2. LATERAL ENTRY ADMISSION TO THE SECOND YEAR OF UG PROGRAMME

2.1 ELIGIBILITY:

A candidate shall be eligible for admission in the BE/BTech programs subject to the following conditions:

The candidate

(i) has passed

(a) diploma, in relevant* discipline, of minimum 3-years duration after matriculation from Polytechnic College/Institute affiliated with State Board of Technical Education/University, or recognized by UGC/AICTE with a minimum of 60% marks (55% for SC/ST) in aggregate or equivalent grade point.

OR

(b) diploma, in relevant* discipline, of minimum 2-years duration after 10+2 from Polytechnic College/Institute affiliated with State Board of Technical Education/University, or recognized by UGC/AICTE with a minimum of 60% marks (55% for SC/ST) in aggregate or equivalent grade point.

OR

(c) BSc(Non-Medical) from recognized University with 60%(55% for SC/ST) marks in aggregate

(ii) has qualified LEET-TU with at least 20% aggregate marks (15% for SC/ST candidates).

(iii) possesses a good moral character.

(iv) is a citizen of India.

*The various UG programs and their relevant diploma disciplines are given as below:

<table>
<thead>
<tr>
<th>SR. No.</th>
<th>Name of Programme</th>
<th>Relevant Disciplines of Diploma</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>CHEMICAL ENGINEERING</td>
<td>Chemical Technology / Chemical Engineering / Food Technology / Biotechnology / Mechanical</td>
</tr>
<tr>
<td>2.</td>
<td>CIVIL ENGINEERING</td>
<td>Civil Engineering / Architectural Assistantship</td>
</tr>
</tbody>
</table>
| 3. | (a) COMPUTER ENGINEERING  
(b) COMPUTER ENGINEERING (WITH SPECIALISATION IN MACHINE LEARNING AND DATA ANALYTICS)  
(c) COMPUTER ENGINEERING (WITH SPECIALISATION IN COMPUTER ANIMATION AND GAMING)  
| 4. | ELECTRICAL ENGINEERING | Electrical Engineering, Electrical & Electronics Engineering, Electronics Engineering, Electronics & Communication |
| 5. | (a) ELECTRONICS & COMMUNICATION ENGINEERING  
(b) ELECTRONICS AND COMPUTER ENGINEERING  

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<tr>
<td>6.</td>
<td>(a) MECHANICAL ENGINEERING (b) MECHANICAL ENGINEERING (PRODUCTION) (c) MECHATRONICS</td>
</tr>
<tr>
<td></td>
<td>Mechanical Engineering/Production &amp; Industrial Engineering/ Refrigeration &amp; Air Conditioning/ Foundry Technology/Industrial/Production Engineering/Maintenance of Plant &amp; Machinery/ Welding Technology/Tool and Die/ Automobile/ Mechatronics/Aerospace Engineering/ Aerospace Engineering/Marine Engineering/ Mechanical Engineering (RAC).</td>
</tr>
</tbody>
</table>

Note: Candidates are required to fill one form for the discipline(s) mentioned at each SR. No. e.g., If a candidate is willing to apply for disciplines at SR. No. 4 and SR. No. 5, then he/she is required to fill two forms with requisite fee for each form and is also required to take the entrance test of each and if he/she is interested for applying in the two different disciplines mentioned at SR. No. 5 then he is required to fill one form and appear in single test corresponding to SR. No. 5 only.

2.2 NUMBER OF SEATS

Lateral Entry admission to BE/BTech programme for diploma holders & BSc (Non-Medical) at the 2nd year (3rd Semester) level will be made through Lateral Entry Engineering Test (LEET) to be conducted by Thapar University (LEET-TU) for 10% seats of sanctioned seats of 2015-16 in all UG programs mentioned in 2.1.

2.3 FEE: The candidates admitted through LEET-TU (2016) are required to deposit the same tuition fee and other dues as applicable to the candidates admitted in BE/BTech through JEE (main)-2016 in the session 2016-17.

2.4 GENERAL INFORMATION REGARDING LEET-TU OFFLINE ENTRANCE TEST INCLUDING ENTRANCE TEST SYLLABUS

I) For Diploma holders

There will be two papers as per details given below:

Paper-I General
Paper-II Professional

Duration of Test: 120 minutes (100 Questions)

The question paper will contain multiple choice objective type questions of one mark each.

Paper-I shall contain 40 questions in all with 10 questions in each of Physics, Chemistry, Mathematics and English. Paper-II shall contain 60 questions in the relevant engineering discipline each carrying one mark.

Negative Marking: 1/4th marks shall be deducted for each wrong answer.
**PAPER-I GENERAL MATHEMATICS**

**Algebra:** Quadratic equation, equations reducible to quadratic form, relation between roots and coefficients. Arithmetic progression, Geometric progression, series of natural numbers, partial fractions, Binomial Theorem and its applications. **Trigonometry:** Trigonometric ratios and their relations, Ratios of some standard angles, solution of trigonometric equations, sum and difference formulae, product formulas. Multiple and sub-multiple angles, solution of triangles.

**Co-ordinate Geometry:** Cartesian Co-ordinates, Equations of straight lines in various forms, Intersection of two straight lines, angles between two lines, Distance formulae, Equation of a circle in various forms, Tangent and normal to a circle. **Differential Calculus:** Concept of a function, limit, standard limits, Continuity, Differentiation, their geometrical and physical meanings, Differentiation from first principles, Differentiation of sum, product, quotient of functions, function of a function, Differentiation of implicit functions, trigonometric functions and logarithmic differentiation.

**Integral Calculus:** Definite and Indefinite integrals, method of integration by substitution, by parts and partial fractions, Integration of rational and irrational functions.

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**PHYSICS**

**Heat:** Heat as a form of energy, Mechanical equivalent of heat (Joule's experiment), Specific heat of a gas, Measurement of temperature, Platinum resistance and thermoelectric thermometers, Temperature scales, kinetic interpretation of temperature, Thermal expansion. Modes of heat transfer, Searle's method and Lee's method for thermal conductivity, Black body radiations, Stefan's law, Wien's law.

**Acoustics:** Wave motion, velocity of sound, Newton's formula and Laplace's correction, Beats, Doppler Effect, Intensity of sound waves, Reverberation, Acoustics of buildings, Production and detection of ultrasonic waves.

**Optics:** Refraction through a compound plate, total internal reflection, Optical fiber, image formation by spherical mirrors/lenses, Lens maker's formula, Chromatic aberration and its removal, Optical instruments- simple and compound microscopes, Astronomical telescope, Magnifying power & resolving power, Huygerns principle & its applications, Young's double slit experiment, Diffraction through a single slit, Polarisation of light.

**Electricity and Magnetism:** Electric field and electric potential, Electric dipole and its field, Gauss's law and applications, Energy stored in a capacitor, Dielectrics, Current Electricity, Kirchoffs laws and applications, Slide wire bridge, Potentiometer, Ammeter, Voltmeter, Thermal and chemical effects of current.

**Electromagnetism:** Magnetic effects of current, Biot-Savart law and applications, Lorentz force, moving coil galvanometers, Laws of electromagnetic induction, Mutual and self-inductance, AC generator, Alternating currents, LR, CR, LCR, circuits.

**Modern Physics:** Determination of e/m and e of electron, Bohr's model and hydrogen spectra, Spectral series, Photoelectric effect, Matter waves.

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**CHEMISTRY**

**Structure and bonding:** Fundamental particles, Heisenberg's uncertainty principle, Quantum numbers, Pauli's exclusion principle, Aufbau rule, Hund's rule, ionic and Covalent bond, orbital concept of covalency, Hybridization (sp, sp2 and sp3). **Chemical Equilibria, Electrochemistry and Redox Chemistry:** Balancing Chemical equations, Oxidation and Reduction reactions, electronic Concept, balancing redox reactions by oxidation number method, Faraday's laws of Electrolysis and its application in Electroplating, Electrometallurgy and Electrorefining, Degree of ionisation, Equilibria in aqueous solutions, solubility product and common ion effect, Modern concepts of acid & base, their strength and ionization constant, pH value, acid base titrations, choice of indicators and Buffer solutions.


ENGLISH

Idioms and phrases and their usage, Correction of sentences, sentence structure, sequence of tenses. Parts of speech, Words often confused in the form of pair of words, Common synonyms and antonyms, Active and Passive voice, Direct and indirect speech, Punctuation.

PAPER-II PROFESSIONAL

A. For candidates seeking admission to the disciplines of MECHANICAL ENGINEERING/MECHANICAL ENGINEERING (PRODUCTION)/MECHATRONICS


Description of various types of Boilers, boiler mountings and accessories. Basic concepts of thermal conduction, convection and radiation. Basic equations of different cases of Conduction, Convection (natural and forced) and radiation. Concept of Black, white and opaque bodies, Stefan Boltzmanns laws.


**Refrigeration and Air Conditioning:** Basic concepts and principles of refrigeration: Refrigeration methods. Air refrigeration cycle, vapour compression cycle, simple vapour absorption cycle, their applications and limitations. Refrigerants: Important properties of refrigerants, properties and applications of commonly used refrigerants such as R11, R12, R22, NH3 etc. Air conditioning, its concepts. Human comfort, application of air conditioning, Description of room air conditioning, packages air conditioner, central air conditioning system.

**Theory of Machines:** Simple mechanisms: Flywheels, Co-efficient of friction, Motion of a body along horizontal and inclined planes. Friction in screw jack, friction between nut and screw square and V-threads. Concept of power transmission, various power transmission systems with their merits and demerits. Flat and V-belts drives, ratio of tensions. Horse power transmitted, centrifugal tension, condition for maximum power transmission, and function of governors. Definitions of sensitivity, stability, synchronism and hunting of governors, description and simple problems on watt, porter and Hartnell governor.

B. For candidates seeking admission to the disciplines of ELECTRONICS & COMMUNICATION ENGINEERING, ELECTRONICS & COMPUTER ENGINEERING and ELECTRONICS (INSTRUMENTATION & CONTROL) ENGINEERING

**Network Analysis:** Circuit laws and their applications in solving problems, Network theorems, all types of network, one port, two port, symmetrical, unsymmetrical balanced, T. Ladder, lattice, bridge, their characteristic impedance. Attenuators, filters. Concept of different types of filters, Impedance matching of filters. Transmission lines, concept and applications, characteristics impedance, different methods of loading, concepts of reflection and standing waves.

**Analog Electronics**
PN junction diode, V-I characteristics, Diode as half wave, full wave and bridge rectifier, Zener diodes, Concepts of bipolar transistors and common base common emitter, common collector configuration and parameters. Different types of amplifiers, working principles and expression of voltage gain, current gain, input impedance, output impedance, etc. Working principles of Multi-vibrators, time base, operational amplifier, timer and regulated power supply.
**Digital Electronics** Binary and hexadecimal number system, Binary addition, subtraction, multiplication and division, Logic Gates, DE Morgan’s Theorems, K-Map, TTL and MOS families, BCD, excess-3 and Gray code, Arithmetic circuits, Decoders, Multiplexers and De-Multiplexers, flip flops, Counters, Types of RAM/ROM, A/D and D/A conversion.

**Computer Architecture and Microprocessors:** Design of basic computer, Introduction to RISC, CISC architecture, Control Unit – Hard wired and Micro programmed, Pipeline processing, Memory Hierarchy, associative memory, cache memory, virtual memory, I/O organization. CPU, Microprocessor, structure of 8085. Instruction set, addressing modes, Instruction Cycle, Register Organization, Simple programming in assembly language. Input/output operations, concept of interrupts structure, Microprocessor applications.

**Programming Language C:** Constants, variables and data types, Operators and Expressions, Control Structures, Functions, Arrays, Pointers, Strings, Structure and Unions, File Handling.

**Operating System (OS)**


**C. For candidates seeking admission to the disciplines of COMPUTER ENGINEERING/COMPUTER ENGINEERING (with specialization in Machine Learning and Data Analytics)/COMPUTER ENGINEERING (with specialization in Computer Animation and Gaming)**

**Analog & Digital Electronics**
PN junction diode, V-I characteristics, Diode as half wave, full wave and bridge rectifier, Zener diodes, CB, CE, CC configuration of the transistor, Binary and hexadecimal number system, Binary addition, subtraction, multiplication and division, Logic Gates, DE Morgan’s Theorems, K-Map, TTL and MOS families, BCD, excess-3 and Gray code, Arithmetic circuits, Decoders, Multiplexers and De-Multiplexers, flip flops, Counters, Types of RAM/ROM, A/D and D/A conversion.

**Programming Language C**
Constants, variables and data types, Operators and Expressions, Control Structures, Functions, Arrays, Pointers, Strings, Structure and Unions, File Handling.

**System Analysis and Design**
Introduction to Databases
Architectures of Database Management Systems, data independence, ER Diagrams, Introduction to network, hierarchical and relational model, Domain, Attributes, Tuples and Relations, Entity and referential integrity, keys, Normalization, First, Second and Third normal forms, Boyce/Codd normal form, Structured Query Language: DDL and DML statements.

Data Structure
Basics, Arrays, Operations on arrays with Algorithms (searching, traversing, inserting, deleting), Traversing a linked list, searching linked list, Insertion and deletion into linked list, Application of linked lists, doubly linked lists, Stacks, Queues, Binary Trees, Search algorithm (Linear and Binary), Sorting algorithms (Bubble Sort, Insertion Sort, Quick Sort, Selection Sort, Merge Sort, Heap Sort) and their comparisons.

Computer Architecture
Instruction Code, Instruction Cycle, Instruction types, Design of basic computer, Register Organization, Addressing modes, Introduction to RISC, CISC architecture, Control Unit – Hard wired and Micro programmed, Pipeline processing, Memory Hierarchy, associative memory, cache memory, virtual memory, I/O organization.

Data Communication and Computer Networks

Object Oriented Programming Using C++
Procedure oriented programming Vs. Object oriented programming (OOP), Classes, Objects, reusability, encapsulation, dynamic binding, message passing, Constructor and Destructor, Member Functions, Overloading Member Functions, Inheritance, Protected, private and public data, types of inheritance, single inheritance, hierarchical inheritance, multiple inheritance, Polymorphism and Virtual Functions.

Operating System (OS)

D. For candidates seeking admission to the discipline of ELECTRICAL ENGINEERING


Three Phase Induction Motor: Slip, torque & their various relations. Torque-slip characteristics, equivalent circuit, starting, testing, speed control, maintenance.

Single Phase Induction Motor: Torque/Speed characteristics, methods of producing starting torque, capacitor, shaded pole and reluctance motors.


Measuring Instruments: Indicating, integrating and recording instruments: deflecting, controlling and damping torques; moving coil and moving iron instruments, sources of errors extension range Watt-meters, Dynamometer type, maximum demand indicators, Energy-meters-single phase and three phase, Megger, Earth tester, Multi-meter, power factor meter.


E. For candidates seeking admission to the discipline of CIVIL ENGINEERING


Surveying: Linear measurements with tape, corrections, chain surveying, offsets, perpendicular offset, oblique offset, measurement of offsets, limiting length of offset, Field book, Instructions for booking field notes, Instruments for setting out right angles, Compass surveying, Prismatic compass. Surveyor’s compass, comparison between prismatic and surveyor’s compass, meridians & bearings, calculation of included angles from bearings, calculation of bearing from including angles, local attraction, magnetic declination levelling, types of levels. Principles of levelling, Classification of levelling, Rise & Fall method,
Height of Instrument method, various corrections in levelling. Theodolite surveying, measurement of angle by theodolisty.

**Transportation Engineering:** Introduction of Transportation Engineering, Traffic Engineering, Road materials, Geometric design, Design of flexible and rigid pavements, Road maintenance, Railway Engg. Rails, Sleepers, ballast, points and crossing. Track laying and track maintenance, typical sections of tunnel, method of construction of tunnels in soft rock.


**Fluid Mechanics, Irrigation and Water Supply Engineering:** Specific weight, density, specific gravity, viscosity, vapour pressure, cohesion, adhesion, surface tension, capilarity and compressibility. Pressure, intensity of pressure, pressure head, and pascal’s Law and its applications. Total pressure, resultant pressure and center of pressure on rectangular, triangular, trapezoidal, circular and curved surfaces. Atmospheric, gauge and absolute pressure, simple differential manometers. Steady and unsteady flow, laminar and turbulent flow, uniform and non-uniform flow. Discharge and continity equation, Bernoulli’s theorem, statement and description, venturimeter, orifices, time of emptying tanks of uniform cross section by a single orifice. Laminar and turbulent flow explained through. Reynolds experiments. Reynolds number and critical velocity and velocity distribution, losses in pipes, hydraulic gradient line, and total energy line flow from one reservoir to another through a long pipe of uniform and composite section. Water hammer, uniform and non-uniform flow, discharge through channels using chezy’s formula and Manning’s formula. Most economical sections, rectangular, trapezoidal and circular. Measurement of discharge by notches and weirs, measurement of velocity by Pitot tube and current meter. Introduction to irrigation Engg. Flow irrigation, head works and river training works, water logging, water supply, sources of water, Water treatment. Types of pipes, lying of pipes. Quality of sewage, laying of sewers, Building drainage and rural sanitation.

**F. For candidates seeking admission to the discipline of CHEMICAL ENGINEERING**

**Basic Chemical Engineering:** Units & conversions, Dimensional analysis, Gas Law, Material Balance consisting key components, simultaneous Equation by pass and recycle. Energy Balance. The first law type of heat effects, heat capacities, thermochemistry.

**Fluid Flow and Mechanical Operation:** Flow of incompressible Fluids, Laminar and Turbulent Flow in Pipes, Frictional Losses in pipes.

**Flow Measurement:** Pitot tube orifice meter, venturimeter, Rotamater, Weir & Notches, (their construction and derivation with formula).

**Transportation of Fluids:** Classification of Pumps, construction and operation of reciprocating, rotary, centrifugal and gear Pumps. Different type of valves, fans, blowers and compressors. Description of various size reduction equipments and laws for power requirement. Separations, Screening, filtration thickeners, classifiers, Centrifuges and cyclone separator.
**Heat Transfer & Mass Transfer**

**Heat Transfer:** Conduction, Fourier’s law, Heat Flow through composite walls, Cylinders and spheres, insulations.

**Convection:** Natural & Forced convection, LMTD, Significance of Reynold number, Prandit’s number and Grashof Number.

**Radiation:** Kirchoff’s Law, Emissive power, wein’s displacement law, Stefan Boltzman law, Emissivity, Absorptivity, Black Body and Green Body radiations. Boiling, Condensation and evaporation, Heat Exchanger: Double Pipe Shell & Tube. **Mass Transfer:** Principles and Description of various unit operations involving mass transfer such as Distillation, Absorption, Extraction, crystallization & Drying.

**Unit Processes & Process Technology:** Principles of some unit Processes such as Nitration. Sulphonation, Halozenation, Oxidation, Reduction, and Products based on them. Basic Processes for the manufacture of products such as sugar, Fertilizer. Dyestuffs and paints.


**Analyzers:** PH meter, oxygen analyzer colorimetric analyzers. Infra-red& near Infix analyzer.

**Transmission:** Pneumatic and Inductance transmission. Concept and advantage of automatic Process Control.

**Controllers:** Pneumatic, Electronics, hydraulic, FD, TI, ID Controllers.

**Engineering Material:** Types of Different materials, such as metals, alloys and polymer their structure. Composition and application of these materials for various situations in Chemical Industry.

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**Sample Questions PAPER – 1(GENERAL)**

**PHYSICS**

1. The earth receives solar radiation, from which one can find the temperature of the surface of the sun. The approximate temperature of sun’s surface is
   (A) 600 K  (B) 900 K  (C) 60,000 K  (D) 6,000 K

2. The characteristics of a fuse wire should be
   (A) low resistivity and high melting point. (B) high resistivity and high melting point. (C) high resistivity and low melting point. (D) low resistivity and low melting point.

**CHEMISTRY**

1. When HCl gas is passed through a saturated brine solution, NaCl is precipitated because
   (A) NaCl is not soluble in acidic solution.
   (B) Solubility product of NaCl decreases in presence of H⁺ ion.
   (C) Saturated solution cannot hold any more solute, hence NaCl precipitates.
   (D) In presence of Cl⁻ ion, ionic concentration exceeds solubility product of NaCl, therefore NaCl separates out.
2. When 13.5 gm of Al is deposited on passing current through molten Alumina, the number of faradays of electricity consumed would be
(A) 0.5  (B) 1.0  (C) 1.5  (D) 2.0

MATHEMATICS

1. If the quadratic equation \((a^2+b^2)x^2+2b(a+c)x+(b^2+c^2)=0\) has equal roots, then
   (A) \(a, b\) and \(c\) are in A.P.  (B) \(a, b\) and \(c\) are in G.P.
   (C) \(a, c\) and \(b\) are in A.P.  (D) \(a, c\) and \(b\) are in G.P.

2. If the angles of a triangle \(ABC\) are in the ratio 1:2:3, then the sides of the triangle are in the ratio:
   (A) 1 : 3 : 2  (B) 1 : 2 : 3  (C) 1 : 2 : 5  (D) 1 : 3 : 1

ENGLISH

1. Choose the appropriate antonym for the following: “Fundamental”
   (A) superfluous  (B) superficial  (C) profound  (D) particular

2. Choose the most appropriate ACTIVE form for the PASSIVE sentence given below:
   PASSIVE: “They are likely to be punished”
   ACTIVE:
   (A) It is likely that they will be punished.
   (B) It is likely for someone to punish them.
   (C) It is likely that someone will punish them.
   (D) Someone is likely to punish them.

PAPER – II (PROFESSIONAL)

COMPUTER ENGINEERING

1. The structure of the Colpitts oscillator is related to the
   (A) Hartley oscillator  (B) Wein Bridge oscillator  (C) Phase shift oscillator  (D) Square wave oscillator

2. Microprogramming refers to
   (A) Developing software for a small computer, like a palmtop.
   (B) Programming in any situations where the memory available is very low
   (C) Control programs for controlling gates within a CPU.
   (D) Writing programs in assembly language.

CIVIL ENGINEERING

1. A combined footing is generally used when
   (A) Number of columns is more than two and they are spaced far apart.
   (B) Number of columns is two and they are spaced far close to each other.
   (C) Number of columns is two and they are spaced far apart.
   (D) There is only one column.

2. In slow sand filters, the rate of filtration of water is in the range of
   (A) 175-250 lits/sqm/hr  (B) 500-1000 lits/sqm/hr
1. When fluid flows in a pipe, the Nusselt number can be calculated from the relation
   (A) \( \frac{V \cdot D}{\Delta C_p} \) \( \frac{h \cdot D}{K} \) \( \frac{K \cdot D}{C_p} \)

2. Angle of torsion refers to the
   (A) Maximum angle by which the shaft bends during power transmission.
   (B) Angle through which one end of a shaft will twist relative to the other end.
   (C) Angular velocity of the shaft in radians.
   (D) Angular moment at the cross section.

CHEMICAL ENGINEERING

1. Stainless steel 316 contains
   (A) 18% chromium and 11% nickel
   (B) 16% chromium and 13% nickel
   (C) 11% chromium and 18% nickel
   (D) No chromium and 8% nickel.

2. The viscosity of a liquid
   (A) Is directly proportional to temperature.
   (B) Is inversely proportional to temperature.
   (C) Is directly proportional to the square root of temperature.
   (D) Is inversely proportional to the square root of temperature.

ELECTRONICS & COMMUNICATION ENGINEERING/ELECTRONICS (INSTRUMENTATION & CONTROL) ENGINEERING/ELECTRONICS & COMPUTER ENGINEERING

1. A direct coupled amplifier has a gain of 1000 and 3 dB frequency of 1000 KHz. What is its unity gain frequency?
   (A) 100 KHz  (B) 1000 KHz  (C) 10^8 Hz  (D) 10 KHz

ELECTRICAL ENGINEERING

1. For parallel operation of two alternators, which of the following factor(s) should be identical for both?
   (A) Voltage only  (B) Frequency
   (C) Phase sequence  (D) All of the above.

2. Mark the correct answer below as the load on an induction motor is increased up to full load:
   \[
   \begin{array}{ccc}
   \text{PF} & \text{Slip} & \text{Efficiency} \\
   \text{A} & \text{increases} & \text{increases} & \text{increases} \\
   \text{B} & \text{decreases} & \text{increases} & \text{increases} \\
   \text{C} & \text{decreases} & \text{decreases} & \text{decreases} \\
   \text{D} & \text{increases} & \text{decreases} & \text{decreases} \\
   \end{array}
   \]
II) For BSc (Non-Medical) holders

Duration of test: 120 minutes (100 Questions)

Physics (30 Questions) Chemistry (30 Questions) Mathematics (30 Questions) and English & Reasoning (10 Questions)

Negative Marking: 1/4<sup>th</sup>marks shall be deducted for each wrong answer.

CHEMISTRY

**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 $\mu_s$ and $\mu_{eff}$ values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal 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.


**Heterocyclic Compounds:** 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


**Nucleic acids:** 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. Polystyres, 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 ψ2, quantum numbers, Schrödinger wave equation and its importance, physical interpretation of the wave function. Hund’s rule and electronic configuration of elements.

**MATHEMATICS**

**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.

**PHYSICS**


**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.
Interpersonal skills including communication skills, anonyms/synonyms, sentence completion, active/passive voice, prepositions, direct/indirect speech, idioms & phrases. Critical reasoning, visual reasoning, assumption-premise-conclusion, assertion and reasons; statements and assumptions, identifying valid inferences, identifying strong arguments and weak arguments, statements and conclusions; cause and effect, identifying probably true, probably false, definitely true, definitely false kind of statement; linear arrangements, matrix arrangements, puzzles, family tree problem, symbol based problems; coding and decoding, sequencing, identifying next number in series, etc;