

Scheme of Examination
M.Sc. (Physics) 5 Year Integrated Course Semester I & II

Paper No.	Title	Duration (Hours)	Maximum
Semester-I			
Phy-101	Mathematical Physics -I	3	50
Phy-102	Mechanics -I	3	50
Phy-103	Electricity	3	50
Phy-104	Mathematics I	3	50
Phy-105	Chemistry -I	3	50
Phy-106	Linear & Digital Integrated Circuits & Instruments -I	3	50
Phy-107	Physics Lab. I	5	100
Chem.101	Chemistry Lab. -I	6	100
Q-101	English (qualifying) -I	3	100
		Total Marks	500

Paper No.	Title	Duration (Hours)	Maximum
Semester-II			
Phy-201	Mathematical Physics -II	3	50
Phy-202	Mechanics -II	3	50
Phy-203	Magnetism	3	50
Phy-204	Mathematics II	3	50
Phy-205	Chemistry -II	3	50
Phy-206	Linear & Digital Integrated Circuits & Instruments -II	3	50
Phy-207	Physics Lab. II	5	100
Chem.201	Chemistry Lab. -II	6	100
Q-201	English (qualifying) -II	3	100
		Total Marks	500

Phy 101 Semester –I Mathematical Physics-I

Max. Marks : 45
Internal Assessment : 05
Time : 3 Hrs.

NOTE :

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two question from each unit. A student has to attempt five question in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit 1. Vector Algebra and Analysis

Review of vector algebra- addition, subtraction and product of two vectors. Polar and axial vectors and their examples from physics. Triple and quadruple product (without frenet-Serret formulae).

Scalar and vector fields, differentiation of a vector w.r.t. a scalar . Unit tangent vector and unit normal vector (without Frenet- Serret formulae).

Directional derivatives, gradient, divergence, curl and Laplacian operations and their meaning. Idea of line, surface and volume integrals. Gauss, Stokes and Green's theorems.

Unit II Orthogonal Curvilinear Coordinates and Multiple integrals

Orthogonal curvilinear coordinates, Derivation of gradient, divergence, curl and Laplacian in Cartesian, spherical and cylindrical coordinate systems. Change of variables and Jacobian. Evaluation of line surface and volume integrals.

Calculus of Variations

Constrained maxima and minima. Method of Lagrange undetermined multipliers and its application to simple problems in physics.

Variational principle Euler-Lagrange equation and its application to simple problems.

Phy-102 Semester-I Mechanics-I

Max. Marks : 45
Internal Assessment : 05
Time : 3 Hrs.

NOTE :

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2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I : Fundamentals of Dynamics:

Motion of charged particle in electric and magnetic fields.
Dynamics of a system of particles. Centre of mass Conservation of momentum. Idea of conservation of momentum from Newton's third law impulse. Momentum of variables mass system: motion of rocket, Work-energy theorem. Potential energy. Energy diagram. Stable and unstable equilibrium. Conservative and non-conservative forces. Force as gradient of potential energy. Particle collisions. Centre of mass frame and laboratory frame.

Unit II Rotational Dynamics:

Angular momentum of a particle and system of particles. Torque Conservation of angular momentum Rotation about a fixed axis Moment of inertia; its calculation for rectangular and cylindrical bodies; idea of calculation for spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

Oscillatory Motion:

Motion of simple and compound pendulum. Loaded spring, Energy considerations. Time average of energy. Damped harmonic oscillator Resonance in a lightly damped system.

Phy 103 Semester –I Electricity

Max. Marks : 45
Internal Assessment : 05
Time : 3 Hrs.

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2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I Electric Circuits:

Kirchhoff's laws for A.C. circuits, Series and parallel resonant circuits, A.C. bridges. Thevenin's theorem and Norton's theorem and their applications to D.C. circuits.

Electric Field:

Electric charge: conservation and quantisation. Coulomb's law and superposition principle. Electric field and electric lines. Gauss's law. Field of spherical, linear and plane charge distributions. Line integral of electric field. Electric potential. Potential and electric field of a dipole, a charged wire and a charged disc. Multipole expansion of potential due to arbitrary charge distribution. Force and torque on a dipole. Laplace's equation: uniqueness theorem. Conductors in an electrostatic field. Description of a system of charged conductors. An isolated conductor and capacitance. Methods of images and its-application to simple electrostatic problems plane infinite sheet and sphere.

Unit II Electrostatic Energy

System of point charges, a uniform sphere a condenser, an ionic crystal, nuclear electric field, point charge.

Dielectric Properties of Matter:

Dielectric polarization and polarization charges Gauss's law in dielectrics. Field vectors D and E and their boundary conditions. Capacitors filled with dielectrics.

Phy 104 Semester-I Mathematics-I

Max. Marks : 45
Internal Assessment : 05
Time : 3 Hrs.

NOTE :

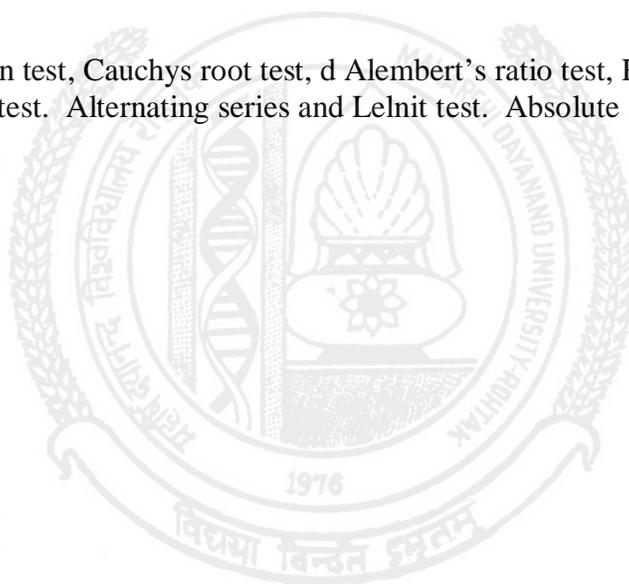
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2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit-I

Sequences of real number Convergent. Cauchy, monotonic and bounded sequences. Subsequences. Limit superior and limit inferior of a sequence. Infinite series and their convergence.

Unit-II

Comparison test, Cauchy's root test, d Alembert's ratio test, Raabe's test. Cauchy's integral test. Alternating series and Leibniz test. Absolute and conditional convergence.



Phy-105 Semester-I Chemistry-I

Max. Marks : 45
Internal Assessment : 05
Time : 3 Hrs.

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2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit-I

Bonding : Qualitative approach to valence bond theory and its limitations. Hybridisation, equivalent and non-equivalent hybrid orbitals, Bent's rule and applications.

Molecular orbital theory, symmetry and overlap. Molecular orbital diagrams of diatomic and simple polyatomic systems (O_2 , C_2 , B_3 , CO , NO , and their ions; HCl , BeF_2 , CH_4 , BCl_3) (ideal of Sp^3 mixing and orbital interaction to be given.

Organisation of solids:

- (i) Packing of ions in crystals, close packed structures. Spinel, ilmenite and perovskite structures of mixed metal oxides. Size effects, radius-ratio rules and their limitations. Lattice energy Born equation (calculations of energy in ion pair. And ion pairs square formation), Madelung constant, Kapustinskii, equation and its applications. Born – Haber cycle and its application.
- (ii) Solvation energy. Packing of atoms in metals, qualitative idea of valence bond and band theories. Semiconductors and insulators. Defects in solids. Conductance in ion solids. Introduction to superconductors.
- (iii) Weak chemical forces: van der Waals forces, hydrogen bonding. Effects of chemical forces on m.p., b.p. and solubility. Energetics of dissolution process.

Unit-II

Coordination compounds and Inorganic Reaction Mechanisms:

Crystal field theory- measurement of $10 Dq$ CFSE in weak and strong fields. Pairing energies, factors affecting the magnitude of $10 Dq$. Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral symmetry. The Jahn-Teller theorem, square-planar coordination Ligand field and molecular orbital theories.

The trans effect, mechanism of the trans effect, kinetics of square planar substitution reactions. Thermodynamic and kinetic stability. Labile and inert complexes.

Kinetics of octahedral substitution reaction. Mechanism of substitution in octahedral complexes. Mechanism of electron transfer reactions (inner and outer sphere mechanism).

Phy-106 Semester-I Linear and Digital Integrated Circuits & Instrumentation-I

Max. Marks : 45

Internal Assessment : 05

Time : 3 Hrs.

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2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I Basic Concepts of Integrated Circuits:

Active and passive components, discrete component circuits, water, chip, advantages of integrate circuits, MSI, LSI and VLSI (basic idea and definitions only).

Operational Amplifiers (Op-Amp)

Basic characteristics without detailed internal circuit of IC: Requirement of ideal voltage amplifier, characteristics of ideal operational amplifier, feedback in amplifier (black box approach), open loop and close loop gain, inverting and non-inverting amplifier, zero crossing detector.

Application of op-amps: Mathematical operations addition, multiplication, integration and differentiation. Electronic circuits – oscillator (Wien's bridge), rectangular and triangular wave generators (all circuit analysis based on Kirchhoff's laws).

Unit II Digital Circuits

Difference between analog and digital circuits, binary numbers, binary to decimal conversion, AND, OR and NOT gates (realization using diodes and transistor), Boolean algebra, Boolean equations of logic circuits, de Morgan theorem, NOR and NAND gates.

Combinational logic: Boolean laws and theorems, sum of products method of realizing a circuit for a given truth table, truth table to karnaugh map and simplification (elementary idea).

Data processing circuits: Multiplexes, demultiplexers, decoders, encoders, exclusive OR gate, parity checker, read-only memories (ROM), PROM, EPROM.

Arithmetic circuits: Binary addition and subtraction (only 2's complement method), half adders and full adders and subtractors (only upto eight bits).

Phy-107 Semester-I Physics laboratory-I

The distribution of marks in laboratory papers will be as follows:

Written test (45 minutes duration)	20	
Internal assessment including laboratory report	30	
Experiment and viva (35+15)	50	
Total (each paper)		100

Unit-I

1. Methodology and Familiarization:
 - i) crude estimation, ungraduated and graduated scales.
 - ii) Triangulation method.
 - iii) Vernier calipers, screw gauge, traveling microscope.
 - iv) Indirect methods, e.g. for estimation of atomic size.
2. Familiarisation with basic electronic components.
3. Familiarisation with operation of basic measuring and test equipment (power supplies, analog and digital multimeters, function generator and CRO).
4. To test a diode and transistor using multi-meter and CRO.

Unit II

1. To study the random error in observations.
2. Experiments for generation of data in linear and non linear regions for the following systems: -
 - i) flow of liquid through capillary tube.
 - ii) Diode characteristics (I – V).
 - iii) Pendulum with large amplitude.
3. Frequency and phase measurements using CRO.
4. Spring constant and mass from vertical oscillations of a spring and determination of modulus of rigidity.

Chem.-101 Semester-I Chemistry Laboratory-I

Max. Marks 100

Time 6 Hrs.

1. Separation of cations and anions by paper chromatography.
2. Preparation of
 - i) Manganese (iii) Phosphate, Estimation of Mn content in the above complex colorimetrically (periodate oxidation). Estimation of oxidizing equivalents in the above complex titrimetrically (titration of liberated iodine).
 - ii) Tetrammine copper (ii) sulfate and estimation of copper as CuCNS gravimetrically in the above complex.
3. Preparation of :
 - i) Aspirin (ii) Hippuric acid (benzoylglycine) (iii) Methyl orange or phenolphthalein. Characterisation by mp, mmp, and TLC.
4. Two-step preparations:
 - i) Nitrobenzene from benzene, purification of nitrobenzene and characterization by refractive index, further nitration.
 - ii) P-bromoacetanllide from aniline.
5. Preparation of lactose and casein from milk or isolation of caffeine from tea leaves (mp, colour test).
6. Estimation of glucose, specification value or iodine value of a fat or oil.

Q-101 Semester-I English (Qualifying-I)

Paper Q.I : qualifying English

For the detailed course of qualifying English, please see the syllabus for 'B.A. (Pass), B.com, (Pass) and subsidiary qualifying English'.



Phy 201 Semester -II Mathematical Physics-II

Max. Marks : 45

Internal Assessment : 05

Time : 3 Hrs.

NOTE :

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two question from each unit. A student has to attempt five question in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I Differential Equations:

Classification of differential equations: linear and nonlinear, homogeneous and non-homogenous equations.

Linear ordinary Differential Equations:

First order: Separable and exact equations. Integrating factor.

Second Order: Homogeneous equations with constant coefficient's. Wronskian and general solution Statement of Existence and Uniqueness theorem for initial value problems. Solution of non-homogeneous equations by operator (D) method. Particular integral. Method of undetermined coefficients and variation of parameters Equations reducible to those with constant coefficient. Bernoulli and Euler equations.

Unit II Fourier Series

Fourier series, Dirichlet conditions (Statement only). Orthogonality of sine and cosine functions. Sine and cosine series. Distinctive features of Fourier expansions. Half-range expansions. Applications Square wave triangular wave, output of full wave rectifier and other simple functions Summary of infinite series

Theory of Errors:

Systematic and random errors. Propagation of errors. Standard and probable error. Least square fitting of data (linear case).

Phy 202 Semester –II Mechanics –II

Max. Marks : 45
Internal Assessment : 05
Time : 3 Hrs.

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2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I: Gravitation and Central Force Motion:

Law of gravitation. Inertial and gravitational mass. Potential energy and field due to spherical shell and solid sphere.

Self-energy. Motion of a particle under central force field Angular momentum conservation one body problem two body problem and its reduction to one body problem and its solution. The energy equation and energy diagram. Kepler's laws. Satellites.

Unit II Non-Inertial Systems:

Inertial frame and Galilean transformation, Non-inertial frame and fictitious forces. Uniformly accelerating system. Physics in rotating coordinate systems, centrifugal and Coriolis forces.

Michelson-Morley experiment and its outcome. Postulates of special theory of relativity. Lorentz transformations. Simultaneity and order of events. Lorentz contraction and time dilation. Relativistic transformation of velocity, frequency and wave number. Velocity dependence of mass and equivalence of mass and energy. . Relativistic Doppler effect, Relativistic Kinematics Transformation of energy and momentum

Phy -203 Semester-II Magnetism

Max. Marks : 45
Internal Assessment : 05
Time : 3 Hrs.

NOTE:

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two question from each unit. A student has to attempt five question in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I Magnetic Field:

Magnetic force between current elements and definition of B. Properties of B Amphere's Circuital Law, Curl and divergence of B, Vector potential. Magnetic flux. Calculation of B for circular and solenoid currents. Torque on a current loop in a uniform magnetic field. Magnetic dipole. Forces on an isolated moving charge.

Magnetic Properties of Matter:

B, H and their relation. Magnetic susceptibility. Stored magnetic energy in matter, Magnetic circuit B-H curve and energy loss in hysteresis.

Unit II : Electromagnetic Induction:

A conducting rod moving through a uniform magnetic field. A loop through on-uniform magnetic field.. A stationary loop with field source moving. Faraday's law of induction. Curl E-D B/dt. Mutual induction – reciprocity theorem ($M_{12} = M_{21}$) Self-induction, energy stored in magnetic field.

Phy-204 Semester-II Mathematics-II

Max. Marks : 45
Internal Assessment : 05
Time : 3 Hrs.

NOTE:

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2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

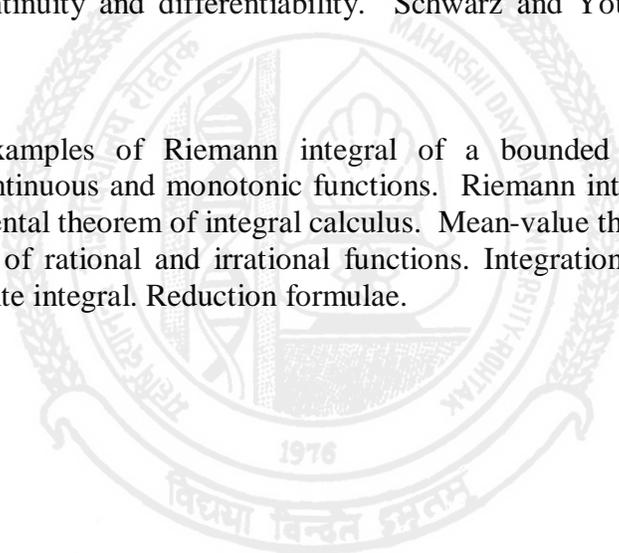
Unit-I

Functions of a real variable. Limits, continuity and differentiability of functions. Uniform continuity on (a,b) implying uniform theorem for analytic functions. Intermediate value theorems and Taylor's theorem and analytic functions. Taylor's and Maclaurin's series of elementary analytic functions. Functions of two and three reals variables their continuity and differentiability. Schwarz and Young theorem, implicit function theorem.

Unit-II

Definition and examples of Riemann integral of a bounded function. Riemann integrability of continuous and monotonic functions. Riemann integral as the limit of a sum. The fundamental theorem of integral calculus. Mean-value theorems.

Integration of rational and irrational functions. Integration by partial functions. Properties of definite integral. Reduction formulae.



Phy-205 Semester-II Chemistry-II

Max. Marks : 45
Internal Assessment : 05
Time : 3 Hrs.

NOTE :

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two question from each unit. A student has to attempt five question in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit-I

General Organic Chemistry:

Bonding in organic molecules and its effects on shape, chirality and RS nomenclature as applied to chiral centers. Treatment of chirality upto three chiral centers. Conformation of acrylic and cyclic systems, conformational analysis of disubstituted cyclohexanes. Geometrical isomerism and E-2 nomenclature.

Electronic displacements in organic molecules. Aromaticity. Reactivity of organic molecules. Heterolytic and homolytic fission. Nucleophiles, electrophiles, acids and bases and their relative strengths (including carbon acids). Addition, elimination and substitution reactions (including electrophilic, nucleophilic and aromatic types).

Unit-II

Arynes and carbons as reaction intermediates.

Functional Group Chemistry:

Rationalisation of functional group reactivity on mechanistic basis of the following groups: hydroxyl, carbonyl, carboxyl and its derivatives such as ester and amide, cyano, nitro and amino, Orientation effect in aromatic substitution, polymerisation and overview of polymers, Organic reactions as synthetic tools: Claisen, Cannizzaro, Grignard, Michael, Mannich, Darzen, aldol, Diekmann, Perkin etc.

Phy-206 Semester-II Linear and Digital Integrated Circuits & Instrumentation-II

Max. Marks : 45

Internal Assessment : 05

Time : 3 Hrs.

NOTE :

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two question from each unit. A student has to attempt five question in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I

Sequential circuits: flip-flops – RS, JK , D, clocked, preset and clear operation, race-around conditions in JK Flip-flop, master slave JK flip-flop as building block of sequential circuits.

Shift registers: Serial-in-serial-out, serial-in-parallel-out, parallel-in-parallel-out, parallel-in-paralleled-out (only upto 4 bits).

Counters: Asynchronous counters, synchronous counter, decade counter.

D/A and A/D conversion: D/A converter-resistive network, accuracy and resolution. A/D converter (only counter method) – accuracy and resolution.

Unit II Electronic Instruments:

Timer: Simple applications of 555 timer circuits.

Power supply: requirement of ideal voltage and current source, voltage source, half-wave and full-wave rectifier, bridge rectifier, L and C filters, some idea of ripple.

Oscilloscope: Input attenuators, DC, AC and ground, horizontal and vertical deflecting system, time base generation and synchronization: measurement of positive, positive-negative wave shape, rise time and fall time; frequency, amplitude and phase of sinusoidal waves.

Phy-207 Semester-II Physics Laboratory-II

The distribution of marks in laboratory papers will be as follows:

Written test (45 minutes duration)	20
Internal assessment including laboratory report	30
Experiment and viva (35+15)	50
Total (each paper)	100

Unit I : Electronics and Instrumentation:

1. To design an amplifier of given gain using op-amp 741 in inverting and non-inverting configurations and to study its frequency response.
2. To design a precision differential amplifier of given I/O specification using 741.
3. To design an astable oscillator of given specifications using 555.
4. To design a monostable oscillator of given specifications using 555.

Unit II: Measurement of Resistance and Voltage:

1. Precise measurement of a low resistance using Carey Foster's bridge potentiometer.
2. To calibrate a Resistance Temperature Device (RTD) to measure temperature in a specified range using null method/off-balance bridge with galvanometer based measurement.
3. To calibrate a thermocouple to measure temperature in a specified range using null method/direct measurement using an op-amp difference amplifier and to determine neutral temperature.
4. To determine the acceleration due to gravity using bar pendulum.
5. To determine the acceleration due to gravity using Kater's pendulum.
6. To determine the acceleration due to gravity and velocity for a freely falling body, using digital timing techniques.
7. To investigate the motion of a simple or physical pendulum with
 - i) variation of moment of inertia and
 - ii) viscous, frictional and electro-magnetic damping (e.g. motion of coil of a B.G.).
8. To investigate the motion of coupled oscillators.

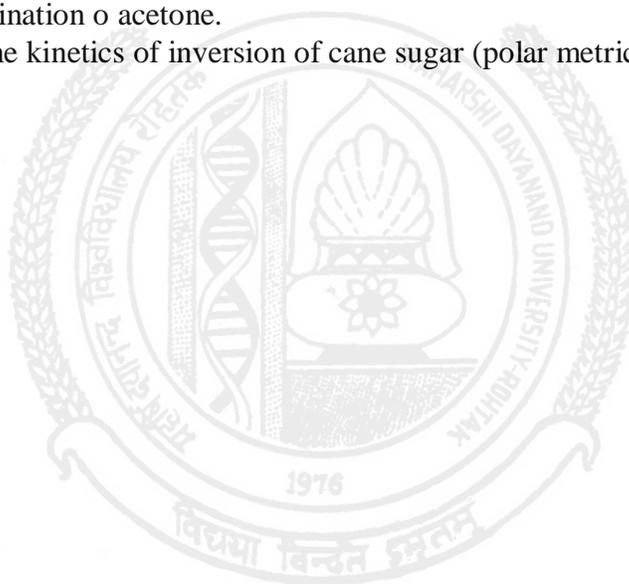
To investigate the forced oscillations of an LCR circuit in series and parallel configurations and calculate quality factor Q.

Chem.-201 Semester-II Chemistry Laboratory-II

Max. Marks 100

Time 6 Hrs.

1. Potentiometer titration of Mohr's salt with $K_2C_{rx}O_7$ or $KmnO_4$ using digital multi-meter or low cost potentiometer.
2. Conduct metric titration of a solution of HCl or $CH_3 COOH$ with NaOH by a direct reading conduct meter.
3. Determination of molecular mass of a polymer by measurement of viscosity.
4. The effect of detergent on the surface tension of water (Variation of surface tension with concentration to be studied).
5. Determination of the rate law for one of the following reactions. All solutions needed to be provided.
 - a. Persulphate-iodide reaction.
 - b. Iodination o acetone.
6. To study the kinetics of inversion of cane sugar (polar metrically).



Q-201 Semester-II English (Qualifying-II)

Paper Q.I : qualifying English

For the detailed course of qualifying English, please see the syllabus for 'B.A. (Pass), B.com, (Pass) and subsidiary qualifying English'.

