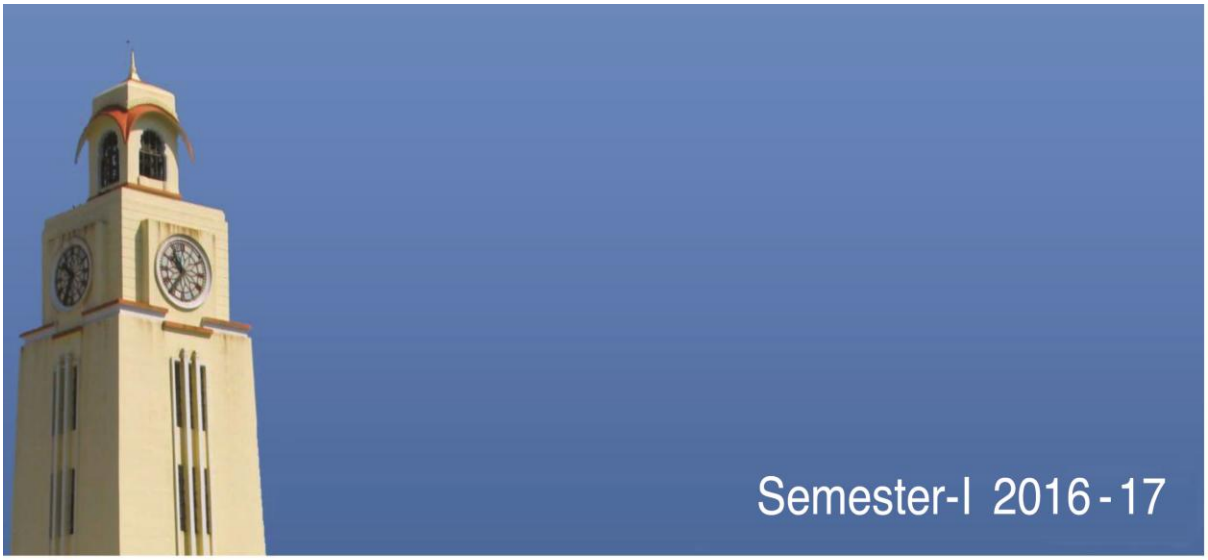

Semester-I 2016-17

BITSAT 2016

A computer based online test for admission to
Integrated First Degree Programmes of BITS, Pilani
at Pilani Campus, K.K.Birla Goa Campus & Hyderabad Campus

BITS Pilani
Pilani | Dubai | Goa | Hyderabad

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Brochure

BITSAT-2016

A Computer Based Online Test for Admission to
Integrated First Degree programmes of BITS, Pilani, 2016-17

The Birla Institute of Technology and Science (BITS) Pilani is an all India Institution declared as Deemed to be University under Section 3 of the UGC Act. Admissions to all the Integrated First Degree programmes of BITS, Pilani, at Pilani campus, Goa campus, and Hyderabad Campus for the academic year 2016-17 will be made on the basis of a Computer based Online Test conducted by BITS, Pilani. This test will be referred to as 'BITS Admission Test – 2016', in short as **BITSAT-2016** hereafter in this document.

1. Integrated First Degree Programmes to which admissions will be made on the basis of BITSAT-2016:

(i) at BITS, Pilani – Pilani Campus:

B.E.: Chemical, Civil, Computer Science, Electrical and Electronics, Electronics & Instrumentation, Mechanical, Manufacturing .

B.Pharm.;

M.Sc.: Biological Sciences, Chemistry, Economics, Mathematics, Physics and

M.Sc.: General Studies.

(ii) at BITS, Pilani – K. K. Birla Goa Campus:

B.E.: Chemical, Computer Science, Electrical and Electronics, Electronics & Instrumentation, Mechanical.

M.Sc.: Biological Sciences, Chemistry, Economics, Mathematics, Physics.

(iii) at BITS, Pilani – Hyderabad Campus:

B.E.: Chemical, Civil, Computer Science, Electronics & Communication, Electrical and Electronics, Electronics & Instrumentation, Mechanical, Manufacturing.

B.Pharm.;

M.Sc.: Biological Sciences, Chemistry; Economics, Mathematics, Physics

2. Eligibility:

(i) **For admission to all the above programmes except B.Pharm.:** Candidates should have passed the 12th examination of 10+2 system from a recognized Central or State board or its equivalent with Physics, Chemistry, and Mathematics and adequate proficiency in English.

(ii) **For admission to B.Pharm.**: Candidates should have passed the 12th examination of 10+2 system from a recognized Central or State board or its equivalent with Physics, Chemistry, and Biology and adequate proficiency in English. However candidates with PCM may also apply for Pharmacy program.

Admission to all the programmes is subject to the conditions given below.

The candidate should have obtained a minimum of aggregate 75% marks in Physics, Chemistry and Mathematics subjects (if he/she has taken Mathematics in BITSAT) or a minimum of aggregate 75% marks in Physics, Chemistry and Biology subjects (if he/she has taken Biology in BITSAT) subjects in 12th examination, with at least 60% marks in each of the Physics, Chemistry, and Mathematics / Biology subjects.

Only Students who are appearing for 12th examination in 2016 or who have passed 12th Examination in 2015 are eligible to appear in the BITSAT-2016 test. If a candidate has taken more than one attempt in 12th class or its equivalent, only his latest performance is considered, provided this attempt has been for the full component of subjects/courses prescribed. Students who have passed 12th examination in 2014 or earlier are NOT eligible to appear in BITSAT-2016. Students who are presently studying in BITS at any of its campuses are not eligible to appear in BITSAT-2016.

Admissions will be made purely on merit. The merit position of the candidate for admission will be based on the score obtained by the candidate in the BITSAT-2016. However, their eligibility for admission is subject to fulfilling the requirement of minimum marks in 12th examination, as mentioned above.

Direct Admission to Board Toppers:

In the past, admission process of the Institute always ensured guaranteed admission to all the students who obtained first ranks in their respective board examinations. This has given a very vital input of highly meritorious students from all over India. First rank students of all the central and state boards in India for the year 2016 will be given direct admission to the program of their choice, irrespective of their BITSAT-2016 score as per the eligibility criteria mentioned above. Further details about this scheme will be available at BITS website by 20th May, 2016.

3. Details of BITSAT-2016:

'Computer Based Online test' means the candidate sits in front of a computer and the questions are presented on the computer monitor and the candidate answers the questions on the computer through the use of keyboard or mouse. Each computer is connected to a server, which prepares the question set and delivers it to the candidate on the computer. This is unlike the traditional paper-pencil based test, which is generally offered on a single day to all candidates. BITSAT-2016 will be offered over a period of time and the candidate can choose the Center, the Day and Time of his/her convenience to take the test, as described in the later sections.

BITSAT-2016 Test Format:

BITSAT-2016 will be of total 3-hour duration (without break). The test consists of four parts:

Part I	:	Physics
Part II	:	Chemistry
Part III	:	(a) English Proficiency and (b) Logical Reasoning
Part IV	:	Mathematics or Biology (For B.Pharm candidates)

All questions are of objective type (multiple choice questions); each question with choice of four answers, only one being correct choice. Each correct answer fetches 3 marks, while each incorrect answer has a penalty of 1 mark (-1mark). No marks are awarded for questions not attempted. While the candidate can skip a question, the computer will not allow the candidate to choose more than one option as correct answer. There will be 150 questions in all. The number of questions in each part is as follows:

	Subject	**No of questions**
Part I	Physics	40
Part II	Chemistry	40
Part III	(a) English Proficiency	15
	(b) Logical Reasoning	10
Part IV	Mathematics/Biology (For B.Pharm)	45
	Total:	**150**

There is no time limit for individual parts of the test. The candidate can go back and change any of his/her answers among the 150 questions.

If a candidate answers all the 150 questions (without skipping any question), the candidate will have an option of attempting 12 (twelve) extra questions, if there is still time left. These extra questions will be from Physics, Chemistry, and Mathematics/Biology only; four questions from each part. Further, once the candidate has opted for extra questions, he cannot go back for correction of any of the earlier answered 150 questions.

The questions are so designed that a good student will be able to answer 150 questions in 180 minutes. The extra questions (a maximum of 12) will give a chance to highly meritorious candidates to score higher. However, candidates should keep in mind the fact that there is negative marking for wrong answers and any attempt to answer the questions by pure guessing of the answers is not likely to have any advantage, but may result in a reduction in the total score.

The questions will be selected at random from a large question bank. Different candidates will get different question sets. An expert committee will ensure that the question sets are of comparable difficulty level, content, question type etc. In this matter, the decision of the expert committee will be final and binding on the candidate.

All the questions and instructions of the test will be in English only. Candidates should bring a pen for the purpose of rough work, signing etc. Blank sheets for rough work will be provided, if required. Calculators and logarithmic tables are not allowed in the test centers. Candidates are not allowed to bring any other personal belongings such as mobiles.

Each candidate who registers for BITSAT-2016 will be instructed to download a ‘Hall Ticket’. Candidates with the hall ticket only will be allowed inside the Test centers. All centers are

closely monitored for security and candidates' identity and activities will be recorded using web cameras and/or closed circuit TV cameras. Candidate's finger print and photograph will be taken at the time of the test and will be matched at the time of admission. Anyone violating the rules of the test center will not be allowed to continue with the test and will automatically be disqualified.

Syllabus:

The BITSAT-2016 test will be conducted on the basis of NCERT syllabus for 11th and 12th class. The detailed syllabus is given in the Annexure. Candidates may refer to the NCERT textbooks for the contents. A sample test demonstrating the features of BITSAT will be made available to the registered candidates at the BITS website on which he/she can practice as many times as desired.

4. BITSAT score report:

At the completion of the test, the computer will announce the result to the candidate in terms of number of total correct answers and wrong answers, with the score. The candidate can also check and print his score report at the BITS website after all the tests are completed. No student will be allowed to repeat the test in the same year.

5. Merit List for Admission:

As explained earlier, a candidate who has appeared in BITSAT-2016 will be eligible for admission only if he/she gets the required minimum marks in the Physics, Chemistry and Mathematics subjects of 12th examination as per the eligibility criteria described already. All candidates who have appeared in BITSAT-2016 and are interested in admission will be required to submit Admission application with 12th marks and preferences to different degree programmes offered, on or before 30th June 2016, the details of this will be available in the BITS website by 20th May 2016.

The merit position of such eligible candidates (i.e., those who have appeared in BITSAT-2016 and who have submitted the application for admission in the prescribed form with 12th marks, preferences and the required fees) will be prepared on the basis of their scores in BITSAT-2016. There will be two separate merit lists prepared for admission. One for all the programmes except the B.Pharm. and, the other only for B.Pharm.. The cases of bracketing, if any, will be dealt with as described below.

When the score of two candidates are the same, first their scores obtained in Mathematics/Biology (For B.Pharm) in BITSAT will be considered for separating them, If the tie still exists, then their scores in Physics in BITSAT will be considered for separating them. Further tie is eliminated using their scores in Chemistry. Finally, their PCM/PCB(For B.Pharm) total marks in 12th examination will be considered for their separation.

6. Test Centers for BITSAT-2016:

In order to facilitate a large number of students all over India to participate in this test, **apart from Pilani, Goa and Hyderabad** campuses of BITS where it is expected that a large number of students will take the test, the Institute is also planning to offer the tests at dedicated test centers in several cities. The planned test centers are in the following cities.

1. Agra
2. Ahmedabad
3. Allahabad
4. Bangalore
5. Bhopal
6. Bhubaneswar
7. Chandigarh
8. Chennai
9. Coimbatore
10. Delhi
11. Dubai Campus of BITS (International center)
12. Ghaziabad
13. Goa Campus of BITS
14. Gorakhpur
15. Gurgaon
16. Guwahati
17. Gwalior
18. Hyderabad Campus of BITS
19. Hyderabad City
20. Indore
21. Jaipur
22. Jalandhar
23. Jammu
24. Jamshedpur
25. Jodhpur
26. Kanpur
27. Kolkatta
28. Kurnool
29. Lucknow
30. Madurai
31. Mumbai
32. Mysore
33. Nagpur
34. Nasik
35. Noida
36. Patna
37. Pilani Campus of BITS
38. Pune
39. Raipur
40. Rajkot
41. Rajamundry
42. Ranchi
43. Roorkee
44. Siliguri
45. Srinagar
46. Surat
47. Tirupati
48. Trivandrum
49. Vadodara
50. Vijayawada
51. Visakhapatnam

The candidate can choose the centers from within India or Dubai. If a candidate chooses centers within India, he/she will be asked to give three preferences and will be allotted one out of these three. **If a candidate chooses Dubai as a center, he/she will not be asked for any other center preference and will be allotted Dubai center only**.

The final list of centers in India and the operating days at each center in India and Dubai will depend on the number of applicants and their preferences and will be announced only after all the applications are received and candidates will be informed of the same through BITS website, so that the candidates can choose their date for the test as per their convenience and availability of slots in any of these centers.

7. Important dates and deadlines:

Deadline to apply for BITSAT-2016	:	**5th March 2016**
Revision/Editing in the application form by candidates	:	**6th – 7th March 2016**
Test center allotment and announcement to candidates	:	**8th March 2016**
Candidates to reserve Test dates	:	**21st March – 10th April 2016**
Candidates to download the Hall tickets with instructions	:	**20th April – 30th April 2016**
BITSAT Online tests	:	**14th May – 28th May 2016**
Candidates to apply for admission with 12th marks and Preferences to Degree programmes	:	**20th May – 30th June 2016**
Admit List and Wait List announcement	:	**1st July 2016**

8. How to Apply:

Interested candidates should register their names for BITSAT-2016 by applying in the prescribed application form online. Complete the application form online at *http://www.bitsadmission.com* and pay the prescribed fees. Also take the print out of the filled form for your future reference**. The prescribed fee for BITSAT 2016 is Rs. 2200/-(Rs. 1700/- for female candidates).**

If a candidate chooses Dubai as a test center the application fee for both male and female candidates will be same and will be US $ 50 (or Indian Rs. 3000/-). Details for payment of fees are available at the website while applying online.

Deadline to apply for BITSAT-2016 online along with the fee payment is 5th March 2016, 5 PM.

Those who register for the test and reserve test dates have to download the 'Hall ticket', alongwith instructions, from BITS website as per the schedule given earlier. The tests will be conducted during 14th May – 28th May 2016.

9. Procedure for Applying for admission:

In addition to applying and appearing for BITSAT-2016, candidates have to also apply for admission to BITS giving details of their 12th marks and preferences to different degree programmes offered. The prescribed application form for admission, the detailed application procedure, details of academic flexibilities such as Dual Degree, Transfer etc ; admission modality and the final list of Degree programmes offered will be available at the BITS website, by 20th May 2016. The completed form with the required application fee has to be submitted so as to reach the under-mentioned on or before 5.00 PM on 30th June 2016.

The Dean Admissions,
BITS
Pilani – 333 031
Rajasthan

10. Board codes

The codes for the name of the Board from which you have passed/ appearing in the 12th examination are as follows:

	Name of the Board and Examination	Board Code
i)	Central Board of Secondary Education - All India Senior School Certificate Examination	CBAT
ii)	Council for the Indian School Certificate Examination - Indian School Certificate (Year-12) Examination	ISCT
iii)	Board of Intermediate Education, Andhra Pradesh - Intermediate Examination	APBT
iv)	Assam Higher Secondary Education Council - Higher Secondary (+2) Examination	ASBT
v)	Bihar Intermediate Council, Bihar Intermediate Examination	BICT
vi)	Board of Secondary Education, Chhatisgarh - Higher Secondary School Certificate Examination	CGBT
vii)	Goa Board of Secondary and Higher Secondary Education - Higher Secondary School Certificate Examination	GDBT
viii)	Gujarat Secondary Education Board, Gujarat - Higher Secondary Certificate Examination (10+2 Pattern)	GJBT
ix)	Board of School Education, Haryana - Senior Secondary Certificate Examination	HRBT
x)	Himachal Pradesh Board of School Education - Senior Secondary (+2) examination	HPBT
xi)	The Jammu & Kashmir State Board of School Education - Higher Secondary Part II Examination, Jammu/Kashmir Region	JKBW
xii)	Jharkhand Intermediate Council, Jharkhand Intermediate Examination	JHCT
xiii)	Board of Pre-University Examination, Karnataka - Second Year Pre-University Examination	KART
xiv)	Board of Higher Secondary Examination, Kerala - Higher Secondary Examination	KERT
xv)	Board of Secondary Education, Madhya Pradesh - Higher Secondary School Certificate Examination (10+2)	MPBT
xvi)	Maharashtra State Board of Secondary and Higher Secondary Education - Higher Secondary Certificate Examination	MSBT
xvii)	Council of Secondary Education, Manipur – Higher Secondary Examination	CHMT

	Name of the Board and Examination	Board Code
xviii)	Meghalaya Board of School Education - Higher Secondary School Leaving Certificate Examination	MEGT
xix)	Mizoram Board of School Education – Higher Secondary School Leaving Certificate Examination	MZBT
xx)	Nagaland Board of School Education - Higher Secondary School Leaving Certificate Examination;	NAGT
xxi)	Council of Higher Secondary Education, Orissa - Higher Secondary Examination	CHOT
xxii)	Punjab School Education Board - Senior Secondary Certificate Examination (Part II)	PNBT
xxiii)	Board of Secondary Education, Rajasthan - Senior Secondary Examination	RJBT
xxiv)	Board of Higher Secondary Examination, Tamil Nadu - Higher Secondary Exam.	TNBT
xxv)	Tripura Board of Secondary Education - Higher Secondary (+2 Stage) Examination	TRBT
xxvi)	Board of Intermediate Examination, Uttaranchal - Intermediate Examination	UABT
xxvii)	Board of Intermediate Examination, Uttar Pradesh - Intermediate Examination	UPBT
xxviii)	West Bengal Council of Higher Secondary Examination - Higher Secondary Examination	WBBT
xxix)	Foreign Qualifications	FORW
xxx)	Any Other Board/ University (not covered above)	AOBW

Important Notes:

i. The tests are generated from a large question bank and different candidates will get different question sets. An expert committee will ensure that the question sets are of comparable difficulty level, content, question type etc. In this matter, the decision of the expert committee will be final and binding on the candidate.

ii. The test assumes that the candidate has basic familiarity with computers, keyboard and mouse operation. It is the responsibility of the candidate to acquire these skills before appearing in the test and the Institute cannot take responsibility for the same.

iii. The Institute is planning to operate test centers in different cities other than Pilani, Goa and Hyderabad campuses of BITS as previously stated. The final list of centers and actual days of operation will be announced to candidates through the BITS website www.bitsadmission.com . The Institute cannot guarantee that test

centers will be set up in all these cities. Further, the Institute reserves the right to cancel any test center if such a situation arises. In such cases, those candidates allotted to these centers will be accommodated in alternate test centers including Pilani/Goa/Hyderabad campuses of BITS.

iv. **While BITSAT-2016 tests are scheduled to be held during the period 14th May –28th May 2016, some of the test centers may operate only for a limited duration during this period depending on the number of applications received. The final list of the centers will be announced at BITS website after all the applications are received.**

v. The preferences that you give are only indicative and are to guide the Institute for deciding the number of centers. The Institute cannot guarantee that you will get your first preference. Further, if the Institute is unable to allot any center of your choice, you will be allotted a center either at Pilani or at Goa or at Hyderabad campuses of BITS. The exact center where you will be appearing for the test will be announced at BITS website www.bitsadmission.com . However, the Institute will try its best to accommodate all female candidates at their first preference of test centers.

vi. Candidates who are allotted test centers in Pilani/Goa/Hyderabad campuses of BITS may be given accommodation on nominal charges in hostels.

vii. The candidate must fully obey the rules of the test centers; otherwise he/she will be automatically debarred from the test.

viii. **A candidate can apply online only once for BITSAT-2016. However, if a candidate completes the application form along with fee but discovers any mistake in the form submitted by him/her, he/she can edit the same during March 6-7, 2016.**

ix. In addition to applying for and appearing in BITSAT-2016, candidates have to also apply for admission to BITS as per the 'Procedure for applying for Admission' outlined earlier. The prescribed application form for admission will be available at the BITS website, by 20th May 2016, for those who appear in BITSAT-2016. The completed form with the required application fee has to be submitted so as to reach the Admissions Office on or before 5.00 PM on 30th June 2016.

x. **All information and communications regarding BITSAT-2016 and Admission to BITS are made available to the registered candidates on the BITS website www.bitsadmission.com. Candidates are advised to view the BITS website regularly for all related information on BITSAT and BITS Admissions.**

xi. In all matters in the conduct of BITSAT-2016, the decision of the Vice Chancellor of BITS will be final

xii. All disputes pertaining to BITSAT-2016 shall fall within the jurisdiction of Pilani only.

Annexure

Syllabus for BITSAT-2016

Part I: Physics

1. Units & Measurement

1.1 Units (Different systems of units, SI units, fundamental and derived units)

1.2 Dimensional Analysis

1.3 Precision and significant figures

1.4 Fundamental measurements in Physics (Vernier calipers, screw gauge, Physical balance etc)

2. Kinematics

2.1 Properties of vectors

2.2 Position, velocity and acceleration vectors

2.3 Motion with constant acceleration

2.4 Projectile motion

2.5 Uniform circular motion

2.6 Relative motion

3. Newton's Laws of Motion

3.1 Newton's laws (free body diagram, resolution of forces)

3.2 Motion on an inclined plane

3.3 Motion of blocks with pulley systems

3.4 Circular motion – centripetal force

3.5 Inertial and non-inertial frames

4. Impulse and Momentum

4.1 Definition of impulse and momentum

4.2 Conservation of momentum

4.3 Collisions

4.4 Momentum of a system of particles

4.5 Center of mass

5. Work and Energy

5.1 Work done by a force

5.2 Kinetic energy and work-energy theorem

5.3 Power

5.4 Conservative forces and potential energy

5.5 Conservation of mechanical energy

6. Rotational Motion

6.1 Description of rotation (angular displacement, angular velocity and angular acceleration)

6.2 Rotational motion with constant angular acceleration

6.3 Moment of inertia, Parallel and perpendicular axes theorems, rotational kinetic energy

6.4 Torque and angular momentum

6.5 Conservation of angular momentum

6.6 Rolling motion

7. Gravitation

7.1 Newton's law of gravitation

7.2 Gravitational potential energy, Escape velocity

7.3 Motion of planets – Kepler's laws, satellite motion

8. Mechanics of Solids and Fluids

8.1 Elasticity

8.2 Pressure, density and Archimedes' principle

8.3 Viscosity and Surface Tension

8.4 Bernoulli's theorem

9. Oscillations

9.1 Kinematics of simple harmonic motion

9.2 Spring mass system, simple and compound pendulum

9.3 Forced & damped oscillations, resonance

10. Waves

10.1 Progressive sinusoidal waves

10.2 Standing waves in strings and pipes

10.3 Superposition of waves, beats

10.4 Doppler Effect

11. Heat and Thermodynamics

11.1 Kinetic theory of gases

11.2 Thermal equilibrium and temperature

11.3 Specific heat, Heat Transfer - Conduction, convection and radiation, thermal conductivity, Newton's law of cooling

11.4 Work, heat and first law of thermodynamics

11.5 2^{nd} law of thermodynamics, Carnot engine – Efficiency and Coefficient of performance

12. Electrostatics

12.1 Coulomb's law

12.2 Electric field (discrete and continuous charge distributions)

12.3 Electrostatic potential and Electrostatic potential energy

12.4 Gauss' law and its applications

12.5 Electric dipole

12.6 Capacitance and dielectrics (parallel plate capacitor, capacitors in series and parallel)

13. Current Electricity

13.1 Ohm's law, Joule heating

13.2 D.C circuits – Resistors and cells in series and parallel, Kirchoff's laws, potentiometer and Wheatstone bridge,

13.3 Electrical Resistance (Resistivity, origin and temperature dependence of resistivity).

14. Magnetic Effect of Current

14.1 Biot-Savart's law and its applications

14.2 Ampere's law and its applications

14.3 Lorentz force, force on current carrying conductors in a magnetic field

14.4 Magnetic moment of a current loop, torque on a current loop, Galvanometer and its conversion to voltmeter and ammeter

15. Electromagnetic Induction

15.1 Faraday's law, Lenz's law, eddy currents

15.2 Self and mutual inductance

15.3 Transformers and generators

15.4 Alternating current (peak and rms value)

15.5 AC circuits, LCR circuits

16. Optics

16.1 Laws of reflection and refraction

16.2 Lenses and mirrors

16.3 Optical instruments – telescope and microscope

16.4 Interference – Huygen's principle, Young's double slit experiment

16.5 Interference in thin films

16.6 Diffraction due to a single slit

16.7 Electromagnetic waves and their characteristics (only qualitative ideas), Electromagnetic spectrum

16.8 Polarization – states of polarization, Malus' law, Brewster's law

17. Modern Physics

17.1 Dual nature of light and matter – Photoelectric effect, De Broglie wavelength

17.2 Atomic models – Rutherford's experiment, Bohr's atomic model

17.3 Hydrogen atom spectrum

17.4 Radioactivity

17.5 Nuclear reactions : Fission and fusion, binding energy

18. Electronic Devices

18.1 Energy bands in solids (qualitative ideas only), conductors, insulators and semiconductors;

18.2 Semiconductor diode – *I-V* characteristics in forward and reverse bias, diode as a rectifier; *I-V* characteristics of LED, photodiode, solar cell, and Zener diode; Zener diode as a voltage regulator.

18.3 Junction transistor, transistor action, characteristics of a transistor; transistor as an amplifier (common emitter configuration) and oscillator

18.4 Logic gates (OR, AND, NOT, NAND and NOR). Transistor as a switch.

Part II: Chemistry

1. States of Matter

1.1 Measurement: Physical quantities and SI units, Dimensional analysis, Precision, Significant figures.

1.2 Chemical reactions: Laws of chemical combination, Dalton's atomic theory; Mole concept; Atomic, molecular and molar masses; Percentage composition empirical & molecular formula; Balanced chemical equations & stoichiometry

1.3 Three states of matter, intermolecular interactions, types of bonding, melting and boiling points

Gaseous state: Gas Laws, ideal behavior, ideal gas equation, empirical derivation of gas equation, Avogadro number, Kinetic theory – Maxwell distribution of velocities, Average, root mean square and most probable velocities and relation to temperature, Diffusion; Deviation from ideal behaviour – Critical temperature, Liquefaction of gases, van der Waals equation.

1.4 Liquid state: Vapour pressure, surface tension, viscosity.

1.5 Solid state: Classification; Space lattices & crystal systems; Unit cell in two dimensional and three dimensional lattices, calculation of density of unit cell – Cubic & hexagonal systems; Close packing; Crystal structures: Simple AB and AB2 type ionic crystals, covalent crystals – diamond & graphite, metals. Voids, number of atoms per unit cell in a cubic unit cell, Imperfections-Point defects, non-stoichiometric crystals; Electrical, magnetic and dielectric properties; Amorphous solids – qualitative description. Band theory of metals, conductors, semiconductors and insulators, and n- and p- type semiconductors.

2. Atomic Structure

2.1 Introduction: Radioactivity, Subatomic particles; Atomic number, isotopes and isobars, Thompson's model and its limitations, Rutherford's picture of atom and its limitations; Hydrogen atom spectrum and Bohr model and its limitations.

2.2 Quantum mechanics: Wave-particle duality – de Broglie relation, Uncertainty principle; Hydrogen atom: Quantum numbers and wavefunctions, atomic orbitals and their shapes (s, p, and d), Spin quantum number.

2.3 Many electron atoms: Pauli exclusion principle; Aufbau principle and the electronic configuration of atoms, Hund's rule.

2.4 Periodicity: Brief history of the development of periodic tables Periodic law and the modern periodic table; Types of elements: s, p, d, and f blocks; Periodic trends: ionization energy, atomic, and ionic radii, inter gas radii, electron affinity, electro negativity and valency. Nomenclature of elements with atomic number greater than 100.

3. Chemical Bonding & Molecular Structure

3.1 Valence electrons, Ionic Bond: Lattice Energy and Born-Haber cycle; Covalent character of ionic bonds and polar character of covalent bond, bond parameters

3.2 Molecular Structure: Lewis picture & resonance structures, VSEPR model & molecular shapes

3.3 Covalent Bond: Valence Bond Theory- Orbital overlap, Directionality of bonds & hybridization (s, p & d orbitals only), Resonance; Molecular orbital theory- Methodology, Orbital energy level diagram, Bond order, Magnetic properties for homonuclear diatomic species (qualitative idea only).

3.4 Metallic Bond: Qualitative description.

3.5 Intermolecular Forces: Polarity; Dipole moments; Hydrogen Bond.

4. Thermodynamics

4.1 Basic Concepts: Systems and surroundings; State functions; Intensive & Extensive Properties;

Zeroth Law and Temperature

4.2 First Law of Thermodynamics: Work, internal energy, heat, enthalpy, heat capacities and specific heats, measurements of ΔU and ΔH, Enthalpies of formation, phase transformation, ionization, electron gain; Thermochemistry; Hess's Law, Enthalpy of bond dissociation, combustion, atomization, sublimation, solution and dilution

4.3 Second Law: Spontaneous and reversible processes; entropy; Gibbs free energy related to spontaneity and non-spontaneity, non-mechanical work; Standard free energies of formation, free energy change and chemical equilibrium

4.4 Third Law: Introduction

5. Physical and Chemical Equilibria

5.1 Concentration Units: Mole Fraction, Molarity, and Molality

5.2 Solutions: Solubility of solids and gases in liquids, Vapour Pressure, Raoult's law, Relative lowering of vapour pressure, depression in freezing point; elevation in boiling point; osmotic pressure, determination of molecular mass; solid solutions, abnormal molecular mass, van't Hoff factor. Equilibrium: Dynamic nature of equilibrium, law of mass action

5.3 Physical Equilibrium: Equilibria involving physical changes (solid-liquid, liquid-gas, solid-gas), Surface chemistry, Adsorption, Physical and Chemical adsorption, Langmuir Isotherm, Colloids and emulsion, classification, preparation, uses.

5.4 Chemical Equilibria: Equilibrium constants (K_P, K_C), Factors affecting equilibrium, Le-Chatelier's principle.

5.5 Ionic Equilibria: Strong and Weak electrolytes, Acids and Bases (Arrhenius, Lewis, Lowry and Bronsted) and their dissociation; degree of ionization, Ionization of Water; ionization of polybasic acids, pH; Buffer solutions; Henderson equation, Acid-base titrations; Hydrolysis; Solubility Product of Sparingly Soluble Salts; Common Ion Effect.

5.6 Factors Affecting Equilibria: Concentration, Temperature, Pressure, Catalysts, Significance of ΔG and ΔG^0 in Chemical Equilibria.

6. Electrochemistry

6.1 Redox Reactions: Oxidation-reduction reactions (electron transfer concept); Oxidation number; Balancing of redox reactions; Electrochemical cells and cell reactions; Standard electrode potentials; EMF of Galvanic cells; Nernst equation; Factors affecting the electrode potential; Gibbs energy change and cell potential; Secondary cells; dry cells, Fuel cells; Corrosion and its prevention.

6.2 Electrolytic Conduction: Electrolytic Conductance; Specific and molar conductivities; variations of conductivity with concentration , Kolhrausch's Law and its application, Electrolysis, Faraday's laws of electrolysis; Coulometer; Electrode potential and electrolysis, Commercial production of the chemicals, NaOH, Na, Al, Cl_2 & F_2.

7. Chemical Kinetics

7.1 Aspects of Kinetics: Rate and Rate expression of a reaction; Rate constant; Order and molecularity of the reaction; Integrated rate expressions and half life for zero and first order reactions.

7.2 Factor Affecting the Rate of the Reactions: Concentration of the reactants, catalyst; size of particles, Temperature dependence of rate constant concept of collision theory (elementary idea, no mathematical treatment); Activation energy; Catalysis, Surface catalysis, enzymes, zeolites; Factors affecting rate of collisions between molecules.

7.3 Mechanism of Reaction: Elementary reactions; Complex reactions; Reactions involving two/three steps only.

7.4 Surface Chemistry

Adsorption – physisorption and chemisorption; factors affecting adsorption of gasses on solids; catalysis: homogeneous and heterogeneous, activity and selectivity: enzyme catalysis, colloidal state: distinction between true solutions, colloids and suspensions; lyophillic, lyophobic multi molecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulations; emulsions – types of emulsions.

8. Hydrogen and s-block elements

8.1 Hydrogen: Element: unique position in periodic table, occurrence, isotopes; Dihydrogen: preparation, properties, reactions, and uses; Molecular, saline, ionic, covalent, interstitial hydrides; Water: Properties; Structure and aggregation of water molecules; Heavy water; Hydrogen peroxide: preparation, reaction, structure & use, Hydrogen as a fuel.

8.2 s-block elements: Abundance and occurrence; Anomalous properties of the first elements in each group; diagonal relationships; trends in the variation of properties (ionization energy, atomic & ionic radii).

8.3 Alkali metals: Lithium, sodium and potassium: occurrence, extraction, reactivity, and electrode potentials; Biological importance; Reactions with oxygen, hydrogen, halogens water and liquid ammonia; Basic nature of oxides and hydroxides; Halides; Properties and uses of compounds such as NaCl, Na_2CO_3, $NaHCO_3$, NaOH, KCl, and KOH.

8.4 Alkaline earth metals: Magnesium and calcium: Occurrence, extraction, reactivity and electrode potentials; Reactions with O_2, H_2O, H_2 and halogens; Solubility and thermal stability of oxo salts; Biological importance of Ca and Mg; Preparation, properties and uses of important compounds such as CaO, $Ca(OH)_2$, plaster of Paris, $MgSO_4$, $MgCl_2$, $CaCO_3$, and $CaSO_4$; Lime and limestone, cement.

9. p- d- and f-block elements

9.1 General: Abundance, distribution, physical and chemical properties, isolation and uses of elements; Trends in chemical reactivity of elements of a group; electronic configuration, oxidation states; anomalous properties of first element of each group.

9.2 Group 13 elements: Boron; Properties and uses of borax, boric acid, boron hydrides & halides. Reaction of aluminum with acids and alkalis;

9.3 Group 14 elements: Carbon: carbon catenation, physical & chemical properties, uses, allotropes (graphite, diamond, fullerenes), oxides, halides and sulphides, carbides; Silicon: Silica, silicates, silicone, silicon tetrachloride, Zeolites, and their uses

9.4 Group 15 elements: Dinitrogen; Preparation, reactivity and uses of nitrogen; Industrial and biological nitrogen fixation; Compound of nitrogen; Ammonia: Haber's process, properties and reactions; Oxides of nitrogen and their structures; Properties and Ostwald's process of nitric acid production; Fertilizers – NPK type; Production of phosphorus; Allotropes of phosphorus; Preparation, structure and properties of hydrides, oxides, oxoacids (elementary idea only) and halides of phosphorus, phosphine.

9.5 Group 16 elements: Isolation and chemical reactivity of dioxygen; Acidic, basic and amphoteric oxides; Preparation, structure and properties of ozone; Allotropes of sulphur; Preparation/production properties and uses of sulphur dioxide and sulphuric acid; Structure and properties of oxides, oxoacids (structures only), hydrides and halides of sulphur.

9.6 Group 17 and group 18 elements: Structure and properties of hydrides, oxides, oxoacids of halogens (structures only); preparation, properties & uses of chlorine & HCl; Inter halogen compounds; Bleaching Powder; Uses of Group 18 elements, Preparation, structure and reactions of xenon fluorides, oxides, and oxoacids.

9.7 d-Block elements: General trends in the chemistry of first row transition elements; Metallic character; Oxidation state; ionization enthalpy; Ionic radii; Color; Catalytic properties; Magnetic properties; Interstitial compounds; Occurrence and extraction of iron, copper, silver, zinc, and

mercury; Alloy formation; Steel and some important alloys; preparation and properties of $CuSO_4$, $K_2Cr_2O_7$, $KMnO_4$, Mercury halides; Silver nitrate and silver halides; Photography.

9.8 f-Block elements: Lanthanoids and actinoids; Oxidation states and chemical reactivity of lanthanoids compounds; Lanthanide contraction and its consequences, Comparison of actinoids and lanthanoids.

9.9 Coordination Compounds: Coordination number; Ligands; Werner's coordination theory; IUPAC nomenclature; Application and importance of coordination compounds (in qualitative analysis, extraction of metals and biological systems e.g. chlorophyll, vitamin B12, and hemoglobin); Bonding: Valence-bond approach, Crystal field theory (qualitative); Stability constants; Shapes, color and magnetic properties; Isomerism including stereoisomerisms; Organometallic compounds.

10. Principles of Organic Chemistry and Hydrocarbons

10.1 Classification: General Introduction, classification based on functional groups, trivial and IUPAC nomenclature. Methods of purification: qualitative and quantitative,

10.2 Electronic displacement in a covalent bond: Inductive, resonance effects, and hyperconjugation; free radicals; carbocations, carbanions, nucleophiles and electrophiles; types of organic reactions, free radial halogenations.

10.3 Alkanes and cycloalkanes: Structural isomerism, general properties and chemical reactions, free redical helogenation, combustion and pyrolysis.

10.4 Alkenes and alkynes: General methods of preparation and reactions, physical properties, electrophilic and free radical additions, acidic character of alkynes and (1,2 and 1,4) addition to dienes.

10.5 Aromatic hydrocarbons: Sources; properties; isomerism; resonance delocalization; aromaticity; polynuclear hydrocarbons; IUPAC nomenclature; mechanism of electrophilic substitution reaction, directive influence and effect of substituents on reactivity; carcinogenicity and toxicity.

10.6 Haloalkanes and haloarenes: Physical properties, nomenclature, optical rotation, chemical reactions and mechanism of substitution reaction. Uses and environmental effects; di, tri, tetrachloromethanes, iodoform, freon and DDT.

10.7 Petroleum: Composition and refining, uses of petrochemicals.

11. Stereochemistry

11.1 Introduction: Chiral molecules; optical activity; polarimetry; R,S and D,L configurations; Fischer projections; enantiomerism; racemates; diastereomerism and meso structures.

11.2 Conformations: Ethane conformations; Newman and Sawhorse projections.

11.3 Geometrical isomerism in alkenes

12. Organic Compounds with Functional Groups Containing Oxygen and Nitrogen

12.1 General: Nomenclature, electronic structure, important methods of preparation, identification, important reactions, physical and chemical properties, uses of alcohols, phenols, ethers, aldehydes, ketones, carboxylic acids, nitro compounds, amines, diazonium salts, cyanides and isocyanides.

12.2 Specific: Reactivity of α-hydrogen in carbonyl compounds, effect of substituents on alpha-carbon on acid strength, comparative reactivity of acid derivatives, mechanism of nucleophilic addition and dehydration, basic character of amines, methods of preparation, and their separation, importance of diazonium salts in synthetic organic chemistry.

13. Biological , Industrial and Environmental chemistry

13.1 The Cell: Concept of cell and energy cycle.

13.2 Carbohydrates: Classification; Monosaccharides; Structures of pentoses and hexoses; Anomeric

carbon; Mutarotation; Simple chemical reactions of glucose, Disaccharides: reducing and non-reducing sugars – sucrose, maltose and lactose; Polysaccharides: elementary idea of structures of starch, cellulose and glycogen.

13.3 Proteins: Amino acids; Peptide bond; Polypeptides; Primary structure of proteins; Simple idea of secondary , tertiary and quarternary structures of proteins; Denaturation of proteins and enzymes.

13.4 Nucleic Acids: Types of nucleic acids; Primary building blocks of nucleic acids (chemical composition of DNA & RNA); Primary structure of DNA and its double helix; Replication; Transcription and protein synthesis; Genetic code.

13.5 Vitamins: Classification, structure, functions in biosystems; Hormones

13.6 Polymers: Classification of polymers; General methods of polymerization; Molecular mass of polymers; Biopolymers and biodegradable polymers; methods of polymerization (free radical, cationic and anionic addition polymerizations); Copolymerization: Natural rubber; Vulcanization of rubber; Synthetic rubbers. Condensation polymers.

13.7 Pollution: Environmental pollutants; soil, water and air pollution; Chemical reactions in atmosphere; Smog; Major atmospheric pollutants; Acid rain; Ozone and its reactions; Depletion of ozone layer and its effects; Industrial air pollution; Green house effect and global warming; Green Chemistry, study for control of environmental pollution.

13.8 Chemicals in medicine, health-care and food: Analgesics, Tranquilizers, antiseptics, disinfectants, anti-microbials, anti-fertility drugs, antihistamines, antibiotics, antacids; Preservatives, artificial sweetening agents, antioxidants, soaps and detergents.

14. Theoretical Principles of Experimental Chemistry

14.1 Volumetric Analysis: Principles; Standard solutions of sodium carbonate and oxalic acid; Acid-base titrations; Redox reactions involving KI, H_2SO_4, Na_2SO_3, $Na_2S_2O_3$ and H_2S; Potassium permanganate in acidic, basic and neutral media; Titrations of oxalic acid, ferrous ammonium sulphate with $KMnO_4$, $K_2Cr_2O_7/Na_2S_2O_3$, $Cu(II)/Na_2S_2O_3$.

14.2 Qualitative analysis of Inorganic Salts: Principles in the determination of the cations Pb^{2+}, Cu^{2+}, As^{3+}, Mn^{2+}, Al^{3+}, Zn^{2+}, Co^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, NH_4^+, Fe^{3+}, Ni^{2+} and the anions CO_3^{2-}, S^{2-}, SO_4^{2-}, SO_3^{2-}, NO_2^-, NO_3^-, Cl^-, Br^-, I^-, PO_4^{3-}, CH_3COO^-, $C_2O_4^{2-}$.

14.3 Physical Chemistry Experiments: preparation and crystallization of alum, copper sulphate. Benzoic acid ferrous sulphate, double salt of alum and ferrous sulphate, potassium ferric sulphate; Temperature vs. solubility; Study of pH charges by common ion effect in case of weak acids and weak bases; pH measurements of some solutions obtained from fruit juices, solutions of known and varied concentrations of acids, bases and salts using pH paper or universal indicator; Lyophilic and lyophobic sols; Dialysis; Role of emulsifying agents in emulsification. Equilibrium studies involving ferric and thiocyanate ions (ii) $[Co(H_2O)_6]^{2+}$ and chloride ions; Enthalpy determination for strong acid vs. strong base neutralization reaction (ii) hydrogen bonding interaction between acetone and chloroform; Rates of the reaction between (i) sodium thiosulphate and hydrochloric acid, (ii) potassium iodate and sodium sulphite (iii) iodide vs. hydrogen peroxide, concentration and temperature effects in these reactions.

14.4 Purification Methods: Filtration, crystallization, sublimation, distillation, differential extraction, and chromatography. Principles of melting point and boiling point determination; principles of paper chromatographic separation – R_f values.

14.5 Qualitative Analysis of Organic Compounds: Detection of nitrogen, sulphur, phosphorous and halogens; Detection of carbohydrates, fats and proteins in foodstuff; Detection of alcoholic, phenolic, aldehydic, ketonic, carboxylic, amino groups and unsaturation.

14.6 Quantitative Analysis of Organic Compounds: Basic principles for the quantitative estimation of carbon, hydrogen, nitrogen, halogen, sulphur and phosphorous; Molecular mass determination by silver salt and chloroplatinate salt methods; Calculations of empirical and molecular formulae.

14.7 Principles of Organic Chemistry Experiments: Preparation of iodoform, acetanilide, p-nitro acetanilide, di-benzayl acetone, aniline yellow, beta-naphthol; Preparation of acetylene and study of its acidic character.

14.8 Basic Laboratory Technique:

Cutting glass tube and glass rod, bending a glass tube, drawing out a glass jet, boring of cork.

Part III: (a) English Proficiency and (b) Logical Reasoning

(a) English Proficiency

This test is designed to assess the test takers' general proficiency in the use of English language as a means of self-expression in real life situations and specifically to test the test takers' knowledge of basic grammar, their vocabulary, their ability to read fast and comprehend, and also their ability to apply the elements of effective writing.

1. Grammar

1.1 Agreement, Time and Tense, Parallel construction, Relative pronouns

1.2 Determiners, Prepositions, Modals, Adjectives

1.3 Voice, Transformation

1.4 Question tags, Phrasal verbs

2. Vocabulary

2.1 Synonyms, Antonyms, Odd Word, One Word, Jumbled letters, Homophones, Spelling

2.2 Contextual meaning.

2.3 Analogy

3. Reading Comprehension

3.1 Content/ideas

3.2 Vocabulary

3.3 Referents

3.4 Idioms/Phrases

3.5 Reconstruction (rewording)

4. Composition

4.1 Rearrangement

4.2 Paragraph Unity

4.3 Linkers/Connectives

(b) Logical Reasoning

The test is given to the candidates to judge their power of reasoning spread in verbal and nonverbal areas. The candidates should be able to think logically so that they perceive the data accurately, understand the relationships correctly, figure out the missing numbers or words, and to apply rules to new and different contexts. These indicators are measured through performance on such tasks as detecting missing links, following directions, classifying words, establishing sequences, and completing analogies.

5. Verbal Reasoning

5.1 Analogy

Analogy means correspondence. In the questions based on analogy, a particular

relationship is given and another similar relationship has to be identified from the alternatives provided.

5.2 Classification

Classification means to assort the items of a given group on the basis of certain common quality they possess and then spot the odd option out.

5.3 Series Completion

Here series of numbers or letters are given and one is asked to either complete the series or find out the wrong part in the series.

5.4 Logical Deduction – Reading Passage

Here a brief passage is given and based on the passage the candidate is required to identify the correct or incorrect logical conclusions.

5.5 Chart Logic

Here a chart or a table is given that is partially filled in and asks to complete it in accordance with the information given either in the chart / table or in the question.

6. Nonverbal Reasoning

6.1 Pattern Perception

Here a certain pattern is given and generally a quarter is left blank. The candidate is required to identify the correct quarter from the given four alternatives.

6.2 Figure Formation and Analysis

The candidate is required to analyze and form a figure from various given parts.

6.3 Paper Cutting

It involves the analysis of a pattern that is formed when a folded piece of paper is cut into a definite design.

6.4 Figure Matrix

In this more than one set of figures is given in the form of a matrix, all of them following the same rule. The candidate is required to follow the rule and identify the missing figure.

6.5 Rule Detection

Here a particular rule is given and it is required to select from the given sets of figures, a set of figures, which obeys the rule and forms the correct series.

Part IV: Mathematics

1. Algebra

1.1 Complex numbers, addition, multiplication, conjugation, polar representation, properties of modulus and principal argument, triangle inequality, roots of complex numbers, geometric interpretations; Fundamental theorem of algebra.

1.2 Theory of Quadratic equations, quadratic equations in real and complex number system and their solutions.

1.3 Arithmetic and geometric progressions, arithmetic, geometric and arithmetico- geometric series, sums of finite arithmetic and geometric progressions, infinite geometric series, sums of squares and cubes of the first n natural numbers.

1.4 Logarithms and their properties.

1.5 Exponential series.

1.6 Permutations and combinations, Permutations as an arrangement and combination as selection, simple applications.

1.7 Binomial theorem for a positive integral index, properties of binomial coefficients, Pascal's triangle

1.8 Matrices and determinants of order two or three, properties and evaluation of determinants, addition and multiplication of matrices, adjoint and inverse of matrices, Solutions of simultaneous linear equations in two or three variables, elementary row and column operations of matrices, Types of matrices, applications of determinants in finding the area of triangles.

1.9 Sets, Relations and Functions, algebra of sets applications, equivalence relations, mappings, one-one, into and onto mappings, composition of mappings, binary operation, inverse of function, functions of real variables like polynomial, modulus, signum and greatest integer.

1.10 Mathematical reasoning and methods of proofs , Mathematically acceptable statements. Connecting words/phrases – consolidating the understanding of " if and only if (necessary and sufficient) condition", "implies", "and/or", "implied" by", "and", "or", " there exists" and through variety of examples related to real life and Mathematics. Validating the statements involving the connecting words – difference between contradiction, converse and contra positive., Mathematical induction

1.11 Linear Inequalities, solution of linear inequalities in one variable (Algebraic) and two variables (Graphical).

2. Trigonometry

2.1 Measurement of angles in radians and degrees, positive and negative angles, trigonometric ratios, functions with their graphs and identities.

2.2 Solution of trigonometric equations.

2.3 Inverse trigonometric functions

3. Two-dimensional Coordinate Geometry

3.1 Cartesian coordinates, distance between two points, section formulae, shift of origin.

3.2 Straight lines and pair of straight lines: Equation of straight lines in various forms, angle between two lines, distance of a point from a line, lines through the point of intersection of two given lines, equation of the bisector of the angle between two lines, concurrent lines.

3.3 Circles: Equation of circle in standard form, parametric equations of a circle.

3.4 Conic sections : parabola, ellipse and hyperbola their eccentricity, directrices & foci.

4. Three dimensional Coordinate Geometry

4.1 Co-ordinate axes and co-ordinate planes, distance between two points, section formula, direction cosines and direction ratios, equation of a straight line in space and skew lines.

4.2 Angle between two lines whose direction ratios are given, shortest distance between two lines.

4.3 Equation of a plane, distance of a point from a plane, condition for coplanarity of three lines, angles between two planes, angle between a line and a plane.

5. Differential calculus

5.1 Domain and range of a real valued function, Limits and Continuity of the sum, difference, product and quotient of two functions, Differentiability.

5.2 Derivative of different types of functions (polynomial, rational, trigonometric, inverse trigonometric, exponential, logarithmic, implicit functions), derivative of the sum, difference, product and quotient of two functions, chain rule, parametric form.

5.3 Geometric interpretation of derivative, Tangents and Normals.

5.4 Increasing and decreasing functions, Maxima and minima of a function.

5.5 Rolle's Theorem, Mean Value Theorem and Intermediate Value Theorem.

6. Integral calculus

6.1 Integration as the inverse process of differentiation, indefinite integrals of standard functions.

6.2 Methods of integration: Integration by substitution, Integration by parts, integration by partial fractions, and integration by trigonometric identities.

6.3 Definite integrals and their properties, Fundamental Theorem of Integral Calculus, applications in finding areas under simple curves.

6.4 Application of definite integrals to the determination of areas of regions bounded by simple curves.

7. Ordinary Differential Equations

7.1 Order and degree of a differential equation, formulation of a differential equation whole general solution is given, variables separable method.

7.2 Solution of homogeneous differential equations of first order and first degree

7.3 Linear first order differential equations

8. Probability

8.1 Various terminology in probability, axiomatic and other approaches of probability, addition and multiplication rules of probability.

8.2 Conditional probability, total probability and Baye's theorem

8.3 Independent events

8.4 Discrete random variables and distributions with mean and variance.

9. Vectors

9.1 Direction ratio/cosines of vectors, addition of vectors, scalar multiplication, position vector of a point dividing a line segment in a given ratio.

9.2 Dot and cross products of two vectors, projection of a vector on a line.

9.3 Scalar triple products and their geometrical interpretations.

10. Statistics

10.1 Measures of dispersion

10.2 Analysis of frequency distributions with equal means but different variances

11. Linear Programming

11.1 Various terminology and formulation of linear Programming

11.2 Solution of linear Programming using graphical method, feasible and infeasible regions, feasible and infeasible solutions, optimal feasible solutions (upto three nonitrivial constraints)

12. Mathematical modelling

12.1 Formulation of simple real life problem, solution using matrices, calculus and linear programming.

Part IV: Biology

1: Diversity in Living World

1.1 Biology – its meaning and relevance to mankind

1.2 What is living; Taxonomic categories and aids; Systematics and Binomial system of nomenclature.

1.3 Introductory classification of living organisms (Two-kingdom system, Five-kingdom system);

1.4 Plant kingdom – Salient features of major groups (Algae to Angiosperms);

1.5 Animal kingdom – Salient features of Nonchordates up to phylum, and Chordates up to class level.

2: Cell: The Unit of Life; Structure and Function

2.1 Cell wall; Cell membrane; Endomembrane system (ER, Golgi apparatus/Dictyosome, Lysosomes, Vacuoles); Mitochondria; Plastids; Ribosomes; Cytoskeleton; Cilia and Flagella; Centrosome and Centriole; Nucleus; Microbodies.

2.2 Structural differences between prokaryotic and eukaryotic, and between plant and animal cells.

2.3 Cell cycle (various phases); Mitosis; Meiosis.

2.4 Biomolecules – Structure and function of Carbohydrates, Proteins, Lipids, and Nucleic acids.

2.5 Enzymes – Chemical nature, types, properties and mechanism of action.

3: Genetics and Evolution

3.1 Mendelian inheritance; Chromosome theory of inheritance; Gene interaction; Incomplete dominance; Co-dominance; Complementary genes; Multiple alleles;

3.2 Linkage and Crossing over; Inheritance patterns of hemophilia and blood groups in humans.

3.3 DNA –its organization and replication; Transcription and Translation;

3.4 Gene expression and regulation; DNA fingerprinting.

3.5 Theories and evidences of evolution, including modern Darwinism.

4: Structure and Function – Plants

4.1 Morphology of a flowering plant; Tissues and tissue systems in plants; Anatomy and function of root, stem (including modifications), leaf, inflorescence, flower (including position and arrangement of different whorls, placentation), fruit and seed; Types of fruit; Secondary growth;

4.2 Absorption and movement of water (including diffusion, osmosis and water relations of cell) and of nutrients; Translocation of food; Transpiration and gaseous exchange; Mechanism of stomatal movement.

4.3 Mineral nutrition – Macro- and micro-nutrients in plants including deficiency disorders; Biological nitrogen fixation mechanism.

4.4 Photosynthesis – Light reaction, cyclic and non-cyclic photophosphorylation; various pathways of carbon dioxide fixation; Photorespiration; Limiting factors.

4.5 Respiration – Anaerobic, Fermentation, Aerobic; Glycolysis, TCA cycle; Electron transport system; Energy relations.

5: Structure and Function - Animals

5.1 Human Physiology – Digestive system – organs, digestion and absorption; Respiratory system – organs, breathing and exchange and transport of gases.

5.2 Body fluids and circulation – Blood, lymph, double circulation, regulation of cardiac activity; Hypertension, Coronary artery diseases.

5.3 Excretion system – Urine formation, regulation of kidney function

5.4 Locomotion and movement – Skeletal system, joints, muscles, types of movement.

5.5 Control and co-ordination – Central and peripheral nervous systems, structure and function of neuron, reflex action and sensory reception; Role of various types of endocrine glands; Mechanism of hormone action.

6: Reproduction, Growth and Movement in Plants

6.1 Asexual methods of reproduction;

6.2 Sexual Reproduction – Development of male and female gametophytes; Pollination (Types and agents); Fertilization; Development of embryo, endosperm, seed and fruit (including parthenocarpy and elminth).

6.3 Growth and Movement – Growth phases; Types of growth regulators and their role in seed dormancy, germination and movement;

6.4 Apical dominance; Senescence; Abscission; Photo- periodism; Vernalisation;

6.5 Various types of movements.

7: Reproduction and Development in Humans

7.1 Male and female reproductive systems;

7.2 Menstrual cycle; Gamete production; Fertilisation; Implantation;

7.3 Embryo development;

7.4 Pregnancy and parturition;

7.5 Birth control and contraception.

8: Ecology and Environment

8.1 Meaning of ecology, environment, habitat and niche.

8.2 Ecological levels of organization (organism to biosphere); Characteristics of Species, Population, Biotic Community and Ecosystem; Succession and Climax. Ecosystem – Biotic and abiotic components; Ecological pyramids; Food chain and Food web;

8.3 Energy flow; Major types of ecosystems including agroecosystem.

8.4 Ecological adaptations – Structural and physiological features in plants and animals of aquatic and desert habitats.

8.5 Biodiversity and Environmental Issues – Meaning, types and conservation strategies (Biosphere reserves, National parks and Sanctuaries), Air and Water Pollution (sources and major pollutants); Global warming and Climate change; Ozone depletion; Noise pollution; Radioactive pollution; Methods of pollution control (including an idea of bioremediation); Deforestation; Extinction of species (Hot Spots).

9: Biology and Human Welfare

9.1 Animal husbandry – Livestock, Poultry, Fisheries; Major animal diseases and their control. Pathogens of major communicable diseases of humans caused by fungi, bacteria, viruses, protozoans and elminthes, and their control.

9.2 Cancer; AIDS.

9.3 Adolescence and drug/alcohol abuse;

9.4 Basic concepts of immunology.

9.5 Plant Breeding and Tissue Culture in crop improvement.

10: Biotechnology and its Applications

10.1 Microbes as ideal system for biotechnology**;**

10.2 Microbial technology in food processing, industrial production (alcohol, acids, enzymes, antibiotics), sewage treatment and energy generation.

10.3 Steps in recombinant DNA technology – restriction enzymes, NA insertion by vectors and other methods, regeneration of recombinants

10.4 Applications of R-DNA technology in human health –Production of Insulin, Vaccines and Growth hormones, Organ transplant, Gene therapy.

10.5 Applications in Industry and Agriculture – Production of expensive enzymes, strain improvement to scale up bioprocesses, GM crops by transfer of genes for nitrogen fixation, herbicide-resistance and pest-resistance including Bt crops.