B. Sc. (Nanoscience and Nanotechnology)

Course Structure

Year I (800M Theory + 400 M Practical) **1200 Marks**			
Code	**Course Name**	**Lectures**	**Marks**
NTT-1	Atomic and Molecular Spectroscopy	72	100
NTT-2	Inorganic and Organic Chemistry	72	100
NTT-3	Materials Science	72	100
NTT-4	Electromagnetism and Optics	72	100
NTT-5	Basic Electronics	72	100
NTT-6	Computer Basics and Programming	72	100
NTT-7	Mathematics and Statistics	72	100
LANG- 8	English	72	100
NTP-9	Practical – I	72	100
NTP-10	Practical – II	72	100
NTP-11	Practical – III	72	100
NTP-12	Practical – IV	72	100
Year II (700M Theory + 300 M Practical) **1000 Marks**			
Code	**Course Name**	**Lectures**	**Marks**
NTT-21	Solid State Physics	96	100
NTT-22	Quantum Mechanics	96	100
NTT-23	Thermodynamics	96	100
NTT-24	Advanced Electronics (VLSI and Sensors)	96	100
NTT-25	Synthesis of Nanomaterials: Physical, Chemical, Biological	96	100
NTT-26	Instrumentation for Characterization	96	100
NTT-27	Cell Biology	96	100
NTP-28	Practical – I	96	100
NTP-29	Practical – II	96	100
NTP-30	Practical – III	96	100
Year III (600M Theory + 300 M Practical) **900 Marks**			
Code	**Course Name**	**Lectures**	**Marks**
NTT-31	Polymer Science and Surface Science	96	100
NTT-32	Molecular Biology	96	100
NTT-33	Nanoscale Device Fabrication	96	100
NTT-34	Applications of Nanotechnology-I	96	100
NTT-35	Applications of Nanotechnology-II	96	100
NTT-36	Applications of Nanotechnology-III	96	100
NTP-37	Practical – I	96	100
NTP-38	Practical – II	96	100
NTP-39	Project	96	100

B. Sc. (Nanoscience and Nanotechnology)

Year I (800M Theory + 400 M Practical) **1200 Marks**			
Code	**Course Name**	**Lectures**	**Marks**
NTT-1	Atomic and Molecular Spectroscopy	72	100
NTT-2	Chemical Sciences	72	100
NTT-3	Materials Science	72	100
NTT-4	Electromagnetism and Optics	72	100
NTT-5	Basic Electronics	72	100
NTT-6	Computer Basics and Programming	72	100
NTT-7	Mathematics and Statistics	72	100
LANG- 8	English	72	100
NTP-9	Practical – I	72	100
NTP-10	Practical – II	72	100
NTP-11	Practical – III	72	100
NTP-12	Practical – IV	72	100

NTT-1: Atomic and Molecular Spectroscopy

Sr. No.	Topic	Lectures
1.	History-Parmanu, Atoms, Dalton's Atomic theory (Postulated and deduction)	**02**
2.	Structure of Atom: J. J. Thomson model, Discovery of electron, e/m, Photoelectric effect. Rutherford Nuclear model, Black body radiation, Hydrogen spectra – Lymen series experiment. Hydrogen atom model-Significance of second and third postulate of Bohr's model. Derivation of radius and energy value. Quantization of energy levels. Using Rydburg's constant, Atomic spectra is signature of the element. Concept of emission and absorption of energy. Ground state and exited state. Emission and absorption spectra. Drawbacks of Bohr Model, Zeeman and Stark effect. Bohr – Sommerfeld model. Drawbacks of Sommerfeld model.	**14**
3.	Vector atom model: Spinning electron and spatial quantization. Quantum numbers. Concept of coupling, Spectral notations. Selection rules. Emission spectra with respect to Na atoms to understand selection rules. Pauli's exclusion principle.	**12**
4.	Atomic nucleus: Radioactivity- Half life period, biological half life, detectors. Properties, Nuclear forces, Binding energy, Nuclear models- liquid drop model, shell model, Nuclear magnetism.	**08**
5.	Molecular Spectroscopy: Electromagnetic waves, Electromagnetic spectrum. Definition- Spectra and spectroscopy. Energy transitions in molecules. Introduction to molecular energy levels. Concept of Excitation, Absorption, Emission. Applications of each region in spectroscopy-Mössbaur, X-ray, UV-Vis., IR, ESR, NMR.	**08**
6.	Pure rotational spectra Energy levels of rigid diatomic molecule. Rigid rotor model – Derivation, energy level diagram for rigid and non rigid rotor. Applications.	**08**
7.	Vibrational-Rotational spectra (IR spectroscopy) Energy levels of diatomic vibrating molecules. Spring and ball model-Derivation, energy level diagram. Vibrational-Rotational spectra, energy level diagram, P and R branch. Principle, construction and working of IR spectrometer. Applications of IR spectroscopy.	**10**
8.	Electronic spectra (UV-Vis. Spectroscopy) Electronic molecular energy levels and transitions. Fluorescence, Phosphorescence. Principle, construction and working of colorimeter, Spectrophotometer, Flurometer. Applications of UV-Vis Spectroscopy	**10**

Reference Books:

1. Introduction to Atomic Spectra, H.E. White, McGraw-Hill Book Company.
2. Atomic and Molecular Spectra: Laser, Raj Kumar, Kedarnath Ramnath, Meruth, Delhi.
3. Atomic Physics, J. B. Rajam, S. chand and Co., Delhi
4. Bioinstrumentation, Veerakumari, MJP Publishers, Chenni.
5. Fundamentals of Molecular Spectroscopy, C.N. Banwell, Mc Graw-Hill
6. Perspectives of Modern Physics, Arthur Beiser, Mc Graw-Hill

NTT-2: Chemical Science

Sr.No	Topic	Lectures
1	Modern Periodic Table and Periodicity: -outline of modern periodic table -Type of element: inert gases, representative elements, transition element and inner transition element. -Blocks in periodic table: S- block, P- block, d- block and f-block element. -Periodic law -Periodicity: 1) Atomic size 2) Ionization energy 3) Electronegativity 4) Electron affinity 5) Reactivity 6) Metallic and non-metallic character. - IUPAC nomenclature of super heavy element -Shielding effect and shielding constant -Salter's rule: Problem based on shielding constant	**06**
2	Chemical bonding and Structure: - Octet rule, Attainment of stable electronic configuration - Type of chemical bonds: 1) Ionic bond 2) covalent bond 3) Coordinate bond 4) metallic bond - Hydrogen bond: Types of hydrogen bond, physical properties of substance like M.P.and B.P., Physical state, Solubility and Viscosity -Van der Waal forces: Origin of van der Waal forces with suitable examples -Type of overlap, formation of σ and π bonds S-S overlap P-P overlap and p-d overlap with suitable examples. - Theories of bonding: Valence bond theory (Hitler London theory and Pauling Slater theory)	**08**
3	Concept of Hybridization and VSEPR Theory: -Definition, need of hybridization and assumption. -Type of hybridization: sp, sp^2, sp^3, dsp^2, sp^3 d and sp^3d^2 with suitable example VSEPR theory: Assumptions, need of theory application of the theory to explain irregular geometry of molecule like H_2O, NH_3, $ClF_3$and $TiCl_4$.	**04**
4	Structure, Nomenclature and Reactivity: Drawing of organic molecules, Nomenclature (common and IUPAC system), Structural effects- Inductive effect, Resonance effect, Hyper conjugation, Tautomerism. Strength of organic acids and bases. Types of reagents, Types of organic reactions and intermediates.	**08**
5	Chemistry of Hydrocarbons: Aliphatic and aromatic hydrocarbons, alkanes, alkenes and alkynes - preparation , physical andchemical properties Benzene- Structure of Benzene, stability of Benzene, reactions of benzene.	**06**
6	Stereochemistry: Types of isomerism, Stereoisomerism, Conformational isomers (ethane, Butane)Optical isomers in compound containing one chiral center Determination of R/S configuration. Geometrical isomers (cis /trans)	**04**
7	Chemical Kinetics: Introduction, order, molecular its rate constant specific reaction rate, second order, third orders rate equations (equal conc.) n^{th} order reaction, effect of temperature on rate of reaction, Theories of reaction rates-(collision and transition state), fast reaction, stop- flow	**08**

	method, effect of substitute , primary and secondary salt effects, effect of dielectric constant of solvent, ion – ion interaction, surface potential.	
8	Electrochemistry: **Part-I** Electrolytic cell: Faraday's laws of electrolysis. Properties of electrolytes**:** Ionic strength of solutions Electrolytic conductance: Determination – variation of conductance with concentration. Equal conductance at infinite dilution. Transference and transference numbers: Absolute velocity of ions and ionic mobilities. Hittorf's rule, determination of transference numbers – Hittorf's method and moving boundary method. **Part-II** Electrochemical cell: Single and standard electrode potentials. Reference electrodes: (i) Primary reference electrode: Standard hydrogen electrode (ii) Secondary reference electrode: Saturated calomel electrode. Measurement of emf using potentiometer. Construction and working of Weston saturated and unsaturated standard cells Conventions regarding sign of EMF. Derivation of Nernst equation and its use in calculating EMF of cells at different activities of the individual electrodes, Different types of electrodes**:** metal-metal ion electrodes, amalgam electrodes, gas electrodes, metal insoluble salt electrodes and oxidation –reduction electrodes. Classification of electrochemical cells: chemical cells and concentration cells with and without transference. . Relationship between EMF and free energy changes, enthalpies changes and entropy changes occurring in electrochemical reactions. Equilibrium constants for electrochemical reactions. Applications of EMF: determination of solubility product of sparingly soluble salt, pH and its determination using hydrogen, quinhydrone and glass electrodes; Potentiometric acid-base, redox and precipitation titrations.	**12**
9	Fundamentals of Polymer Science: Basic Concepts, classification, techniques of polymerization: mass, solution, suspension, emulsion and gas phase; control of molecular weight and their determination, step polymerization, radical/chain polymerization, co-polymerization, ionic polymerization, ring opening polymerization, kinetics and mechanism of polymerization. Polymer properties - chemical resistance, crystallinity and effect of temperature. Conducting polymers - classification and applications. Types of polymer degradation-thermal degradation, mechanical degradation, photodegradation, photo stabilizers.	**10**
10	Modern Separation and Purification Methods: **General purification techniques:** Purification of solid organic compounds, recrystallisation, use of miscible solvents, use of drying agents and their properties, sublimation. Purification of liquids. Experimental techniques of distillation, fractional distillation, distillation under reduced pressure. Extraction, use of immiscible solvents, solvent extraction. **Chromatography:** Principle of adsorption and partition chromatography. Column chromatography, thin layer chromatography, Paper chromatography,	**06**

Reference Books:

Chapter 1,2 and 3

1. Concise inorganic chemistry by J.D.Lee,chapman and hall 5th Ed.(1996)
2. Advanced inorganic chemistry by satyaprakashTuli,Basu and Madan 6thedn.
3. A new guide to Modern valence Theory by G.I. Brown.
4. Basic Inorganic Chemistry by Cotton and Wilkison.

Chapter 4

5. A guidebook to reaction mechanism by Peter Sykes
6. Organic chemistry by Clayden , Greeves, Warren and Wothers(Oxford press)

Chapter5

7. Organic chemistry by Morrison and Boyd 6th editionChapter6
8. Stereochemistry of carbon compounds by Eliel J Ernest.
   Chapter7
9. Chemical Kinetics- Laidiler
10. Physical chemistry, P.W. Atkins, Oxford university press, 1978.

Chapter8

11. Physical chemistry through problems, S.K. Dogra and S. Dogra, New age international,4th edition 1996.
12. Physical chemistry, Gilbert. W. Castellan, Narosa publishing house, third edition 1985.
13. Physical chemistry, P.W. Atkins, Oxford university press, 1978

Chapter 9

14. Polymer Chemistry, Bruno Vollmert. Springer, New York.
15. Principles of Polymer Systems, F. Rodriguez, McGraw Hill.
16. Polymer Science, V. R. Gowariker, N. V. Vishwanathan and J. Shreedhar, Willey Eastern Ltd., New Delhi.

Chapter10

17. 1. Quantitative Inorganic Analysis – A.I. Vogel, ELBS. Ed.
18. 2. Chemical separation Methods – J. A. Dean, Van Nostrand Reinhold Company.

NTT3: Material Science

Sr. No.	Topic	Lectures
1.	Properties of Materials: Mechanical Properties- Stress, Strain, Elastic Strain, Plastic Strain, Strength, Plasticity, Ductility, Hardness, Toughness, Malleability, Creep, Fatigue, Stiffness, Fracture-ductile and brittle. Thermal Properties: Specific Heat, Thermal Expansion, Thermal Conductivity. Electrical Properties: Resistivity, Conductivity, dielectric strength. Magnetic Properties: magnetic susceptibility, Giant Magnetic Resonance (GMR).	**12**
2.	Materials Science and engineering –Definition. Classification of materials. Structure levels. Structure-Property relationship.	**04**
3.	Crystal geometry and structure: The space lattice, space lattice and crystal structures, crystal directions and planes.	**06**
4.	Structure of Solids Crystalline and noncrystalline states, Inorganic solids- Covalent solids, Metals and alloys, Ionic solids, The structure of silica and silicates Polymers- Classification of polymers, Structure of long chain polymers, Crystallinity of long chain polymers.	**12**
5.	Atomic Disorder in Materials: Impurities in solids, Solid solutions in metals, Rules of solid solubility, Imperfection in crystals, Defects in solids-point, line, surface and volume, Atomic diffusions- Definition, The atomic model of diffusion, Other diffusion processes, Fick's laws of diffusion.	**12**
6.	Phase Diagrams: The phase rule, Single component system, Binary phase diagram, Microstructural phase changes during cooling, the lever rule, Some typical phase diagrams.	**10**
7.	Single phase alloys: Deformation, Elastic Deformation, Plastic Deformation, Mechanism of plastic Deformation- by slip, Critical resolved shear stress (CRSS), Plastic deformation in poly crystalline materials.	**06**
8.	Introduction to nanomaterials. Relationship between their properties and applications. Current status and future of nanomaterials.	**10**

Reference Books:-

1. Materials Science and Engineering, V. Raghavan, Prentice-Hall of India Pvt. Ltd, New Delhi, 4th Edition.
2. Elements of Materials Science and Engineering, L.H. Van Vlack, Addison Wesley, 6th Edition

NTT4: Electromagnetism and Optics

Sr. No.	Topic	Lectures
1.	Introduction: Sources and effects of electromagnetic fields , Vector fields, Different co-ordinate systems, vector calculus, Gradient, Divergence and Curl - Divergence theorem , Stoke's theorem.	**05**
2.	Electrostatics: Coulomb's Law , Electric field intensity, Field due to point and continuous charges , Gauss's law and application , Electric potential , Electric field, Electric field in free space, conductors, dielectric , Dielectric polarization , Dielectric strength, Electric field, Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density.	**10**
3.	Magnetostatics: Lorentz Law of force, magnetic field intensity – Biot–Savart Law, Ampere's Law , Magnetic field due to straight conductors, circular loop, infinite sheet of current , Magnetic flux density (B) in free space, conductor, magnetic materials, Magnetization, Magnetic field in multiple media, Boundary conditions, Scalar and vector potential, Magnetic force.	**12**
4.	Electromagnetic Fields: Faraday's laws, induced emf – Transformer and motional EMF – Forces and Energy in quasi-stationary Electromagnetic Fields - Maxwell's equations (differential and integral forms) – Displacement current – Relation between field theory and circuit theory.	**09**
5.	Introduction to Geometrical Optics: Lenses: thin and thick lenses, Lens equation, Cardinal points of an optical system, Types of aberrations: monochromatic and chromatic aberration and their reduction	**09**
6.	Interference and Diffraction: Classification of interference of thin films, Interference by division of amplitude, Interference by wedge shaped film: Interference due to reflected light and transmitted light. Fringes of equal inclination, equal thickness, equal chromatic order (FECO fringes), colors of thin films, Interferometry: Michelson's interferometer, Types of diffraction: Fresenel's diffraction and Fraunhoffer's diffraction, Plane diffraction grating, Rayleigh's criterian for resolution, Resolving power of a grating .	**15**
7.	Polarization: Introduction to polarization, Types of polarization- plane, circular, elliptical., Polarization by reflection of light, Brewster's law, Polarisation by double refracting uniaxial crystals, Linear polarizer (Polaroid), Fabrication of linear polarizer by Nicol prism	**12**

Reference Books:

1. Mathew N. O. Sadiku, 'Elements of Electromagnetics', Oxford University press Inc. First India edition, 2007.
2. Ashutosh Pramanik, 'Electromagnetism – Theory and Applications', Prentice-Hall of India Private Limited, New Delhi, 2006.
3. Joseph. A.Edminister, 'Theory and Problems of Electromagnetics', Second edition, Schaum Series, Tata McGraw Hill, 1993.
4. William .H.Hayt, 'Engineering Electromagnetics', Tata McGraw Hill edition, 2001. 3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 1999.
5. A Text book of Optics, N.Subhramanyam, Brijlal, M. N. Avadhanulu, S. Chand publication.
6. Physical Optics by A.K.Ghatak, McMillan, New Delhi
7. Fundamental of Optics, F.A.Jenkins, H.E.White, McGraw-Hill international Edition.
8. Principles of optics, D.S. Mathur, Gopal Press, Kanpur

NTT5: Basic Electronics

Sr. No.	Topic	Lectures
1.	Semiconductor Physics: Brief review of Band Theory, Basic concepts, Intrinsic and extrinsic semiconductors , Donor and acceptor Impurities, charge densities in semiconductor.PN Junction, Reverse and Forward bias conditions, Diode Characteristic and parameter, rectification-half and full wave, Bridge rectifiers, Zener diode, its role as regulator, photodiode.	**10**
2.	Transitors: Bipolar junction transistor (BJT) and their characteristics as circuit and gain elements. PNP and NPN transistors, Common Base, Common Emitter and Common Collector Characteristics, DC Load line and Bias Point., Biasing Methods - Base Bias, Collector-to-Base Bias, Voltage Divider Bias,, and their Comparison. Unijunction transistor (UJT), UJT characteristics, parameters and circuit operation.	**14**
3.	Amplifiers : Amplifiers: Introduction of different types of amplifiers and their characteristics, Principle of amplification, Frequency response of RC coupled amplifiers, amplifier bandwidth and Concept of Cascaded Amplifiers, Feedback amplifiers, Effect of positive and negative feedback on amplifier gain and bandwidth. Single Stage CE Amplifier, Resistance-Capacitance Coupled Two-Stage Amplifier, Series Voltage Negative Feedback, Additional Effects of Negative Feedback	**12**
4.	Introduction to Operational Amplifiers Basic Operational Amplifier, Inverting and Non-Inverting Op-Amp Circuit. Need for an Op-Amp, Modes of Operation, Op-Amp characteristics and its applications as adder, Subtractor, Integrator, differentiator and comparator, Photo transistor: its characteristics and applications. Numerical Examples, Cathode Ray Oscilloscope, Power Suppliers: Introduction and Working of Switched Mode Power Supply (SMPS), Voltage Regulator, Introduction to Inverters and UPS.	**18**
5.	Number System Introduction, Decimal Binary, Octal and Hexadecimal number systems and conversions, Binary Addition, Binary Subtraction, Fractional Number, Binary Coded Decimal Numbers, Boolean Algebra, Truth tables of logic gates (AND, OR, NOT), NAND, NOR as universal gates. XOR and XNOR Gate, Half-adder, Full-adder, Parallel Binary adder	**10**
6.	Displays : Seven segment display, Fourteen segment display, Dot matrix display LED Display : Introduction, Construction, Advantage of LEDs in electronics display LCD Display : Introduction; Types of LCD display:- Dynamic scattering and field effect type; Types of liquid crystal cells :- Transmitting type and reflective type; Advantage and disadvantage of LCD display common applications.	**08**

Reference Books:-

1. A.P.Malvino.Electronic Principles.
2. J.D. Ryder Electronic Fundamentals and Applications.
3. J.Millman and C.C.Halkias Electronic Circuits and Devices.
4. J.Millman and C.C.Halkias Integrated Circuits and Devices.
5. Electronic Devices. Electronic Devices and Circuits: Jacob Millman, Christos C. Halkias TMH, 1991 Reprint 2001
6. Electronic Communication Systems, George Kennedy, TMH 4th Edition

NTT6: Computer Basics and Programming

Sr. No.	Topic	Lectures
1.	Introduction to computers: Overview and functions of a computer system , Input and output devices, Storage devices: Hard disk, Diskette, Magnetic tape, RAID, ZIP devices, Digital tape, CD-ROM, DVD(capacity and access time), Main Circuit Board of a PC: Chips, Ports, Expansion Slots, Memory: Register, buffer, RAM, ROM, PROM, EPROM, EEPROM (comparison), Types of Processing : Batch, Real-Time, Online, Offline	**05**
2.	Modern computers: The workstation, The Minicomputer, Mainframe Computers, Parallel processing Computer and The Super Computer	**06**
3.	Introduction to operating systems: Operating System concept, Windows 98/XP, Windows server NT/2000, Unix/Linux and servers	**12**
4.	Data processing and presentation: Introduction, MS office (World, Excel and Power Point)	**09**
5.	Concepts of programming: Definition and Properties of algorithms, Algorithm development, Flow charts- symbols and simple flowcharts.	**04**
6.	C Programming: Introduction: Structure of C program, Character set, key words, Constants and variables, Variable names, Data types and their declarations, Symbolic Constants. Operators and Expressions: Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Conditional Operator. Input/output functions: scanf ( ), printf ( ), getchar ( ), putchar ( ), getch ( ), Formatted input/output, gets ( ), puts ( ). Control statements: If, if else, while, do while for loop, nested control structures (nested if, nested loops), break, continue, switch- case statement, goto statement. Use of Library functions: e.g. mathematical, trigonometric, graphics. Arrays: 1-D, 2-D and String Concept of Pointers, User defined functions: Definitions and declaration of function, function prototype, passing arguments (Call by value, Call by reference). Storage Classes: Auto, External, Static, Register variables. File handling: Use of text files- Reading and writing Graphics: Some simple graphic commands- Line, Circle, Arc, Ellipse, Bar.	**24**
7.	Computational Physics: I. Errors in Computation: Inherent errors in storing Numbers due to finite bit representation to use in Computer, Truncation error, round off errors (Explain with the help of examples) II. Iterative methods: Discussion of algorithm and flowcharts and writing C programs for finding single root of equation using bi-section method, Newton- Raphson method. III. Least Square Curve fitting: Discussion of algorithm and flowcharts and writing C program for straight line fit with example in physics	**12**

Reference Books:

1. Computer Fundamentals – P.K. Sinha
2. Programming in C- (Schaum's series) Gottfreid TMH
3. Programming in C- Balgurusami Prentice Hall publications
4. Let us C- Yashwant Kanetkar BPB publications
5. Programming with C- K.R. Venugopal, S. R. Prasad, TMH.
6. Introductory methods of numerical analysis-S. Sastry Prentice Hall
7. Computer oriented numerical methods – V. Rajaraman.
8. Mastering turbo C- Stan Kelly- Bootle, BPB publications.

NTT7: Mathematics and Statistics

Sr. No.	Topic	Lectures
	Mathamatics	
1.	Matrices: Characteristic equation – Eigen values and eigen vectors of a real matrix – Properties of eigen values Orthogonal reduction of a symmetric matrix to diagonal form – Orthogonal matrices – Reduction of quadratic form to canonical form by orthogonal transformations.	**06**
2.	Functions of Variables: Function of two variables – Partial derivatives , Frequently occurring partial differential equations, degree, order, linearity and homogeneity (revision), Method of separation of variables, Successive differentiation, Total differentiation, Exact differential, Chain rule, Theorems of differentiation, Singular points, Total differential , Simultaneous first order linear equations with constant coefficients – Linear equations of second order with constant and variable coefficients ,Degree, order, linearity and homogeneity of differential equation.	**10**
3.	Complex Numbers: Introduction to complex numbers, Argand diagram, Rectangular, polar and exponential forms of complex numbers, De-Moivre's Theorem (statement only), Different functions of complex numbers, Applications of complex numbers to determine velocity and acceleration in curved motion, Problems.	**08**
4.	Vector Algebra: Introduction to scalar and vector fields, scalars, vectors: dot product and cross product, Scalar triple product and its geometrical interpretation, Vector triple product and its proof. Vector differential operator, Gradient of scalar field and its physical significance, Divergence of scalar field and its physical significance, Curl of vector field and its physical significance, Problems	**12**
	Satistics	
1.	Data Condensation and Graphical Methods: Definition of Attribute and variable – Discrete variable, continuous variable Classification – Discrete and continuous frequency distribution, Cumulative frequency distribution, Relative frequency distribution Graphical Representation of frequency distribution- Histogram, frequency polygon, frequency curve and ogive curve.	**02**
2.	Measures of Central Tendency : Concept of central Tendency. Different measures of central Tendency- Arithmetic mean, median and mode. Computation of arithmetic mean, median and mode for ungrouped and grouped data. Merits and demerits of mean, median and mode. Requisites of a good Measure of Central Tendency. Partition values-Quartiles, Deciles and Percentiles.	**03**

3.	Measures of Dispersion : Concept of Dispersion. Different measures of Dispersion- Range, Quartile deviation, Mean Deviation about (mean, median and mode), Variance, Standard Deviation. Computation of these measures for ungrouped and grouped data.	**03**
4.	Skewness and Kurtosis: Concept of skewness. Different types of skewness, measures of skewness- Pearson's and Bowely's Coefficient of skewness. Concept of kurtosis and types of kurtosis.	**02**
5.	Correlation and Regression : Concept of bivariate data, correlation, scatter diagram, Covariance, Karl Pearson's coefficient of correlation, Properties of correlation coefficient, computation of correlation coefficient for ungrouped data. Regression: Concept of regression, lines of regression. Regression coefficient: Definition, computation, properties (with proof). Fitting of lines of regression. Examples and Problems.	**05**
6.	Multiple Correlation and Regression : For trivariate data: concept of plane of regression, equation of plane of regression multiple and partial correlation coefficient.. Examples and Problems.	**03**
7.	Elementary Probability Theorey : Sample space and events, types of events. Probability: Classical definition of Probability .Axiomatic approach to Probability. Theorems on probability (without proof). Conditional probability, Theorem of compound probability. Independent of two events.	**04**
8.	Random variable and probability distributions: Random variable- Discrete random variable, discrete probability distributions: Bernoulli , binomial and Poisson distribution. Continuous random variable, continuous probability distribution: Normal distribution, exponential distribution.	**06**
9.	Tests of Hypothesis: Concept of statistical hypothesis, null and alternative hypothesis, critical region. Level of significance.(I) Large sample Test for population mean (i) H0 : $\mu = \mu 0$ (ii) H0 : $\mu 1 = \mu 2$ (i) Chi –square Test for Independence of attribute (ii) t –test for testing (i) H0 : $\mu = \mu 0$ (ii) H0 : $\mu 1 = \mu 2$ Confidence interval for population mean.	**05**
10.	Analysis of variance : One way classification, two way Classification	**03**

Reference Books:

Mathematics

1. Mathematical Physics – P. K. Chattopadhyay New Age International Publishers.
2. Mathematical methods in the Physical Sciences (Second Edition) – Marry L. Boas John Willy and Sons Publication.
3. Fourier series – Seymour Lipschutz, Schaum outlines series.
4. Laplace transform : Seymour Lipschutz, Schaum outlines series.
5. Mathematical methods for Physicists : Weber and Arfken. (6th edition) Academic press – N. Y.

Statistics

6. Goon Gupta and Das Gupta : Fundamentals of Statistics, Vol. 1, The World Press Pvt. Ltd., Kolkata.
7. Miller and Fruend : Modern Elementary Statistics.
8. Snedecor and Cochran : Statistical Methods, Oxford and IBH Publishers.
9. Mukhopadhyay, P. : Mathematical Statistics (1996), New Central Book Agency, Calcutta, Introduction to Mathematical Statistics, Ed. 4 (1989), MacMillan Publishing Co. New York.
10. Gupta and Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
11. Neil Weiss : Introductory Statistics : Pearson Publishers
12. Gupta and Kapoor : Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi

LANG8: English
Oral and Written Communication

Sr. No.	Topic	Lectures
1.	Sounds of English: Vowels, consonants, diphthongs Weak forms, strong forms Intonation	**05**
2.	Vocabulary: Affixation, Norm, Verb, Adjective and Adverb. Lexical sets, word formation, words often confused	**13**
3.	Grammar: Tenses, change of voice, reported speech, conjunctions, use of prepositions, phrases, simple, compound and complex sentences, model auxiliaries	**18**
4.	Writing Skills: a) Information transfer-Graphic to verbal, Charts- Pie chart, Bar chart, Tree diagram, Flow chart. b) Note making and note taking c) Summarizing d) Abstract writing e) Expansion of ideas f) Application writing	**26**
5.	Oral Presentation: Lecture, Speech, Presentation, Group discussion, Anchoring, Turn taking and Interview.	**10**

Reference Books:

1. Enriching Your Competence in English- Dr. Shridhar Gokhale
2. Written Communication in English-Sarah Freeman
3. English Grammar and Composition – Pal and Suri
4. English Grammar and Composition-Wren and Martin
5. English for Practical Purposes- Ashok Thorat and Zeenath Marchant

NTP10: Practical I
Chemical Science

Sr. No.	Title	No. of Practicles
1.	Determination of solubility product of a sparingly soluble salt by conductometric method.	**01**
2.	Determination of P^{Ka} value of weak acid using pH Metric method.	**01**
3.	To Prepare and characterize Phenol – formaldehyde and Urea formaldehyde resin.	**01**
4.	Kinetics of acid catalyzed hydrolysis of methyl acetate and comparison of rate constants.	**01**
5.	Isolation of natural food colours (chlorophyll) by soxhelet extraction and its characterization by spectrophotometer.	**01**
6.	Determination of molecular status and partition coefficient of benzoic acid in Toluene and water	**01**
7.	Determination of redox potentials of Fe2+/Fe3+by potentiometric titration of ferrous ammonium sulphate vs. potassium dichromate.	**01**
8.	Separation and identification of cations by Paper chromatography and its Rf values determination.	**01**
9.	Determine the water of crystallization in compound ($MgSO_4$/$BaCl_2$) gravimetrically	**01**
10.	Determination of hardness of water from given sample by E.D.T.A. method.	**01**
11.	Separation of binary mixture of cations by paper chromatography technique.	**01**
12.	Prepare tetramminecopper (II) sulphate complex and determine the purity of complexes.	**01**
13.	Prepare Potassium trioxalatoferrete (III) complex and determine the purity of complexes.	**01**
14.	Purify the given organic compound by crystallization (in water, water-alcohol and alcohol.)	**01**
15.	Purification of organic liquid by simple distillation.	**01**
16.	Separation and identification of components of given organic mixture by Thin layer chromatography.	**01**
17.	Determination of Type, elements, functional group and physical constant of given organic compound (acid, phenol, base and neutral.)	**02**
18.	Determination of molecular weight of given monobasic/dibasic acid.	**01**
19.	Preparation of DNP derivative of compound containing carbonyl functional group.	**01**

Reference Books:

1. A textbook of Practical Organic Chemistry by - A. I .Vogel
2. A handbook of Organic Analysis Qualitative and Quantitative, by – H.T. Clarke.

NTP10: Practical II

Sr. No.	Title	No. of Practicles
	Atomic and Molecular Physics	
1.	e/m by Thomson's method	**01**
2.	Plank's constant	**01**
3.	Characteristics of Photo-voltaic cell	**01**
4.	To verify inverse square law of radiation using a photo-electric cell	**01**
5.	Study of Uv-Vis. spectrophotometer and draw a calibration curve.	**01**
6.	Quantitative analysis using Uv-Vis. spectrophotometer.	**01**
7.	Study of IR spectrometer and analysis of spectra.	**02**
8.	Study of sodium emission spectra	**01**
9.	Find the wavelength of spectral lines of Balmer series using constant deviation spectrometer.	**01**
10.	To draw the plateau curve for a G.M. counter	**01**
11.	To find the dead time of G.M. counter	**01**
	Materials Science	
1.	Study of Hook's law, elastic limit, plastic limit and breaking point.	**01**
2.	Determination of tensile strength of given materials.	**01**
3.	Determination of Young's Modulus of the material	**01**
4.	Determination of Rigidity Modulus of the material – Torsion Pendulum	**01**
5.	Resistivity determination for a semiconductor wafer using Four probe method.	**01**
6.	Determination of thermal conductivity – Lee's Disc method	**01**
7.	Susceptibility, Gauy method.	**01**
8.	Study of crystal structures (Bravice Lattices, Millar Indices, Planer density, Packing fraction, etc.)	**01**
9.	Observation of grains and grain boundaries.	**01**
10.	Study of single unary phase diagrams	**01**
11.	Study of binary phase diagrams.	**01**

NTP11: Practical III

Sr. No.	Title	No. of Practicles
	Electromagnetism and Optics	
1.	High resistance by Leakage method	**01**
2.	To study the growth and decay of current in LR circuit using magnetic core inductor	**01**
3.	Anderson's bridge	**01**
4.	Study of LR and RC circuit	**01**
5.	LCR series circuit	**01**
6.	Charging and discharging of capacitor	**01**
7.	Determination of wavelength for a given laser source using grating	**01**
8.	Study of Spectrometer and determination of angle of prism	**01**
9.	To find the refractive index of the material of given prism using a spectrometer	**01**
10.	To find the dispersive power of the material of a given prism	**01**
11.	Diffraction at straight edge/cylindrical obstacle	**01**
12.	Optical activity of sugar solution (polarimeter)	**01**
	Electronics	
1.	Circuit Theorems. (Thevenin's, Norton's and Maximum power transfer theorem)	**01**
2.	I-V characteristics of a diode	**01**
3.	Study of Zener diode	**01**
4.	Study of rectifiers (half wave and full wave), line and load regulations	**01**
5.	Band gap of the semi-conductor material	**01**
6.	Temperature coefficient of resistance of thermistor	**01**
7.	Transistor characteristics (CE/CB configuration)	**01**
8.	RC coupled transistor amplifier (single stage)	**01**
9.	Operational amplifiers as adder and substractor	**01**
10.	Study of logic gates (using IC) and verification of De Morgan's theorem.	**01**
11.	Use of CRO (AC/DC voltage measurement, frequency measurement)	**01**

NTP11: Practical IV

Sr. No.	Title	No. of Practicles
	Statistics	
1.	Measures of central Tendency	**01**
2.	Measures of Dispersion	**01**
3.	Correlation and regression for ungrouped data	**01**
4.	Multiple regression, multiple and Partial correlation coefficients.	**01**
5.	Application of binomial and Poisson distribution	**01**
6.	Application of normal and exponential distribution	**01**
7.	Large sample test for testing (i) H0 : $\mu = \mu 0$ ii) H0 : $\mu 1 = \mu 2$	**01**
8.	t-test for testing (i) H0 : $\mu = \mu 0$ ii) H0 : $\mu 1 = \mu 2$ Chi-square test for independence of attribute, variance. F test for testing population variances.	**02**
9.	ANOVA One – way and Two- way fixed effect model	**01**
	Computer Basics	
1.	File handling: copy, rename, delete type etc. Directory structure: make, rename, move directory	**01**
2.	Word Processing (Microsoft Word)	**01**
3.	Use of internet – Searching/Surfing on the WWW. Downloading and Installing software/plug-ins on Windows 98/XP (Acrobat Reader, Post Scripts Viewer, etc.)	**01**
4.	Database Applications (Microsoft Access)	**02**
5.	Usage of multimedia – (Microsoft Power Point)	**02**
	Programming in 'C'	
6.	Factorial of a number	**01**
7.	To find out the first 100 prime numbers	**01**
8.	Matrix operation	**01**
9.	Graphics (line, circle, arc, ellipse, bar, draw poly)	**01**
10.	Sorting using file pointer	**01**