
U = number of Unattempted questions
T = total number of questions
Then the total marks obtained is R-1/4W. Calculated to the second place of decimal, the examiner will also check that T = R + W + U = T