UNIVERSITY OF KOTA

SCHEME OF EXAMINATION

AND

COURSES OF STUDY

Department of Pure & Applied Physics
Faculty of Science

B.Sc. (Hons.) I & II Semester

First Semester (July-December, 2020)
Second Semester (January-June, 2021)

UNIVERSITY OF KOTA
MBS Marg, Near Kabir Circle, KOTA (Rajasthan)-324 005
INDIA

Edition: 2020

Course Structure with Distribution of Marks

Year / Sem.	Serial Number, Code & Nomenclature of Paper		Duration of Exam.	Teaching Hrs/Week & Credit			Distribution of Marks			Min. Pass Marks	
	Number	Nomenclature		L	P	C	Conti. Assess.	Sem. Assess.	Total Marks	Conti. Assess.	Sem. Assess.
I Year I Sem	1.1	General Hindi	3 Hrs	2	--	--	--	100	--	--	36
	1.2	Elementary Computer Applications	3 Hrs	2	--	--	--	100	--	--	36
	1.3	Mathematics-I	3 Hrs	3	--	3	15	60	75	06	24
	1.4	Mathematics-II	3 Hrs	3	--	3	15	60	75	06	24
	1.5	Mathematics Practical	6 Hrs	--	4	2	--	50	50	--	25
	1.6	Physics (Hons)-I : Mechanics	3 Hrs	3	--	3	15	60	75	06	24
	1.7	Physics (Hons)-II: Wave and Oscillations	3 Hrs	3	--	3	15	60	75	06	24
	1.8	Physics (Hons)-III: Physics & Chemistry of Materials	3 Hrs	3	--	3	15	60	75	06	24
	1.9	Physics (Hons)-IV: Computer Programming	3 Hrs	3	--	3	15	60	75	06	24
	1.10	Physics Practical (Hons)	6 Hrs	--	8	4	--	100	100	--	50
	Total			**22**	**12**	**24**	**--**	**--**	**600**	**--**	
I Year II Sem	2.1	General English	3 Hrs	2	--	--	--	100	--	--	36
	2.2	Environment Studies	3 Hrs	2	--	--	--	100	--	--	36
	2.3	Mathematics-I	3 Hrs	3	--	3	15	60	75	06	24
	2.4	Mathematics-II	3 Hrs	3	--	3	15	60	75	06	24
	2.5	Mathematics Practical	6 Hrs	--	4	2	--	50	50	--	25
	2.6	Physics (Hons)-I : Electricity and Magnetism	3 Hrs	3	--	3	15	60	75	06	24
	2.7	Physics (Hons)-II: Optics	3 Hrs	3	--	3	15	60	75	06	24
	2.8	Physics (Hons)-III: Materials Physics & Engineering	3 Hrs	3	--	3	15	60	75	06	24
	2.9	Physics (Hons)-IV: Computer Oriented Numerical and Statistical Methods	3 Hrs	3	--	3	15	60	75	06	24
	2.10	Physics Practical (Hons)	6 Hrs	--	8	4	--	100	100	--	50
				22	**12**	**24**	**--**	**--**	**600**	**--**	

Note: The syllabi of the compulsory / subsidiary papers are same as prescribed for the B.Sc. Pass Course.

Objectives of the Course:

Innovation and Employability-Physics is concerned with the study of the universe from the smallest to the largest scale, why it is the way it is and how it works. Such knowledge is basic to scientific progress. Although physics is a fundamental science it is a very practical subject. Physicists have to be able to design and build new instruments, from satellites to measure the properties of planetary atmospheres to record-breaking intense magnetic fields for the study of condensed matter. Many of the conveniences of modern life are based very directly on the understanding provided by physics. Many techniques used in medical imaging are derived directly from physics instrumentation. Even the internet was a spin-off from the information processing and communications requirement of high-energy particle physics.

The Department of Pure and Applied Physics has been started the Hons. course from July, 2013. Our current programme involves the students in a holistic experience of Physics education and instills the spirit of research in the formative years of their careers. This flagship programme of University is a pioneering model in Indian science and education, imparting education in Physics while simultaneously encouraging a participation in research. This course shall provide the thorough knowledge of Pure and Applied branches of Physics with extensive theoretical and experimental knowledge in major areas of Physics such as Material science, Plasma science, Advanced Electronics, Energy Studies etc. at Masters' level. This course also emphasizes on the Communication & Presentation skills of the students. The students after completing the course shall be placed in premier research institutes and companies in India and abroad, qualify NET/GATE/JEST examinations and eligible for M.Tech., PhD and teaching.

Duration of the Course:

The course B.Sc. (Hons.- Phsyics) shall consist of three academic years divided in to six semesters.

Eligibility for Admission:

The basic eligibility for admission to the course is XII with Physics, Chemistry and Mathematics with minimum marks for GEN category candidates of Rajasthan-55%; Other state-60%; SC/STOBC/SOBC- Minimum Pass Marks. The admission in the course is based on merit of XII class.

Structure of the Programme:

The B.Sc. (Hons.-Physics) consists of:

(i) Core and applied courses of theory as well as practical papers which are compulsory for all students.

(ii) Dissertation / Project Work / Practical training / Field work, which can be done in an organization (Government, Industry, Firm, Public Enterprise, *etc.*) approved by the Department.

Attendance:

Every teaching faculty handling a course shall be responsible for the maintenance of attendance Register for candidates who have registered for the course. The teacher of the course must intimate the Head of the Department at least seven calendar days before the last instruction day in the semester about the attendance particulars of all students. Each student should earn 75% attendance in the courses of a particular semester failing which he or she will not be permitted to appear in the End-Semester Examinations. However, it shall be open to the authorities to grant exemption to a candidate who has failed to obtain the prescribed

75% attendance for valid reasons and such exemptions should not under any circumstance be granted for attendance below 65%.

Teaching Methodologies:

The classroom teaching would be through conventional lectures or power point presentations (PPT). The lecture would be such that the student should participate actively in the discussion. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skills. In the laboratory, instructions would be given for the experiments followed by demonstration and finally the students have to do the experiments individually.

Maximum Marks:

Maximum marks of a theory and practical paper shall be decided on the basis of their contact hours/credit per week. One teaching hour per week shall equal to one credit and carry 25 maximum marks and therefore, four teaching hours/credit per week shall carry 100 maximum marks for each theory paper/course. Each four contact hours per week for laboratory or practical work shall be equal to two credits per week and carry 50 marks and therefore, eight teaching hours per week shall carry 100 maximum marks for laboratory or practical work.

Scheme of Examinations:

The examination shall be divided into two parts in which first part is continuous assessment or internal assessment and second part is semester assessment or external assessment. The schemes for the internal and external examinations shall be as under:

a) The internal assessment for each theory paper shall be taken by the teacher concerned in the Department during each semester. There will be two components of internal assessment; one by test having 2/3 weightage (10 marks) and another by seminar / assignment / presentation / quiz / group discussion / vivo of 1/3 weightage (05 marks), for theory papers in each semester. Internal assessment test shall be of one hour duration for each paper and shall be taken according to academic calendar notified by the University / Departments. There will be no internal examination in the practical paper.

b) A student who remains absent (defaulter) or fails or wants to improve the marks in the internal assessment may be permitted to appear in the desired paper(s) (only one time) in the same semester with the permission of the concerned Head of the Department. A defaulter / improvement fee of Rupees 250/- per paper shall be charged from such candidates. Duly forwarded application of such candidates by the teacher concerned shall be submitted to HOD who may permit the candidate to appear in the internal assessment after depositing the defaulter/ improvement fee. A record of such candidates shall be kept in the Department.

c) The external assessment shall be of three hours duration for each theory paper and six hours duration for practical paper. The practical examination shall be taken by the panel of at least one external and one internal examiner at the end of each semester.

d) The syllabus for each theory paper is divided into five independent units and each theory question paper will have the format as mentioned below:

There will be ten long answer type questions covering all units with two questions from each unit, descriptive type, answer in about 400 words. *Students have to attempt* 5 questions by taking one question from each unit. *Paper setter shall be instructed to design question paper covering from all five units.*

e) The pattern of question paper of external shall be as follows:

Duration of Examination: 3 Hours **Max. Marks: 60**

There will be ten long answer type questions covering all units with two questions from each unit, descriptive type, answer in about 400 words. *Students have to attempt* 5 questions by taking one question from each unit. *Paper setter shall be instructed to design question paper covering from all five units.*

Unit – I

Q. No. 1 12 Marks

or

Q. No. 2 12 Marks

Unit – II

Q. No. 3 12 Marks

or

Q. No. 4 12 Marks

Unit – III

Q. No. 5 12 Marks

or

Q. No. 6 12 Marks

Unit – IV

Q. No. 7 12 Marks

or

Q. No. 8 12 Marks

Unit – V

Q. No. 9 12 Marks

or

Q. No. 10 12 Marks

Distribution of Marks for Practical Examinations (For Hons. subject):

Duration of Exam: 06 Hours **Maximum Marks: 100**

S. No.	Name of Exercise	Marks
1.	Exercise No. 1	35
2.	Exercise No. 2	35
3.	Viva-voce	15
4.	Practical Record	15
	Total Marks	**100**

Rules regarding Determination of Results:

Each semester shall be regarded as a unit for working out the result of the candidates. The result of the each semester examination shall be worked out separately (even if he/she has appeared at the paper of the lower semester along with the papers of higher semester) in accordance with the following conditions:

a) The candidate shall be declared as pass in a semester examination, if he/she secures at least 40% marks in each theory paper separately in external & internal examination and 50% marks in each practical paper/project/dissertation with 40% aggregate marks in that semester.

b) A candidate declared as fail/absent in one or more papers at any odd semester examination shall be permitted to take admission in the next higher semester (even semester) of the same academic session.

c) A candidate may be promoted in the next academic session (odd semester) if he/she has cleared collectively at least 50% of the papers of both semesters of previous academic session. The candidate who does not fulfill the above condition will remain as an ex-student and will reappear in the due papers along with next odd/even semester exams.

d) If any student who is provisionally admitted in higher odd semester but could not secure prescribed minimum marks in previous semesters will be treated as ex-student and his/her admission fee will be carry forwarded to the next odd semester of forthcoming academic session.

e) If a candidate, who is declared as pass, wishes to improve his/her performance in the theory papers of previous semester, he/she may re-appear only one time in these papers in next odd/even semester examinations.

f) Candidate shall not be permitted to re-appear or improve the marks obtained in the external examination of practical / dissertation in any condition.

g) If the number of papers prescribed in a semester examination is an odd number, it shall be increased by one for the purpose of reckoning 50% of the papers for considering the student pass/fail.

h) A candidate may be given only two additional chances for passing the semester thus maximum tenure for completing for three years under-graduate programme up to five years and so on.

i) The marks secured in the Gen Hindi, Gen English, Elementary Computer applications and Environment studies shall not be counted in awarding the division to a candidate. The candidate shall have to clear the compulsory subjects in the additional three chances and non-appearance or absence in the examination of compulsory subjects shall be counted as chance and shall be declared fail in that examination.

j) The grace marks scheme shall be applicable as per University norms.

Classification of Successful Candidates:

The classification of successful candidates after last semester examination shall be as under:

Description of Marks Obtained	**Division / Result**
• 75% and above marks in a paper.	Distinction in that paper.
• A candidate who has secured aggregate 60% and above marks	First Division
• A candidate who has secured aggregate 50% and above but less than 60% marks	Second Division
• A candidate who has secured aggregate 40% and above but less than 50% marks	Pass

I SEMESTER

1.6-Mechanics

Unit 1
Inertial frame of references, Motion and rest, Galilean transformations, transformation of displacement, velocity and acceleration, Special theory of relativity, Lorentz transformation and rotation in space-time, time like and space like vector, energy-mass relation.

Unit 2
Rotating frame of references, transformation of velocity and acceleration between rotating frames, Coriolis and centrifugal forces, effects of coriolis and centrifugal forces due to Earth's rotation, Foucault's pendulum.

Unit 3
Conservation Laws: Conservative forces, potential energy, Gravitational Potential, electric potential, center of mass and motion of center of mass of a system of particles, two particle system and reduced mass, conservation of linear momentum in Lab and CM system, collision of two bodies in one and two dimensions, slowing down of neutrons in a moderator, motion of a system with varying mass.

Unit 4
Dynamics of rigid body and motion under central forces: Rotational motion of a body, Moment of inertia, inertial coefficients, kinetic energy of rotation and concept of principal axes, Precessional motion of a spinning top and spin precession in constant magnetic field, motion under central forces, general solution under gravitational interaction, cases of elliptical and circular orbits, scattering of charged particles by heavy nucleus, planetary motion, Kepler's Laws.

Unit 5
Hooke's law, three moduli of elasticity, Young's modulus, Bulk modulus and modulus of rigidity, Poison's ratio, Relation between various elastic constants, torsion of a Cylinder, bending of beam, experimental determination of elastic constants by bending of beam and Searle's method, Modulus of rigidity by static and dynamic method and Poisson's ratio for rubber.

Text/Reference Books:

1. Mechanics by M P Saxena, P R Singh, S S Rawat and N S Saxena (4th ed., College Book House, 1999)
2. Mechanics by D S Mathur (S. Chand & Co., 2001)
3. Berkley Physics Course Vol. I, Mc Graw Hill International, New York.
4. Mechanics by P. K. Srivasatava, New Age International Publisher, Delhi

1.7-Waves and Oscillations

Unit 1
Oscillations in a potential well, examples of harmonic motion - mass on a spring, torsional oscillators, LC circuit, energy of the oscillator, damping, viscous and solid friction damping, damped harmonic oscillator, power dissipation.

Unit 2
Forced harmonic oscillator with viscous damping, frequency response, phase relation, quality factor, resonance, electrical oscillation, anharmonic oscillator, simple pendulum as an example.

Unit 3
Equation of motion of two coupled simple harmonic oscillators, normal modes, motion in mixed modes, transient behavior, effect of coupling in mechanical systems, electrically coupled circuits, frequency response, reflected impedance, effect of coupling and resistive load.

Unit 4
Dynamics of number of oscillators with near-neighbour interactions, equation of motion for one dimensional monoatomic and diatomic lattices, acoustic and optical mode, dispersion relations, concept of group and phase velocities.

Unit 5
Wave Motion-Wave motion and its parameters, stationary waves, wave velocity and group velocity, production, properties and uses of ultrasonic waves, reverberation time, Sabine's formula.

Text/Reference Books:
1. Oscillations and Waves by M. P. Saxena and S. S. Rawat, College Book House,1997.
2. Berkley Physics Course Vol. I, Mc Graw Hill International, New York.
3. Vibration and Waves by A. P. French, CBS Publications, Delhi, 1987

1.8- Physics & Chemistry of Materials

Unit 1
Atomic Structure-Schrodinger wave equation, significance of Ψ, Ψ*Ψ, quantum numbers, shapes of s, p, d orbitals, Aufbau and Pauli principles, Hund's multiplicity rule, exchange energy, pairing energy, symmetrical distribution of charge, extra stability of half-filled and completely-field orbitals, electronic configurations of elements up to atomic No. 71, effective nuclear charge, shielding effect, Slater's rules for evaluation of shielding constant.

Unit 2
Covalent bond:- resonance, valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, valence shell electron pair repulsion (VSEPR) theory with reference to BF_3, BF_4^-, NH_3, H_2O, H_3O^+, PCl_5, SF_4, CIF_3, I_3^-, SF_6, IF_7, ICI_2^-, and $POCl_3$; MO theory, simple LCAO theory, sigma and pi molecular orbitals, homonuclear and heteronuclear (CO and NO) diatomic molecules and their ions, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

Unit 3
Introduction to chemical kinetics, measurement of reaction rate, integration and determination of rate laws, rate constant, unit of rate constant for zero order, first order and second order reactions, order of reaction, molecularity of reaction, difference between order

and molecularity of reaction, chemical kinetics and its scope, factors influencing the rate of a reaction-concentration, temperature, pressure, solvent, light, catalyst; concentration dependence of rates, mathematical characteristics of simple chemical reactions-zero order, first order, second order, pseudo order; half-life and mean life; determination of the order of reaction-differential method, graphical method, method of integration, method of half-life period and isolation method, radioactive decay as a first order phenomenon, applications

Unit 4

Phase Equilibrium-Introduction, terminology: - phase, component, degree of freedom or variance; phase diagram of one-component system: -water system, sulphur system, CO_2 system, phase rule for two-components system: - Pb-Ag system and its applications, reduced phase rule, eutectic point.

Unit 5

Electric transport in electrolytic solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution, migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its uses and limitations, Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only), applications of conductivity measurement: determination of degree of dissociation, determination of K_a of acids, determination of solubility product of sparingly soluble salt, conductometric titrations.

Text/Reference Books:

1. Lee, J. D. “Concise Inorganic Chemistry”, Blackwell Publication.
2. Atkins, P. W. “Physical Chemistry”, ELBS.
3. Material Science & Engineering, A first course, V Raghavan, PHI, New Delhi.
4. Material Science & Engineering an introduction, William D Callister Jr., John Wiley & Sons.

1.9 Computer Programming

Unit 1

C programming: structure of C program, A Simple C program, identifiers, basic data types and sizes, Constants, Operators, variables, expressions, type conversions, conditional expressions, precedence and order of evaluation. Input-output statements, if and switch statements, loops- while, do-while and for statements, break, continue, goto and labels.

Unit 2

Designing structured programs, Functions, basics, parameter passing, storage classes- extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, header files, C preprocessor.

Unit 3

Arrays-concepts, declaration, definition, accessing elements, storing elements, arrays and functions, two-dimensional and multi-dimensional arrays, applications of arrays, pointers-concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays, dynamic memory managements functions.

Unit 4

Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bitfields, Input and output - concept of a file, text files and binary files, streams, standard I/o, Formatted I/o, file I/o operations, command line arguments.

Unit 5

FORTRAN programming: Variables, expressions, jumping, branching and looping statements, input/output statement, special statements: COMMON, ENTRY, FORMAT, PAUSE, EQUIVALENCE, programming of simple problems involving use of interpolation differentiation, integration, matrix inversion and least square analysis.

Text/Reference Books:

1. Kochan Stephen G., Programming in C, Pearson Eductaion
2. Wirth N., Algorithms & Data Structures, Prentice Hall

1.10-PHYSICS PRACTICAL

1. Study of bending of a beam and determination of Young's modulus.
2. Determine the modulus of rigidity using Maxwell's needle.
3. Determination of the Poisson's ratio of rubber tube.
4. Determination of modulus of rigidity by stattical method.
5. Elastic constant by Searle's method.
6. Low resistance by Carey-Foster' bridge.
7. Study of frequency of energy transfer as a function of coupling strength using coupled oscillator.
8. Study the damping of a compound pendulum and determine the damping coefficient and quality factor.
9. Conversion of a galvanometer in to an ammeter and to calibrate it.
10. Conversion of a galvanometer in to a voltmeter and to calibrate it.
11. Study of charging and discharging of a capacitor through a resistance.
12. Study of temperature variation of surface tension by Jeagger's method.
13. Variation of magnetic field along the axis of circular coil and hence determine the radius of coil.
14. To study resonance in a series LCR circuit and determine Q of the circuit.
15. Loop Statement using for, while, do–while statement, conditional checking using if statement, nested if statement, switch statement and unconditional goto.
16. Problems based on array data types. Problems on One Dimensional Array-Searching (Linear, Binary), Sorting (Bubble, Selection, Insertion), Merging.
17. Problems on two Dimensional Array-Matrix Operation: Addition, Subtraction, Multiplication etc.
18. Problems based on pointers, Parameter passing in functions, Recursion.
19. Declaration, Reading, Writing and manipulation on struct and union data type, File handling, Command Line Arguments.
20. Any other experiments of the equivalent standard can be set.

II SEMESTER

2.6-Electricity and Magnetism

Unit 1

Electric potential-Gradient of a scalar function, line integral of vector field, potential difference and potential function. Potential energy of a system, energy required to build a uniformly charged sphere, classical radius of an electron, Potential and field due to a short dipole.

Unit 2

Measurement of charge in motion, invariance of charge, electric field measured in different frames of reference, field of a point charge moving with constant velocity, force on a moving charge, interaction between a moving charge and other moving charges, Magnetic field, Amperes circuital law with applications, Ampere's law in differential form, vector potential, field of a current carrying conductor and deduction of Biot-Savart law.

Unit 3

The moment of a charge distribution, atomic and molecular dipoles, permanent dipole moments, potential and field due to a polarized sphere, dielectric sphere in a uniform field, the field of charge in a dielectric medium and Gauss's law, electric susceptibility and atomic polarizability, polarization in changing fields.

Unit 4

Bohr Magneton, electron spin and magnetic moment, magnetic susceptibility, the magnetic field due to magnetized matter, Faraday's laws in differential form, the displacement current, Maxwell's equations in differential and integral forms.

Unit 5

Maxwell's equations, Electromagnetic waves in isotropic medium, Properties of electromagnetic waves, Energy density, radiation pressure, momentum and poynting vector, radiation resistance of free space, Spectrum of electromagnetic waves.

Text/Reference Books:

1. Electricity and Magnetism by D C Tayal, Himalaya Publishing House, 2005.
2. Electricity and Magnetism by M P Saxena, College Book House, 1997.
3. Elements of Electromagnetics by Mathew N.O. Sadiku, New Delhi, Oxford Univ. Press
4. Berkley Physics Course - Volume 2, Singapore, McGraw Hill International.

2.7- Optics

Unit 1

Formation of images, sign convention, position of object and its image formed by refraction on spherical surfaces, lateral, axial and angular magnification, Abbe's sine condition, aplantic points, deviation produced by thin lenses, equivalent focal length, combination of two thin lenses, Abberations: chromatic, Achromatic Combination of lenses, spherical, method of reducing spherical aberrations, Eye-piece: Huygen's, Ramsden's.

Unit 2
Superposition of waves from two point sources, the necessity of coherence, spatial & temporal coherence, Effective size of a point source, Shape of interference fringes, Intensity distribution in space, Fresnel's biprism experiment, Interference by division of amplitude, Interference in thin films, colur of thin films in transmission and reflection, Newton's rings, Michelson's interferometer, fringes of different shapes Determination of λ and $\Delta\lambda$ with Michelson's interferometer.

Unit 3
Fraunhofer diffraction by a single slit, circular aperture, two parallel slits, Plane diffraction grating, transmission and reflection gratings, dispersion by grating, resolving power, Rayleigh's criterion of resolution, Resolving power of a grating, Resolving power of a telescope, Fresnel's diffraction, half-period zones, Fresnel's diffraction by a circular aperture, Straight edge and thin slit, Cornu's (geometrical) spiral to study Fresnel's diffraction, Zone plate.

Unit 4
Polarised light, Production and analysis of plane, circularly and elliptically polarised light, Huygen's theory of double refraction using Fresnel ellipsoidal surfaces (No mathematical derivation), Theory of polarized light, Quarter and half wave plates, Optical activity, Specific rotation, Fresnel's explanation for optical rotation, Biquartz and half shade Polarimeters.

Unit 5
Spontaneous and stimulated emission, Einstein's A and B coefficients, Laser Criterion, Condition for amplification, population inversion, methods of optical pumping, He-Ne Laser, Ruby lasers, Holography, Construction of hologram and reconstruction of the image, Basic characteristics of the optical fiber, total internal reflection, acceptance angle, acceptance cone, numerical aperture.

Text/Reference Books:
1. Optics by Brij Lal and Subrahmanium, S. Chand Publication, 2006.
2. Introduction to Fiber optics - A. Ghatak and K. Thyagarajan, Cambride University Press, Cambridge, 1988.
3. Introduction to Modern Optics- A. K. Ghatak, Tata McGraw Hill.

2.8- Materials Physics & Engineering

Unit 1
WATER-Common impurities of water, hardness of water:-determination of hardness by Clark's test and complex metric (EDTA) method, degree of hardness, numerical based on hardness and EDTA method, municipal water supply:-requisites of drinking water, steps involved in purification of water, sedimentation, coagulation, filtration and sterilization, break point chlorination, Water Treatment- Softening of water**:** lime-soda method, zeolite method and deionization or demineralization method, boiler troubles (scale and sludge, priming and foaming), their causes, disadvantages and prevention; boiler corrosion and caustic embrittlement, numerical problems based on lime-soda and zeolite softening methods.

Unit 2
Corrosion-Definition and its significance, mechanisms of corrosion: chemical corrosion and electrochemical corrosion, protection from corrosion: protective coatings, cathodic protection, sacrificial anode and modification in designs, Polymers-Different methods of classification and constituents of polymers, plastics:-thermosets and thermoplasts; preparation, properties and uses of polyethylene, bakelite, terylene and nylon; elastomers:-natural rubber, vulcanization, synthetic rubbers viz. Buna-S, Buna-N, Butyl and neoprene rubbers.

Unit 3
Cement-Definition, composition, basic constituents and their significance, manufacturing of Portland cement by rotary kiln technology, chemistry of setting and hardening of cement and role of gypsum, Glasses-Definition, properties, manufacturing of glass, types of silicate glasses and their commercial uses, importance of annealing in glass making.

Unit 4
Refractories-Definition, classification, properties, requisites of good refractory and manufacturing of refractory, detailed study of silica and fire clay refractory and their uses, Seger's cone test and RUL test.

Unit 5
Fuels-Organic fuels: general aspects of organic fuels; solid fuels:-coal, carbonization of coal, manufacturing of coke by Beehive oven and Otto-Hoffman byproduct oven method; liquid fuels:-advantages and refining of petroleum, cracking, refining, reforming, polymerization and isomerization of refinery products, synthetic petrol:-Berguis and Fischer-Tropsch process, gaseous fuels: composition and calorific value of coal, gas and oil gas, Fuels (Analyses)-calculations of calorific value based on Dulong's formula, combustion and requirement of oxygen/ air in combustion process, flue gas analysis by Orsat's apparatus and its significance.

Text/Reference Books:
1. Senapati, M. "Advanced Engineering Chemistry", Second Edition, Laxmi Publications, New Delhi, 2007.
2. Qanungo, K. "Engineering Chemistry", PHI, New Delhi, 2009.
3. Material Science & Engineering, A first course, V Raghavan, PHI, New Delhi.
4. Material Science & Engineering an introduction, William D Callister Jr., John Wiley & Sons.

2.9-Computer Oriented Numerical and Statistical Methods

Unit 1
Computer arithmetic and errors, absolute error, relative error, percentage error, Floating point arithmetic and error estimates, Implication of precision, Illustrations of errors due to round-off.
Solution of non-linear equations: Bisection, Fixed point iteration, Newton - Raphson method, Aitkins process, rate of convergence.

Unit 2
Solution of Linear system of equations: Direct method - matrix inversion method, modified Gaussian elimination, Cramer's rule, iterative method- Jacobi's and Gauss-Sidel, Solution of

ordinary differential equations - Taylor's series method, Euler's and modified Euler's method, Runge-methods, Predictro-Corrector method, multistep method.

Unit 3
Interpolation: Newton-Gregory forward and backward interpolations for evenly spaced data, Lagrangian method, divided differences, Gauss central forward and backward interpolation formula, Stirling central interpolation formula, Interpolating with cubic splins, Inverse interpolations, Approximation: Approximation of functions by Taylor's series, Chebysheve polynomials.

Unit 4
Numerical differentiation: Differentiation formula based on interpolating polynomials, formulae for higher derivatives, Extrapolation techniques, Numerical integration: The Trapezoidal, rule, Simpson's 1/3 & 3/8 rule, Weddle's rule, Newton-Cotes integration formulae, Romberg integration, Gaussian quardrature formulae for integration.

Unit 5
Applicable statistics: Curve fitting by principle of least square, linear and non linear curves fitting by least squares approximation, Curve fitting by second order polynomial, Weight least square curve fitting, Chi-square test for goodness of fit, correlation and regression, concept of population and sample.

Text/Reference Books:
1. V. Rajaraman, Computer Oriented Numerical Methods, Prentice Hall, New Delhi
2. R. Govil, Kamputer se sankhyatmak Reetiyan, et.al. Pitamber Publications, New Delhi,
3. S.P. Gupta., Statistical Methods, Sultan Chand Publications
4. S. S. Shastri, Introducing Methods of Numerical Analysis, PHI, New Delhi

2.10-PHYSICS PRACTICAL

1. To determine the polarizing angle for the glass prism surface and to determine the refractive index of the material of prism using Brewster's law =tan (i_p).
2. To study the variation of charge and current in RC circuit for different time constants (using DC source).
3. To study the behavior of RC circuit with varying resistance and capacitance using AC as a power source and also determine the impedance and phase relations.
4. To study the rise and decay of current in LR circuit with a source of constant emf.
5. To study the voltage and current behavior of LR circuit with a AC power source also determine power factor, impedance and phase relation.
6. Study of RC / LC transmission line.
7. Measurement of wavelength of monochromatic source of light by Newton's rings.
8. Measurement of wavelength of monochromatic source of light by plane transmission grating. Measurement of wavelength of monochromatic source of light by biprism.
9. Study of specific rotation by polarimeter.
10. Determination of resolving power of a plane transmission grating.
11. Determination of resolving power of telescope.
12. Determination of dispersive power of material of a prism using spectrometer.
13. Perform floating point operations using normalization (addition, subtraction, multiplication, division).

14. Find the roots of equation (bisection method, regula-falsi method, Newton raphson method, secant method, successive approximation method).
15. Find solution of n linear equation (Gauss elimination method (with & without pivoting), Gauss Seidel method, Gauss Jordan method).
16. Generate following difference tables (forward, backward, divided difference).
17. Interpolate value of f(x) at given x (Lagrange's interpolation method, Newton forward interpolation method, Newton's backward interpolation method).
18. Interpolate value of x at given f(x) using Inverse interpolation method.
19. Fitting of different curves (straight line fit (x on y), straight line fit (y on x), parabola, geometric curve, exponential curve).
20. Find order of polynomial.
21. Find derivative of a given tabulated function at given value (Newton's forward method, Newton's backward method).
22. Find Integrated value, (when tabulated function given-Trapezoidal rule (simple & modified), Simpson's 1/3 (simple & modified), Simpson's 3/8 (simple & modified)
23. Find Integrated value, when algebraic expression given (when algebraic expression given-Trapezoidal rule (simple & modified), Simpson's 1/3 (simple & modified), Simpson's 3/8 (simple & modified)
24. Solve differential equation (Euler's method, Runge-Kutta 2^{nd} order method, Runge-kutta 4^{th} order method, Modified Euler's method, Predictor-corrector method.
25. Any other experiments of the equivalent standard can be set.