COURSE SCHEME AND DETAILED SYLLABUS
Bachelor of Sciences [B. Sc.(NM)]

B. Sc. (General) Non-Medical

with

Physics, Chemistry and Mathematics

Three-Year (Six-Semester) Programme

Objectives

The programme comprises of study of Physics, Mathematics and Chemistry with Computer Science as positional course for undergraduate students. The student will be able to select various options for higher studies like M. Sc. in Physics, Mathematics, Chemistry and MCA after completion of this programme. In addition, the programme provides a good platform to create interest of undergraduate students towards M. Tech. in Allied Sciences and Nanoscience.

Eligibility Qualification:

(a) The candidate should have passed 10+2 (Class XII) Examination or its equivalent from a recognized Board/University with Physics, Chemistry and Mathematics with 50% or equivalent grade (for SC/ST candidates marks of eligibility will be 45% or equivalent grade) from .

 (b) In case of candidates who are studying in University/Board/College/Schools in any of the foreign countries the eligibility/Qualifying marks will be the same as recognized/equivalent to 10+2 by the University or the association of the Indian University with 50% marks of equivalent grade (for SC/ST candidates, eligibility will be 45% marks or equivalent grade).

(c) The candidate who has appeared in the qualifying examination but whose result has so far not been   declared can also apply but his/her eligibility for admission based on interview / entrance test will be purely provisional subject to the condition that he/she has to produced a

passing certificate scoring at least the minimum percentage of marks as prescribed for the qualifying examination on the day and the specified time of counseling.

(d) The candidate shall not be more than 22 years of age as on 01st July of the year of admission. Date of birth as recorded in the Secondary Education Board/ University Certificate Only will be considered as authentic.

Admission Procedure

Admission may be based on the merit of the qualifying examination or entrance test to be conducted by IEC University or any other mode as to be decided by the University from time to time.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Undergraduate Programmes of IEC shall be followed.

The **weightage** for marks obtained for each theory paper will consist of

(i)   **Internal – 30 Marks**: Continuous Evaluation (CW) which comprise of Assignments, Attendance etc - 10 marks and Mid Term Exams -20 marks.
(ii)   **External -20 Marks**: The external papers for each subject will be of 50 marks and the marks obtained by the students after evaluation will be converted to out of 20 marks (20% of the marks obtained).

The **weightage** for marks obtained for each Practical (Lab course) will consist of

(i)   **MLT (Mid-Lab Test) – 30 Marks**: The marks will be based on continuous assessment and Attendance, Practical Note book, Mid-lab Test including Viva etc.
(ii)   **ELT (End-Lab Test) – 20 Marks**: The marks will be based on End-Lab Test (Performance, Viva, Note-book etc.)

GENERAL INSTRUCTIONS/GUIDELINES

The tuition fee and other monthly/annual charges will be as per University rules.

B.SC. (NM) SYLLABUS

Course structure, Scheme of Study and Evaluation

Ist Year (First Semester)

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
		L	T	P			CW*	MTE	ETE
BPH-101	Semiconductor Devices and Electronics	3		-	3	3	10	20	20
BPHP-103	Physics Laboratory-I	-	-	4	2	3	MLT- 30		ELT 20
MATH-104	Algebra	3			3	3	10	20	20
MATH-105	Calculus	3			3	3	10	20	20
BCH-101	Inorganic Chemistry - I	3			3	3	10	20	20
BCH-102	Physical Chemistry -I	3			3	3	10	20	20
BCHP-103	Chemistry Laboratory - I			4	2	3	MLT- 30		ELT 20
ENG-102	Foundation English-I	3	-	-	3	3	10		20
ENG-102P	Communication Skill lab	-	-	1	2	3	MLT- 30		ELT 20
	Sub Total	**18**	**-**	**9**	**24**				

B.SC. (NM) SYLLABUS

Ist Year (Second Semester)

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
		L	T	P			CW*	MTE	ETE
BPH-201	Electricity & Magnetism	3		-	3	3	10	20	20
BPH-202	Vibrations, Waves and EM Theory	3	-	-	3	3	10	20	20
BPHP-202	Physics Laboratory-II	-	-	4	2	3	MLT- 30		ELT20
MATH-204	Number Theory and Trigonometry	3			3	3	10	20	20
MATH-205	Ordinary Differential Equations	3			3	3	10	20	20
MATH-106	Solid Geometry	3			3	3	10	20	20
BCH-201	Organic Chemistry –I	3			3	3	10	20	20
BCHP-202	Chemistry Laboratory - II			4	2	3	MLT- 30		ELT20
EVS-101	Environmental Studies &Technology (non-credit)	-	-	-	-	2	10	20	20
	Sub Total	**18**	**-**	**8**	**22**				

B.SC. (NM) SYLLABUS

IInd Year (Third Semester)

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
		L	T	P			CW*	MTE	ETE
BPH-301	Optics	3	-	-	3	3	10	20	20
BPH-302	Mechanics	3			3	3	10	20	20
BPHP-303	Physics Laboratory-III	-	-	4	2	3	MLT- 30		ELT 20
MATH-303	Advanced Calculus	3			3	3	10	20	20
MATH-304	Partial Differential Equations	3			3	3	10	20	20
MATH-305	Groups and Rings	3			3	3	10	20	20
BCH-301	Physical Chemistry –II	3			3	3	10	20	20
BCH-302	Inorganic Chemistry –II	3			3	3	10	20	20
BCHP-303	Chemistry Laboratory - III	-	-	4	2	3	MLT- 30		ELT 20
	Sub Total	**21**	**-**	**8**	**25**				

B.SC. (NM) SYLLABUS

IInd Year (Fourth Semester)

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
		L	T	P			CW*	MTE	ETE
BPH-401	Quantum Physics	3			3	3	10	20	20
BPHP-402	Physics Laboratory-IV	-	-	4	2	3	MLT- 30		ELT20
MATH-401	Sequence and Series	3			3	3	10	20	20
MATH-402	Special Functions and Integral Transforms	3			3	3	10	20	20
BCH-401	Organic Chemistry –III	3			3	3	10	20	20
BCHP-402	Chemistry Laboratory - IV	-	-	4	2	3	MLT- 30		ELT20
BHI-401	Hindi – I	2			2	2	10		20
BIT-401P	Fundamentals of Computer and Information Technology	-	-	4	2	3	MLT- 30		ELT20
	Sub Total	**14**	**-**	**12**	**20**				

IIIrd Year (Fifth Semester)

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
		L	T	P			CW*	MTE	ETE
BPH-501	Solid State & Nano-physics	3	-	-	3		10	20	20
BPH-502	Thermodynamics & Statistical Physics	3	0	-	3	3	10	20	20
BPHP-503	Physics Laboratory-V	-	-	4	2	3	MLT- 30		ELT20
MATH-501	Real and Complex Analysis	3	-		3	3	10	20	20
MATH-502	Statics	3			3	3	10	20	20
MATH-503	Numerical Analysis	3			3	3	10	20	20
BCH-501	Physical Chemistry –IV	3			3	3	10	20	20
BCH-502	Inorganic Chemistry –IV	3			3	3	10	20	20
BCHP-503	Chemistry Laboratory - V	-	-	4	2	3	MLT- 30		ELT20
	Sub Total	**21**	**-**	**8**	**25**				

B.SC. (NM) SYLLABUS

IIIʳᵈ Year (Sixth Semester)

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
		L	T	P			CW*	MTE	ETE
BPH-601	Nuclear Physics	3	-	-	3		10	20	20
BPHP-602	Physics Laboratory-VI	-	-	4	2	3	MLT- 30		ELT 20
MATH-601	Linear Algebra	3			3	3	10	20	20
MATH-602	Dynamics	3			3	3	10	20	20
BCH-601	Organic Chemistry –IV	3			3	3	10	20	20
BCHP-602	Chemistry Laboratory - VI	-	-	4	2	3	MLT- 30		ELT 20
BHI-601	Hindi – II	2			2	3	10	20	20
	Sub Total	**14**	**-**	**8**	**18**				

*CW: Course Work; **MTE:** Mid Term Examination; **ETE:** End Term Examination*

* Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc

Chemistry Papers & Syllabi for B.Sc.(General) Semesters-I to VI

B.Sc.-Ist year (Semester-I)

Paper Code	Name of the Paper	External	Internal	Time
BPH-101	Semiconductor Devices and Electronics	20 Marks	30 Marks	3 Hours
	Semiconducting Physics			
BPHP-103	Practical Laboratory	20 Marks	30 Marks	3 Hours

B.Sc.-Ist year (Semester-II)

Paper Code	Name of the Paper	External	Internal	Time
BPH-201	Electricity and Magnetism	20 Marks	30 Marks	3 Hours
BPH-202	Vibrations, Waves	20 Marks	30 Marks	3 Hours
	and EM Theory			
BPHP-202	Practical Laboratory	20 Marks	30 Marks	3 hours

B.Sc.–IInd Year (Semester-III)

Paper Code	Name of the Paper	External	Internal	Time
BPH-301	Optics	20 Marks	30 Marks	3 Hours
BPH-302	Mechanics	20 Marks	30 Marks	3 Hours
BPHP-303	Practical Laboratory	20 Marks	30 Marks	3 Hours

B.SC. (NM) SYLLABUS

B.Sc.-IInd year (Semester-IV)

BPH-401	Quantum Physics	20 Marks	30 Marks	3 Hours
BPH-402	Practical Laboratory	20 Marks	30 Marks	3 Hours

B.Sc.-IIIrd Year (Semester-V)

BPH- 501	Solid State & Nano-Physics	20 Marks	30 Marks	3 Hours
BPH-502	Thermodynamics & Statistical Physics	20 Marks	30 Marks	3 Hours
BPHP-503	Practical Laboratory	20 Marks	30 Marks	3 Hours

B.Sc.-IIIrd (Semester-VI)

BPH-601	Nuclear Physics	20 Marks	30 Marks	3 Hours
BPHP-602	Practical Laboratory	20 Marks	30 Marks	3 Hours

BASIC ELECTRONICS AND SEMICONDUCTING DEVICES

BPH-101   **Max. Marks: 50**

UNIT-1

Introduction: Concepts of current and voltage sources, Fermi level in Semiconductor , P-N junction, biasing of P-N junction, V-I characteristics of P-N junction, Zener Diode, Tunnel diode, Light Emitting Diodes(LED), (LCD), Semiconductor Diodes as half wave Rectifier and full wave rectifier, Qualitative analysis of Filter circuits(RC, LC, and Π circuits.

UNIT-II

Bipolar junction Transistors and Amplifiers: Junction Transistor structure and working, sign conventions, Common Base and Common Emitter characteristics, Transistor as an Amplifier, (Common Base , Common Emitter), Transistor load line analysis, Transistor \biasing(Qualitative

idea)

UNIT-III

Field Effect Transistors(FET): Introduction, Junction field effect transistor(JFET), Operation, Characteristic curves for FET, parameters of FET, Applications, JFET biasing, FET as an amplifier, Metal Oxide semiconductor FET(MOSFET)-Enhancement and Depletion MOSFET, Difference between FET and BJT, difference between JFET and MOSFETS

Books Suggested:

1. Basic Electronics and Linear Circuits by N.N.Bhargava. D.C. Kulshreshtha and

S.C.Gupta (TITI CHD).

2. Solid State Electronics by J.P. Agarwal, Amit Agarwal (Pragati Prakashan Meerut).

3. Electronics Fundamentals and Applications by J.D. Ryder (Prentice Hall India)

4. Solid State Electronics by B.L.Theraja

5. Digital Design by M. Morris Mano, (Prentice Hall of India 2003)

6. Digital Circuits and Design by S. Salivahanan and S. Arivazhagan, (Vikas
    Publishing House New Delhi, 2006)).

3. Waves and Oscillations by N. Subrahmanayam & B. Lal (Vikas Pub., Delhi

Electricity and Magnetism

BPH-201   **Max. Marks: 50**

Time: 3 Hours

UNIT-I

Vector Calculus: Basic ideas of Vector Calculus, scalar and vector fields, Integration of vectors, flux, Divergence, physical significance, Gauss's divergence theorem, circulation, curl of a vector field, Stokes theorem and its applications in Electrostatic field,, gradient of scalar field, Types of vector fields and their properties, Green's theorem, spherical and cylindrical co-ordinates

UNIT-II

Current and current density, equation of continuity. Microscopic form of Ohm's Law ($\mathbf{J} = \sigma\mathbf{E}$) and conductivity. Failure of Ohm's Law. Invariance of charge. $\mathbf{E}$ in different frames of reference. Field of a point charge moving with constant velocity. Interaction between moving charges and force between parallel currents. Motion of Charged Particles in a Uniform Electric Field. The method of images, separation of variables, Magnetic vector potential, Permeability and susceptibility and their interrelationship. Orbital motion of electrons and diamagnetism, Electron spin and paramagnetism, Ferromagnetism, Hysteresis Loss, Magnetisation curve.

UNIT-III

Lorentz's force. Definition of $\mathbf{B}$. Biot Savart's Law and its application to long straight wire, circular current loop and solenoid. Ampere's Circuital law and its application. Divergence and curl of $\mathbf{B}$. Hall effect, expression and co-efficient. Vector potential, Definition and derivation, current density— definition, its use in calculation of change in magnetic field at a current sheet. Transformation equations of E and B from one frame to another. Faraday's Law of EM induction, Displacement current, Maxwell's equations. Mutual inductance and reciprocity theorem.

Books Suggested :

Essential Readings :

1. Fundamentals of Electricity and Magnetism by Arthur F. Kipp
2. Electricity and Magnetism, Berkeley Physics Course, Vol. II by E.M. Purcell.
3. Introduction to Classical Electrodynamics by David Griffith, Prentice Hall.

Further Readings :

4. Electricity & Magnetism, A.S. Mahajan & A.A. Rangwala (Tata McGraw Hill).
5. Electricity & Magnetism, 4th Edition, W.J. Duffin.
6. EM Waves and Radiating Systems, Edward C. Jordan and K. G. Balmain, Prentice Hall.

VIBRATIONS, WAVES & EM THEORY

BPH-202   **Max. Marks: 50**

Time: 3 Hours

Unit-I

Periodic Motion, Oscillatory Motion, Simple Harmonic Motion, Projection of uniform circular motion, characteristics of S.H.M. , Graphical representation, Simple harmonic mechanical oscillator, Differential form of mechanical oscillator, energy of a S.H.M., Different types of oscillations, Differential Equation of angular S.H.M., Compound pendulum, Torsional Pendulum.

Unit-II

Electrical oscillations and oscillator, energy of an electrical oscillator, analogy between mechanical and electrical oscillator, composition of two perpendicular S.H.Ms. of same period, damping, damped mechanical oscillators, type of damping, relaxation time, Q-factor, damper electrical oscillators, applications of damping to electrical measuring instruments.

Unit-III

Forced Oscillator, equation of forced oscillator, Transient and steady state response of the forced oscillator, solution of equation of forced mechanical oscillator, Q-factor and amplification factor, band width, stiffness coupled simple pendulum, excitation of modes, degrees of freedom, significance of normal modes. Physical interpretation of Maxwell's equations, Poynting vector, Impedance of a dielectric to EM waves. EM waves in a conducting medium and skin depth. EM wave velocity in a conductor and anomalous dispersion.

Books Suggested :

1. Text Book of Vibrations and Waves by S.P. Puri (Macmillan India Ltd.).
2. Physics of Vibrations and Waves by H.J. Pain, ELBS & John Wiley, London.
3. EM Waves and Radiating Systems by Edward C. Jordan and K.G. Balmain, Prentice Hall.

Further Readings :
1. Vibrations and Waves by A.P. French (Arnold Heinemann India, New Delhi).
2. The Mathematics of Waves and Vibrations by P.K. Ghosh (Mcmillan India

B.SC. (NM) SYLLABUS

OPTICS

BPH-301   **Max. Marks: 50**

Time: 3 Hours

Unit-1

Interference of light: Superposition of light waves, Young's double slit experiment,Coherence, interference by Fresnel's biprism, achromatic fringes, interference in thin films, Newtons rings, Michelson's interferometer.

Unit-II

Diffraction: Fresnel's half period zones, Fresnel's diffraction at circular aperture, circular disc and straight edge, zone plates,Fraunhauffer differaction, diffraction grating, dispersive power of aa plane diffraction grating, limit of resolution of resolving power(telescope,microscope,prism,interferometer)

Unit-III

Polarization: concept of unpolarized,plane polarized, circularly polarized, elliptically polarized light,Polaroids,, Malu's law,Brewster's law, polarization by reflection , polarization by scattering,polarization by double refraction Nicol's prism, quarter waveplate, half wave plate, full wave plates, analysers.

Mechanics

BPH-302   **Max. Marks: 50**

Time: 3 Hours

UNIT -I

Co-ordinate systems and conservation Laws : Introduction of Cartesian ,Spherical and cylindrical coordinare systems,Displacement, velocity and acceleration in Cartesian, plane polar and spherical polar coordinates, area and volume in Cartesian and spherical coordinates, concept of solid angle.Properties of time and space, conservative force,homogeneity of space and conservation of linear momentum, isotropy of space and conservation of angular momentum, homogeneity of flow of time and conservation of energy.

UNIT – II

Inverse Square Law Force and Collisions: Forces in nature, central and non central forces, centre of mass, reduction of two body problem to one body problem,motion of a body under central force.nature of motion under inverse square field, Kepler's laws.Elastic and in-elastic scattering, laboratory and center of mass systems, elastic scattering in Lab and CM system, comparative study of Lab and CM system in elastic collisions, Rutherford scattering.

UNIT - III

Theory of relativity: Frame of reference, limitation of Newton's law of motion, Inertial frame of reference, Galilean transformation, Frame of reference with linear acceleration, Classical relativity-Galilean invariance, Transformation equation for a frame of reference. Non-inertial frames, Effect of centrifugal and coriolis forces due to Earth's rotation, Fundamental frame of reference, Michelson- Morley's experiment.Special theory of relativity, Lorentz co-ordinate and physical significance of Lorentz invariance, Length Contraction, Time Dilation, Twin Paradox,, Mass energy equivalence, Transformation of relativistic momentum and energy, relation between relativistic momentum and energy, Mass, velocity, momentum and energy of zero rest mass.

Books Suggested:

1.   Properties of Matter by D.S. Mathur.
2.   Mechanics, Berkeley, Vol. I, C. Kittle.
3.   Mechanics, H.S. Hans & S.P. Puri.
4.   An Introduction to Machines, Daniel Kleppner & Robert J. Kolenkow (TMH).
5.   Basic Concepts of Relativity, R.H. Good (East-West Press, New Delhi, 1974).
6.   Special Theory of Relativity, S.P. Puri (Asia Publishing House, Bombay, 1972).
7.   http://www.einsteins-theory-of-relativity-

Quantum Physics

BPH-401   **Max. Marks: 50**
                                       Time: 3 Hours

UNIT-I

Origin of Quantum Theory: Limitations of classical theory, Photoelectric effect, Compton effect, de Broglie hypothesis, phase velocity , group velocity ,Davisson-Germer experiment, Heisenberg's uncertainty principle and its applications

UNIT-II

Quantum Mechanics: Wave function and its physical significance,Time dependent Schrodinger wave equation, Time independent Schrodinger wave equation, concept of operators, expectation value, degeneracy, parity , orthogonality of energy eigen functions.

UNIT-III

Solutions of Schrodinger Equations: Particle in one-dimensional infinite potential well, energy eigen values,Potential step, potential barrier,tunnel effect,harmonic oscillator.Hydrogen atom.

B.Sc. (NM) Syllabus

Solid State and Nano- Physics

BPH-501 <div align="right">**Max. Marks: 50**
Time: 3 Hours</div>

Note:- 1. Nine Questions will be set in total out of which 5 (five) questions will have to be attempted. All questions will carry equal marks.

2. Question number 1 will be compulsory and will be based on the conceptual aspects of entire syllabus. This question may have five parts and the answer should be in brief.

3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts.

4. Sufficient number of Numerical problems (~20%) may be set, wherever possible.

5. Use of scientific (non-programmable) calculator is allowed.

UNIT - I

Crystal Structure I: Crystalline and glassy forms, liquid crystals, crystal structure, periodicity, lattice and basis, crystal translational vectors and axes. Unit cell and Primitive Cell, Winger Seitzprimitive Cell, symmetry operations for a two dimensional crystal, Bravais lattices in two and three dimensions. Crystal planes and Miller indices, Interplaner spacing . Crystal Structure II: X-ray diffraction, Bragg's Law and experimental X-ray diffraction methods. K-space and reciprocal lattice and its physical significance, reciprocal lattice vectors, reciprocal lattice to a simple cubic lattice, b.c.c. and f.c.c.

UNIT - II

Super conductivity: Historical introduction, Survey of superconductivity, Super conducting systems, High Tc Super conductors, Isotopic Effect, Critical Magnetic Field, Meissner Effect, London Theory and Pippards' equation, Classification of Superconductors (type I and Type II),BCS Theory of Superconductivity, Flux quantization, Josephson Effect (AC and DC), Practical Applications of superconductivity and their limitations, power application of superconductors.

UNIT - III

Introduction to Nano Physics: Definition, Length scale, Importance of Nano-scale and technology, History of Nantechnology, Benefits and challenges in molecular manufacturing. Molecular assembler concept, Understanding advanced capabilities. Vision and objective of Nano-technology, Nanotechnology in different field, Automobile, Electronics, Nano-biotechnology, Materials, Medicine.

Books Suggested:

1. C. Kittel, *Introduction to Solid State Physics*, 7th Ed (1996) John Wiley & Sons, New Delhi.
2. H. Ibach and H. Luth, *Solid State Physics, An Introduction to Theory and Experiment*, Springer-Verlag, Berlin, 1991
3. Pillai O S, *Solid State Physics*, New Age International Publishers (2007) New Delhi
4. Mark R and Denial R, *Nano-tecnology* – A Gentle Introduction to the Next Big Idea (2002)
5. Dekkar A J, Solid State Physics (2000), Mc Millan India Ltd New Delhi
6. Ascroft N W and Mermin N D, Solid State Physics (2003) Harcourt Asia, Singapore
7. Keer H V, Solid State Physics (1993), Wiley Eastern Ltd, New Delhi
8   Kachhava C M, Solid State Physics (1990) Tata Mc Graw Hill Co Ltd, New Delhi
9. Gupta, Solid State Physics (1995) Vikas Publishing House Pvt Ltd, New Delhi

B.SC. (NM) SYLLABUS

Thermodynamics and Statistical Physics

BPH-502
<div align="right">

Max. Marks: 50
Time: 3 Hours
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UNIT-I

Thermodynamic system and Zeroth law of thermodynamics. First law of thermodynamics and its limitations, reversible and irreversible process. Second law of thermodynamics and its significance, Carnot theorem, Absolute scale of temperature, Absolute Zero and magnitude of each division on work scale and perfect gas scale, Entropy, calculations of entropy of reversible and irreversible process, T-S diagram, entropy of a perfect gas, Nernst heat law(third law of thermodynamics)

UNIT- II

Derivation of Clausius-Clapeyron and Clausius latent heat equation and their significance,specific heat of saturated vapours,phase diagrame and triple point of a substance, development of Maxwell thermodynamical relations. Thermodynamical functions: Internal energy (U), Helmholtz function (F), Enthalpy (H), Gibbs function (G) and the relations between them, derivation of Maxwell thermodynamical relations from thermodynamical functions,Application of Maxwell relations: relations between two specific heats of gas, Derivation of Clausius-Clapeyron and Clausius equation,variation of intrinsic energy with volume for (i) perfect gas (ii)Vanderwall gas (iii)solids and liquids , derivation of Stefans law, adiabatic compression and expention of gas & deduction of theory of Joule Thomson effect.

UNIT - III

Basic ideas of Statistical Physics, Scope of Statistical Physics, basic ideas about probability, distribution of four distinguishable particles in two compartments of equal size. Concept of macrostates, microstates, thermodynamic probability, effects of constraints on the system, distribution of n particles in two compartments, deviation from the state of maximum probability, equilibrium state of dynamic system, distribution of distinguishable n particles in k compartments of unequal sizes. Phase space and elementary cells,Maxwell Boltzmann statistics(ideal gas in equilibrium) Quantum statistics, B-E statistics-Planks law, Wein's displacement law, Stefan's law F-D statistics,

Books Suggested:

1. Roy S K, Thermal Physics and Statistical Mechanics, New Age International Publishers, New Delhi

2. Sharma J K and Sarkar K K, Thermodynamics and Statistical Physics, Himalaya Publishing House, Bambay

3. Stowe Keith, Introduction to Thermodynamics and its Applications, University press (India) Pvt Ltd, Hyderabad

4. Infelta Pierre P. Introductory Thermodynamics Publisher: BrownWalker Press
5. Johnson J. K, Fundamentals of Thermodynamics University of Pittsburgh 2009
6. Jefferson Tester, Michael Modell, Thermodynamics and Its Applications 3rd Edition
7. Thomas Engel, Philip Reid, Thermodynamics, Statistical Thermodynamics, & Kinetics 2nd Edition
8. 1. Bhatia, V.S. : *Statistical Physics and Thermodynamics,* Shoban Lal Nagin Chand, Jalandhar.

B.SC. (NM) SYLLABUS

Nuclear Physics

BPH- (601)   Max. Marks: 50
                                                   Time: 3 Hours

Note:- 1. Nine Questions will be set in total out of which 5 (five) questions will have to be attempted. All questions will carry equal marks.
   2. Question number 1 will be compulsory and will be based on the conceptual aspects of entire syllabus. This question may have five parts and the answer should be in brief.
   3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts.
   4. Sufficient number of Numerical problems (~20%) may be set, wherever possible.
   5. Use of scientific (non-programmable) calculator is allowed.

UNIT - I

Nuclear Structure and Properties of Nuclei, Nuclear size, spin, parity, statistics, magnetic dipole moment, quadruple moment (shape concept), Determination of mass by Bain-Bridge, Bain-Bridge and Jordan mass spectrograph, Determination of charge by Mosley Law, Rutherford Back Scattering.

Nuclear Radiation decay Processes: Alpha-disintegration and its theory. Energetics of alpha-decay, Origin of continuous beta spectrum (neutrino hypothesis), types of beta-decay and energetics of beta-decay. Nature of gamma rays, Energetics of gamma rays.

UNIT - III

Radiation interaction: Interaction of heavy charged particles (Alpha particles); Energy loss of heavy charged particle (idea of Bethe formula, no derivation), Range and straggling of alpha particles. Geiger-Nuttal law. Interaction of light charged particle (Beta-particle), Energy loss of

beta-particles (ionization)

UNIT-III

Range of electrons, absorption of beta-particles. Interaction of Gamma Ray; Passage of Gamma radiations through matter (Photoelectric, Compton and Pair production effect) electron-positron annihilation. Absorption of Gamma rays (Mass attenuation coefficient) and its application.

Nuclear reactions: Nuclear reactions, Elastic scattering, Inelastic scattering, Nuclear disintegration, Photonuclear reaction, Radiative capture, Direct reaction, Heavy ion reactions and

spallation Reactions. Conservation laws, Q-value and reaction threshold.

Books Suggested:

1. Kaplan I, Nuclear Physics, 2nd Ed (1962), Oxford and IBH, New Delhi
2. Sriram K, Nuclear Measurement Techniques, (1986), AEWP, New Delhi
3. Ghoshal S N, Atomic and Nuclear Physics Vol II (1994), S Chand & Co New Delhi
4. Srivastava B N, Basic Nuclear Physics, (1993), Pragati Prakashan Meerut
5. Halliday, Introductory Nuclear Physics, Asia Publishing House, New Delhi
6. Cohen B L, Comcepts of Nuclear Physics (1998), Tata Mc Graw Hill, New Delhi
7. Krane K S, Introductory Nuclear Physics (1988), John Wiley & Sons New Delhi
8. Patel S B, Nuclear Physics (1992), Wiley Eastern Ltd, New Delhi
9. Roy R R and Nigam B P, Nuclear Physics (1993), Wiley Eastern Ltd New Delhi.

Physics Practicals

Ist Year (Semester –I and –II) Labs   **BPHP- 103 and   BPHP- 202**

1. Moment of Inertia of a fly-wheel.

2. M.I. of an irregular body using a torsion pendulum.

3. Surface tension by Jeager's Method.

4. Young's Modulus by bending of beam.

5. Modulus of rigidity by Maxell's needle.

6. Elastic constant by Searle's method.

7. Viscosity of water by its flow through a uniform capillary tube.

8. 'g' by Bar pendulum.

9. E.C.E. of hydrogen using an Ammeter.

10. Calibration of a thermocouple by Potentiometer

11. Low resistance by Carey Foster's bridge with calibration.

12. Determination of Impedance of an A.C. circuit and its verification.

13. Frequency of A.C. mains by Sonometer using an electromagnet.

14. Frequency of A. C. mains by Sonometer using an electromagnet.

15. High resistance by substitution method.

16. To draw forward and reverse bias characteristics of a semiconductor diode.

17. Zener Diode voltage regulation characteristics.

18. Verification of inverse square law by photo-cell.

19. To study the characteristics of a solar cell.

20. Plot the graphs using ORIGIN software

21. To get acquainted with use of Mathematica software

B.SC. (NM) SYLLABUS

IInd Year (Semester –III and –IV) Labs   **BPHP- 303 and   BPHP- 402**

1. To measure the (a) area of a window
                    (b) height of an inaccessible object.
2. Refractive index and dispersive power of a prism material by spectrometer.
3. To draw a graph between wave length and minimum deviation for various lines from a Mercury discharge source.
4. Determination of wave length of Na light and the number of lines per centimeter using a diffraction grating.
5. Wave length by Newton's Rings.
6. Resolving power of a telescope.
7. Comparison of Illuminating Powers by a Photometer.
8. Measurement of (a) Specific rotation (b) concentration of sugar solution using polarimeter.
9. Ordinary and extra ordinary refractive indices for calcite or quartz.
10. To find the equivalent focal length of a lens system by nodal slide assembly.
11. Determine the λ_{Na} by Fresnel Byprism
12. Determine the velocity of ultrasonic in the Kerosene oil
13. Diameter of a Lycopodium powder using corona rings
14. Study double slit interference by He-Ne laser
15. To draw common base and common emitter characteristics of a transistor and calculate transistor characteristics parameters.
16. To study the ripple factor in a d.c. power supply.
17. Study of Hartley oscillator (calibration of gang condenser).
18. To find out the frequency of a tuning fork by Melde's experiment.
19. Study of series and parallel resonance circuits.
20. Electronic Voltmeter measurement of peak, average & R.M.S. value of signal.
21. Study of voltage doubler and trippler circuits.

IIIʳᵈ Year (Semester-V and –VI) Labs   **BPHP- 503 and   BPHP- 602**

1. Determine the diameter of a wire using (He-Ne Laser) diffraction method
2. Determine the Young modulus 'Y' by Searl's interference method
3. Determine the resolving power of a prism
4. Thickness of a paper using interference fringes in an air wedge
5. Determine the resolving power of a transmission grating
6. Determine the RH by grating and Hydrogen tube
7. Determine e/m by Thomson's method
8. Study the C B transistor amplifier
9. Study the C E transistor amplifier
10. Study the B H curve using oscilloscope
11. Study the Hall effect
12. Measurement of energy band gap of Ge/Si by four probe method
13.   (a) Draw the plateau using G M counter

       (b) Determine the mass attenuation coefficient by G M counter

13. Compute the product of two matrices of different dimension using DO loop
14. Numerical integration by Simpson 1/3 rule
15. Fitting of a straight line using Least-Square method
16. Using array variable, find out the average and standard deviation
17. Compute the sum of a finite series up to correct three decimal place
18. With the help of a program arrange the marks in ascending of descending order

Chemistry Papers & Syllabii for B.Sc.(General) Semesters-I to VI

Paper	Paper code	Internal	External	Total
Semester-I				
Inorganic-I	BCH-101	30	20	50
Physical-I	BCH-102	30	20	50
Practical	BCHP-103	30	20	50
Semester-II				
Organic-I	BCH-201	30	20	50
Practical	BCHP-202	30	20	50
Semester-III				
Physical-II	BCH-301	30	20	50
Inorganic-II	BCH-302	30	20	50
Practical	BCHP-303	30	20	50
Semester-IV				
Organic-III	BCH-401	30	20	50
Practical	BCHP-402	30	20	50
Semester-V				
Physical-IV	BCH-501	30	20	50
Inorganic-IV	BCH-502	30	20	50
Practical	BCHP-503	30	20	50
Semester-VI				
Organic-IV	BCH-601	30	20	50
Practical	BCHP-602	30	20	50

INORGANIC CHEMISTRY-I

BCH-101   **Max. Marks: 50**
                                                                                      Time: 3 Hours

Note:- 1. Nine Questions will be set in total out of which 5 (five) questions will have to be attempted. All questions will carry equal marks.

2. Question number 1 will be compulsory and will be based on the conceptual aspects of entire syllabus. This question may have five parts and the answer should be in brief.

3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts.

4. Sufficient number of Numerical problems (~20%) may be set, wherever possible.

5. Use of scientific (non-programmable) calculator is allowed.

UNIT- I

Atomic Structure:

Schrodinger's Wave equation, Significance of Ψ and Ψ^2. The four quantum numbers and their significance. Radial and angular probability. The shapes of s, p, d and f orbitals. Effective nuclear charge and shielding effect, Slater rules. Calculation of screening constant.

UNIT II

The Periodic Table and Chemical Periodicity Nomenclature of Inorganic compounds:

The relationship between chemical periodicity and electronic structure of the atom. The long form of the periodic Table – Classification of elements in s, p, d and f block of elements. Periodicity in oxidation state of valence, metallic/non-metallic character, oxidizing or reducing behaviour; acidic and basic character of oxides; Anomalous behaviour of elements of 2nd short period (Li to F) compared to other members in the same groups of s & p block elements. Effect of lanthanide contraction on the elements following lanthanides. The diagonal behavior between elements. The inert pair effect; variability of oxidation states of transition elements, colour, magnetic properties and other characteristics of transition elements.

UNIT- III

The s-block elements:
Production and uses of metals (important); chemical reactivity and trends in alkali and alkaline earth metals; structure and properties of oxides, halides and hydroxides. Organometallic compounds of alkali metals, Crown and Crypts. Behaviour of solutions in liquid ammonia.

UNIT- IV

The p-block elements

Group III

(i) Boron, Al, Ga, In, Ti family: Chemical reactivity and trends. Boron : Structures of crystalline boron, electronic and/or crystal structures of borides, boranes and carboranes, metallocarboranes and their chemistry. Boron halides. Boric acid, borates, boron-nitrogen compounds, $LiAlH_4$ – its uses as a reducing and hydrogenating reagent, structure of alumina and aluminates.

Group IV

(ii) Carbon, Si, Ge, Sn, Pb family : Chemical reactivity and group trends Carbon : Allotropic forms, graphitic compounds, graphite intercalation compounds, carbides. Silicon : Silicon carbides, silicides, silanes and silylamines structures of silicate mineral, organo silicon compounds and silicones.

Suggested Books :

1. Cotton F.A., Wilkinson G.W. and Gaus P.L., Basic Inorganic Chemistry, Pubs: John Wiley & Sons ,1987.
2. Lee J.D., Concise Inorganic Chemistry, 4th edition, Pubs: ELBS,1991.
3. Huheey J.E., Keiter E.A., Keiter R.L., Inorganic Chemistry: Principles of Structures and Reactivity; 4th Edition, Pubs: Harper Collins, 1993.
4. Greenwood N.N. and Earnshaw A., Chemistry of the Elements, 2nd edition. Pubs: Butterworth/Heinemann, 1997.

FURTHER READING:

1. Cotton F.A. and Wilkinson G., Murillo C.A., Bochmann M., Advanced Inorg. Chemistry, 6th Edition, Pubs: John Wiley & Sons. Inc. 1999.
2. Shriver D.F., Atkins F.W. and Langford C.M., Inorganic Chemistry; 3rd Edition, Pubs: Oxford University Press, 1999.
3. Douglas B., Daniel D. Mc and Alexander J., Concepts of Models of Inorganic Chemistry, Pubs: John Wiley, 1987.
4. Gray H.B., Electrons and Chemical Bonding, Pubs: W.A., J Benjamin Inc., 1965.

PHYSICAL CHEMISTRY-I

BCH-102   **Max. Marks: 50**
                                                                                Time: 3 Hours

Note:- 1. Nine Questions will be set in total out of which 5 (five) questions will have to be attempted. All questions will carry equal marks.
2. Question number 1 will be compulsory and will be based on the conceptual aspects of entire syllabus. This question may have five parts and the answer should be in brief.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts.
4. Sufficient number of Numerical problems (~20%) may be set, wherever possible.
5. Use of scientific (non-programmable) calculator is allowed.

UNIT- I

Equation of State:

Kinetic molecular theory of gases, derivation of kinetic gas equation, deduction of gas laws from kinetic gas equation, imperfection in real gases, the compressibility of real gases, isotherms of real gases, equations of state, vander Waal's equation, effect of attractive forces, Liquification of gases, critical phenomenon, P-V isotherms of carbondioxide, principle of continuity of state, vander Waal's equation and critical constants, principle of corresponding states.

UNIT- II

The First Law of Thermodynamics:

Thermodynamic terms and basic concepts, Intensive and extensive properties, State functions and differentials, partial derivative relations, thermodynamic processes, reversibility, irreversibility, Nature of heat and work, Conservation of energy, various statements of first law, Manipulations of first law, internal energy (U) and enthalphy (H). Work done in reversible isothermal expansion, Molar heat capacity at constant pressure Cp and at constant volume CV, relation between Cp and Cv, work of adiabatic expansion, Joule Thomson effect.

UNIT- III

Electrochemical Cells:

Interfacial potential difference, the electrodes, potential at interfaces, electrode potentials, galvanic cells, emf, direction of spontaneous reactions. Concentration dependence of emf, equilibrium Constant from electrode potential, standard electrode potentials and their

determination. Measuring activity co-efficient, thermodynamic data from cell emf. The temperature dependence of emf. Applications of emf. Measurements – solubility product, potentiometric titrations, pK and pH measurements of pK and pH. Acid-base titrations. Concentration cells with & without transference

UNIT-IV

Perfect and imperfect crystals:

Intrinsic and extrinsic defects, point defects, line and plane defects, vacancies-Schottky and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colour centres, non-stoichiometry and defects. Metals insulators and semiconductors, Band theory, Band structure of metals, Insulators and semiconductors, intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, High temperature super conductors.

Suggested Books

1. Physical Chemistry by P.W. Atkins, 8th Ed., Oxford University Press, 2006 (Indian Print).

2. Physical Chemistry by T. Engel & P. Reid, 1st ed., Pearson Education, 2006.

FURTHER READING:

1. Physical Chemistry by Castellan, 3rd Ed., Addison Wisley/Narosa, 1985 (Indian Print)

2. Physical Chemistry by G. M. Barrow, 6th Ed., New York, McGraw Hill, 1996.

3. Physical Chemistry by R. J. Silbey, R. A. Albert & Moungi G. Bawendi, 4th Ed., New York: John Wiley, 2005

ORGANIC CHEMISTRY-I

BCH – 201   **Max. Marks: 50**
                                                                      Time: 3 Hours

Note:- 1. Nine Questions will be set in total out of which 5 (five) questions will have to be attempted. All questions will carry equal marks.
   2. Question number 1 will be compulsory and will be based on the conceptual aspects of entire syllabus. This question may have five parts and the answer should be in brief.
   3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts.
   4. Sufficient number of Numerical problems (~20%) may be set, wherever possible.
   5. Use of scientific (non-programmable) calculator is allowed.

UNIT-I

Structure and Bonding

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, van der Waals interactions, inclusion compounds, clatherates, charge transfer complexes resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

Mechanism of Organic Reactions

Curved arrow notation, drawing electron movements with arrows half-headed and double-headed arrows, hemolytic and heterolytic bond breaking. Types of reagents (electrophiles and nucleophiles). Reactive intermediates – carbocations, carbanions, free radicals,carpenes, arynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species. Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies)

UNIT-II

Stereochemistry of Organic Compounds

Concept of isomerism. Types of isomerism. Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogeric centers, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization.

Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

Geometric isomerism – determination of configuration of geometric isomers. E & Z system of nomenclature..

Conformational isomerism – conformational analysis of ethane and *n*-butane;

UNIT-III

Alkanes and Cycloalkanes

IUPAC nomenclature of branched and unbranched alkanes. Isomerism in alkanes, sources, methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids). Physical properties and chemical reactions of alkanes.

Cycloalkanes – nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings.

UNIT-IV

Alkenes, Cycloalkenes, Dienes and Alkynes

Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rules, Hofmann elimination, physical properties and relative stabilities of alkenes.

Chemical reactions of alkenes – mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikiff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$ Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes.

Suggested Books

1. Morrison R.T. and Boyd P.S., Organic Chemistry, 5th Edn., Pubs: Allyn and Bacon Inc., Boston ,1992.
2. Mukerji S. M., Singh S. P. and Kapoor R. P., Organic Chemistry Vol. I/II, Pubs: Wiley Eastern Ltd., New Delhi, 1985.

FURTHER READING :

1. Wade L.G.Jr., Organic Chemistry, Pubs:Prentice-Hall,1990.
2. Solomons G., Fundamentals of Organic Chemistry, Pubs: John Wiley,2002.
3. Carey F.A., Organic Chemistry, Pubs: McGraw-Hill, Inc, 2003.
4. Streitwisser A., Jr. and Heathcock C.H., Introduction to Organic Chemistry, 3rd Edn., Pubs: MacMillan Pub. Co., N.Y,1992.

B.SC. (NM) SYLLABUS

Inorganic Chemistry-II

BCH-301   **Max. Marks: 50**
                                                                                Time: 3 Hours

Note:- 1. Nine Questions will be set in total out of which 5 (five) questions will have to be attempted. All questions will carry equal marks.
2. Question number 1 will be compulsory and will be based on the conceptual aspects of entire syllabus. This question may have five parts and the answer should be in brief.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts.
4. Sufficient number of Numerical problems (~20%) may be set, wherever possible.
5. Use of scientific (non-programmable) calculator is allowed.

UNIT- I

Chemical Bonding-I

Electronegativity and Polarity of bond : Electronegativity, different scales and methods of determination. Recent advances in electronegativity theory, variation of electronegativity, Group electronegativity. Polarities of bonds and molecules, Dipole moments. Percentage of ionic character form dipole moment and electronegativity difference.

UNIT- II

Chemical Bonding-II:

Ionic bond: Factors affecting the stability of ionic compounds. Lattice energy, Born Lande equation and its applications, Madelung constant, Born-Haber cycle, applications of lattice energy, covalent character in ionic compounds, polarizing power and polarizability, Fazan's rules, Ionic radii, Factors affecting the radii of ions, Radii of polyatomic ions, Efficiency of packing and crystal lattices, Radius ratio rule, calculation of some limiting radius ratio values for different coordination members, Structure of crystal lattices, NaCl, CaCl, ZnS, (Zinc blende and Wurzite), fluorite, rutile and cadmium iodide. Predictive power of thermochemical calculations on ionic compounds.

UNIT-III

Valence Bond theory and Molecular Orbital Theory

Valence bond (VB) approach. Resonance structures. Bond angles and shapes of molecules and ions (containing bond pairs and lone pairs) Criterion of bond strength and bond length.

Molecular orbitals (MO) approach of bonding (LCAO Method). Symmetry and overlap, symmetry of molecular orbitals, Bonding in Homonuclear molecules (H_2 to Ne_2) and NO, CO, CN^+, CO^+, CN^-, HF, HCl, BeH_2, CO_2, Comparison of VB and MO theories.

Unit IV

The p-Block Elements

Nitrogen, P, As, Sb & Bi family : Chemical reactivity and group trends.

Nitrogen: Introduction, types of covalence in nitrogen, stereochemistry, chemical reactivity, dinitrogen complexes (basic idea only), hydrides of nitrogen, liquid NH_3 as a solvent, nitrogen halides, oxides and oxoacids.

Phosphorus, As, Sb & Bi : Stereochemistry of their compounds, production of elemental P and its allotropic forms, hydrides, halides, oxides and oxy-acids, phosphorus-nitrogen compounds, some organo-metallic compounds.

Oxygen, S, Se and Te Family : Chemical Reactivity, group trends & stereochemistry, dioxygen as a ligand (basic idea only), structure of O_3 and H_2O_2, clathrate hydrates allotropic forms of S & Se, structures of halides, oxides and oxyacids of S, Se & Te, liquid SO_2 and 100% Sulphuric acid as solvent, S-N compounds (neutral) Polyatomic cations of S, Se & Te.

Suggested Books

1. Cotton F.A., Wilkinson G.W. and Gaus P.L., Basic Inorganic Chemistry, Pubs: John Wiley & Sons ,1987.
2. Lee J.D., Concise Inorganic Chemistry, 4th edition, Pubs: ELBS,1991.
3. Huheey J.E., Keiter E.A., Keiter R.L., Inorganic Chemistry : Principles of Structures and Reactivity; 4th Edition, Pubs: Harper Collins, 1993.
4. Greenwood N.N. and Earnshaw A., Chemistry of the Elements, 2nd edition, Pubs: Butterworth/Heinemann, 1997.

FURTHER READING:

1. Cotton F.A. and Wilkinson G., Murillo C.A., Bochmann M., Advanced Inorg. Chemistry, 6th Edition, Pubs: John Wiley & Sons. Inc., 1999.
2. Shriver D.F., Atkins F.W. and Langford C.M., Inorganic Chemistry; 3rd Edition, Pubs: Oxford University Press, 1999.
3. Douglas B., Daniel D. Mc and Alexander J., Concepts of Models of Inorganic Chemistry, Pubs: John Wiley,1987.
4. Gray H.B., Electrons and Chemical Bonding, Pubs: W.A., J Benjamin Inc.,1965.

PHYSICAL CHEMISTRY-II

BCH-302   **Max. Marks: 50**
                                                                       Time: 3 Hours

Note:- 1. Nine Questions will be set in total out of which 5 (five) questions will have to be
            attempted. All questions will carry equal marks.
       2. Question number 1 will be compulsory and will be based on the conceptual aspects of
            entire syllabus. This question may have five parts and the answer should be in brief.
       3. Four more questions are to be attempted, selecting one question out of two questions set
            from each unit. Each question may contain two or more parts.
       4. Sufficient number of Numerical problems (~20%) may be set, wherever possible.
       5. Use of scientific (non-programmable) calculator is allowed.

UNIT-I

The Second Law of Thermodynamics:
Spontaneous change, Carnot Cycle, conclusions from Carnot cycle, efficiency of heat engines, second law of thermodynamics, entropy, entropy as a state function, clausius inequality, entropy as criterian of spontaneity, natural processes, different types of entropy changes under isothermal and non-isothermal conditions, entropy change in irreversible processes. Helmholtz function (A), Gibbs function (G), standard molar free energy changes, Maxwell relations, dependence of free energy functions on temperature and pressure, total differential equations. Gibbs- Helmholtz equations, thermodynamic criteria for spontaneity. Heat capacity at low temperature, Nernst heat theorem, third law of thermodynamics, third law entropies.

UNIT-II

Partial Molar Properties and Fugacity:

Partial molar properties. Chemical potential of a perfect gas, dependence of chemical potential on temperature and pressure, Gibbs- Duhem equation, real gases, fugacity, its importance and determination, standard state for gases.

Changes of State, Physical Transformation of Pure Materials:

Stability of phases, clapeyron equation. Clausius-clapeyron equation

First and second order phase transitions. Attainment of low temperature and energetics of refrigeration, adiabatic demagnetization.

UNIT-III

Phase Equilibria:

Phase rule and its thermodynamic derivation. One component systems-water, sulphur, carbon dioxide, helium. Two component systems, construction and interpretation of general phase diagrams for liquid-vapour, liquid-liquid and liquid-solid systems.

Unit –IV

Chemical Equilibrium:

Direction of spontaneous change in a chemical reaction, extent of reaction, stoichiometric coefficients, equilibrium constant in terms of G. Temperature and pressure dependence of equilibrium constant, homogeneous & heterogeneous equilibria.

Colligative Properties:

Solutions of non-volatile solutes: colligative properties, elevation in boiling point, depression in freezing point, osmosis and osmotic pressure

Suggested Books

1. Atkins P.W., Physical Chemistry, 8th Edn., Pubs: Oxford University Press, 2006 (Indian Print).
2 Engel T. & Reid P., Physical Chemistry, 1st Edn., Pubs: Pearson Education, 2006.
FURTHER READING:
1. Castellan G.W., Physical Chemistry, 3rd Edn., Pubs: Addison Wisley/Narosa, 1985 (Indian Print).
2. Barrow G. M., Physical Chemistry, 6th Edn., Pubs: McGraw Hill, New York, 1996.
3 Silbey R. J., Albert R. A. & Bawendi Moungi G., Physical Chemistry, 4th Edn., Pubs: John Wiley, New York, 2005.

ORGANIC CHEMISTRY-II

BCH-401   **Max. Marks: 50**
                                                                                Time: 3 Hours

Note:- 1. Nine Questions will be set in total out of which 5 (five) questions will have to be attempted. All questions will carry equal marks.

2. Question number 1 will be compulsory and will be based on the conceptual aspects of entire syllabus. This question may have five parts and the answer should be in brief.

3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts.

4. Sufficient number of Numerical problems (~20%) may be set, wherever possible.

5. Use of scientific (non-programmable) calculator is allowed.

UNIT-I

Arenes and Aromaticity

Nomenclature of benzene derivatives. The aryl group. Aromatic nucleus and side chain. Structure of benzene : molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture.

Aromatic electrophilic substitution – general pattern of the mechanism, role of L-and _ complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profilediagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benezene derivatives. Birch reduction.

Methods of formation and chemical reactions of alkylbenzenes and biphenyl.

UNIT -II

Alkyl and Aryl Halides

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams.

Methods of formation of aryl halides, nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions.

Relative reactiviteis of alkyl halides vs. allyl, vinyl and aryl halides.

UNIT-III

Alcohols

Classification and nomenclature.

Monohydric alcohols – nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature. Reactions of alcohols.

Dihydric alcohols – nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4 and pinacol-pinacolone rearrangement.

Trihydric alcohols – nomenclature and methods of formation, chemical

reactions of glycerol

UNIT IV

Phenols

Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Ledrer-Manasse reaction and Reimer-Tiemann reaction.

Ethers and Epoxides

Nomenclature of ethers and methods of their formation, physical properties. Chemical reactions – cleavage and autoxidation, Ziesel's method. Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.

Suggested Books:

1. Morrison R.T. and Boyd P.S., Organic Chemistry, 5th Edn., Pubs: Allyn and Bacon Inc., Boston (1992).
2. Mukerji S. M., Singh S. P. and Kapoor R. P., Organic Chemistry Vol. I/II, Pubs: Wiley Eastern Ltd., New Delhi, 1985.

FURTHER READING :

1. Wade L.G.Jr., Organic Chemistry, Pubs:Prentice-Hall,1990.
2. Solomons G, Fundamentals of Organic Chemistry, Pubs: John Wiley,2002.
3. Carey F.A., Organic Chemistry, Pubs: McGraw-Hill, Inc, 2003.
4. Streitwisser A., Jr. and Heathcock C.H., Introduction to Organic Chemistry, 3rd Edn., Pubs: MacMillan Pub. Co., N.Y,1992.

INORGANIC CHEMISTRY-III

BCH-502   Max. Marks: 50
                                                               Time: 3 Hours

Note:- 1. Nine Questions will be set in total out of which 5 (five) questions will have to be attempted. All questions will carry equal marks.

2. Question number 1 will be compulsory and will be based on the conceptual aspects of entire syllabus. This question may have five parts and the answer should be in brief.

3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts.

4. Sufficient number of Numerical problems (~20%) may be set, wherever possible.

5. Use of scientific (non-programmable) calculator is allowed.

UNIT-I

The Halogen Family : (12 Hrs.)

Chemical Reactivity, group trends, chemistry of preparation of fluorine, hydrogen

halides, HF as a solvent, inter-halogen compounds (their preparation and structures), polyhalide and polyhalonium ions; polyatomic cations of halogens, oxides and oxyacide of halogens.

Noble gases Chemical reactivity and group trends, Clathrate compounds; preparation, structure & bonding of noble gas compounds.

UNIT-II

Coordination Compounds

Various definitions, types of ligands : classical ligands, non-classical ligands (π-bonding or π-acid ligands); The Chelate and Microcyclic effects, Multidentate ligands, conformation of Chelate rings, stereochemistry and various coordination numbers, isomerism in coordination compounds, nomenclature, stability of coordination compounds, thermodynamic and kinetic stability, stability constants, experimental and statistical ratios of stability constants factors which influence the stability constant and chelate effect.

UNIT- III

Symmetry and group theory (Part I)

Symmetry elements and symmetry operations, point groups, definitions of group, subgroup relation between orders of a finite group and its subgroup; group multiplication tables, conjugacy relation and classes. Schoenflies symbols, Representation of groups character of a representation.

UNIT-IV

Symmetry and group theory (Part II)

Properties of irreducible representations, the great orthogonality theorem (without proof) and its importance. Character Tables, Symmetry criteria for optical activity, Symmetry restrictions on dipole moment, Hybridization schemes of orbitals.

Suggested Books

1. Cotton F. A.,Wilkinson G., Murillo C. A., Bochmann M., Advanced Inorg. Chemistry, 6th Edition, Pubs: John Wiley & Sons. Inc., 1999.
2. Greenwood N. N. and Earnshaw A., Chemistry of the Elements, 2nd Edition, Pubs: Butterworth/Heinemann, 1977.
3. Shriver D. F., Atkins F. W. and Langford C. M., Inorganic Chemistry, 3rd Edition, Pubs: Oxford University Press, 1999.
4. Huheey J. E., Keiter E. A., Keiter R. L., Inorganic Chemistry : Principles of Structure and Reactivity; 4th Edition, Pubs: Harper Collins, 1993.
5. Massey Allan G., Main Group Chemistry, Pubs: Ellis Horwood, NewYork 1990.
6. Cotton F. A.,Chemical applications of group theory, 3rd Edition, Pubs: John Wiley New York, 1971 [Indian print by Wiley Eastern, 1999].
7. Jaffe H. H. and Orchin M., Symmetry in Chemistry, Pubs: John Wiley NewYork, 1965.

PHYSICAL CHEMISTRY-IV

BCH-501   Max. Marks: 50
                                                                                      Time: 3 Hours

Note:- 1. Nine Questions will be set in total out of which 5 (five) questions will have to be
             attempted. All questions will carry equal marks.
       2. Question number 1 will be compulsory and will be based on the conceptual aspects of
          entire syllabus. This question may have five parts and the answer should be in brief.
       3. Four more questions are to be attempted, selecting one question out of two questions set
          from each unit. Each question may contain two or more parts.
       4. Sufficient number of Numerical problems (~20%) may be set, wherever possible.
       5. Use of scientific (non-programmable) calculator is allowed.

UNIT–I

Kinetic theory of gases and transport properties

Review of kinetic molecular theory of gases, kinetic energy and temperature. Distribution of molecular speeds in an ideal gas, distribution in one dimension, distribution of speeds in three dimensions. Derivation of Maxwell-Boltzmann distribution law. Derivation of most probable speed, root mean square speed and average speed from Maxwell-Boltzmann distribution law. Collision frequency, mean free path, collision diameter, collision cross-sectionRate of effusion, Graham's law of effusion.

Transport phenomena in gases. kinetic theory of diffusion in gases. Thermal conductivity, kinetic theory of thermal conductivity in gases. Viscosity of gases, kinetic theory of gas viscosity, molecular diameters and intermolecular force constants from viscosity

UNIT-II

Thermodynamics of diffusion

Thermodynamic view of diffusion. Relation between transport properties. Einstein relation, Nernst-Einstein relation, stoke's Einstein relation. Diffusion in non-steady state. Fick's second law of diffusion. Theory of diffusion in liquids.

Electro-Chemistry:Equilibrium Electrochemistry

Transport of ions in solution, conductivity, Kohlrausch's law, Ostwald dilution law. Mobilities of ions, transport number and its measurement. Arrhenius theory of Conductivity, Debye-Huckel-Onsager theory of conductivity.

Applications of conductivity: conductometeric titrations, solubility of sparingly soluble salts, degree of dissociation of weak electrolytes.

UNIT–III

Dynamic Electrochemistry :

Processes at electrodes, double layer at the interface, non-equilibrium electrode potentials, over potential, derivation of Butler-Volmer equation, Tafel plot, Polarization and electrolysis, concentration overpotential, diffusion current and polarography, current and cell emf, Power.

Applications of dynamic electrochemistry : Power generation (Fuel cells), power storage (batteries), photochemical cells, corrosion and passivation.

UNIT-IV

Chemical Kinetics

Rate of reaction, rate constant and rate laws, the order of reaction, first, second & third and zero order reactions, half-lives; determination of reaction order. Temperature dependence of reaction rates, reaction mechanism, rate-determining step approximation, steady-state approximation.

Kinetics of Complex reactions: Reversible first order reactions, consecutive first order reactions, parallel first order reactions, Chain reactions. Catalysis, homogeneous catalysis, autocatalysis, oscillation reactions, bistability. Enzyme catalysis, heterogeneous catalysis.

Suggested Books:

1. Atkins P.W., Physical Chemistry, 7th Edition., Pubs: Oxford University Press (2002).
2. Lavine I. N., Physical Chemistry, 3rd Edition, Pubs: Pearson Eductaion (1988). 3. Billmeyer, Textbook of Polymer Science, 2nd Edition, Pubs: Wiley Interscience (1977).
4. Friedlander G., Kennedy J.W., Macias E.S. and Miller J.M., Nuclear and Radiochemistry, 3rd Edition, Pubs: John Wiley and Sons (1981).
5. Arnikar H.J., Essentials of Nuclear Chemistry, 2nd Edition, Pubs: Wiley Eastern Limited (1987),
6. Adamson A.W., Physical Chemistry of Surfaces, Pubs: John Wiley & Sons (1982)

FURTHER READING

1. Castellan G.W., Physical Chemistry, 3rd Edn., Pubs: Addison Wisley/Narosa (1985) (Indian Print).
2. Barrow G. M., Physical Chemistry, 6th Edn., Pubs: McGraw Hill, New York (1996).
3. Sood D. D., Reddy A.V.R. and Ramamoorthy N., Fundamentals of Radiochemistry, Pubs: Indian Association of Nuclear Chemists and Allied Scientists (2004).

ORGANIC CHEMISTRY-III

BCH-601   Max. Marks: 50
                                                               Time: 3 Hours

Note:- 1. Nine Questions will be set in total out of which 5 (five) questions will have to be attempted. All questions will carry equal marks.
2. Question number 1 will be compulsory and will be based on the conceptual aspects of entire syllabus. This question may have five parts and the answer should be in brief.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts.
4. Sufficient number of Numerical problems (~20%) may be set, wherever possible.
5. Use of scientific (non-programmable) calculator is allowed.

UNIT-I

Organic Compounds of Nitrogen:

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid.

Halonitroarenes: reactivity. Structure and nomenclature of amines, physical roperties. Stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds nitriles), reductive amination of aldehydic and ketonic compounds. Garbriel-phthalimide reaction, Hoffmann bromamide reaction.

Organosulphur Compounds:

Nomenclature, structural features, Methods of formation and chemical reactions of thiols, trioethers, sulphonic acids, sulphonamides and sulphaguanidine.

UNIT-II

Heterocyclic Compounds:

Introduction : Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed five and six-membered heterocycles. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fischer indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

UNIT-III

Carbohydrates:

Classification and nomenclature. Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Determination of ring size of nonosaccharides. Cyclic structure of D(+)-glucose. Mechanism of mutarotation. Structures of ribose and deoxyribose.

Fats, Oils and Detergents:

Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates.

UNIT-IV

Amino Acids, Peptides, Proteins and Nucleic Acids:

Classification, structure and stereochemistry of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation and reactions of _-amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins..

Nucleic acids : Introduction. Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

Synthetic Dyes :

Colour and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red, Malachite green, Crystal violet, Phenolphthalein, Fluorescein, Alizarin and Indigo.

Suggested Books

1. Morrison R.T. and Boyd P.S., Organic Chemistry, 5th Edn., Pubs: Allyn and Bacon Inc., Boston (1992).
2. Mukerji S. M., Singh S. P. and Kapoor R. P., Organic Chemistry Vol. I/II, Pubs: Wiley Eastern Ltd., New Delhi, 1985.

FURTHER READING :

1. Wade L.G.Jr., Organic Chemistry, Pubs:Prentice-Hall,1990.
2. Solomons G, Fundamentals of Organic Chemistry, Pubs: John Wiley,2002.
3. Carey F.A., Organic Chemistry, Pubs: McGraw-Hill, Inc, 2003.
4. Streitwisser A., Jr. and Heathcock C.H., Introduction to Organic Chemistry 3rd Edn., Pubs: MacMillan Pub. Co., N.Y, 1992.

CHEMISTRY PRACTICALS

(**BCHP-103**)

Section-A (In-organic) Semester-I

1. **Qualitative Analysis**:

Qualitative analysis of inorganic mixtures containing not more than six radicals

2. **Quantitative Analysis:** Volumetric Methods

(a) Acid-base titrations – Preparation of standard hydrochloric acid and sodium hydroxide solution. Preparation of some buffers and measuring their pH value, pH titration of unknown soda ash.

Section-B (Physical)

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetatecatalyzed by hydrogen ions at room temperature.
2. To prepare arsenious sulphide sol and compare the precipitating power of mono- bi – and trivalent anions.
3. To determine the surface tension of a given liquid by drop number method.
4. To determine the viscosity of a given liquid**.**
5. To determine the specific refractivity of a given liquid

(**BCHP-202**)   **Semester-II**

1. Preparation and purification through crystallization or distillation and ascertaining their purity through melting point or boiling point

(i) Iodoform from ethanol (or acetone)
(ii) *m*-Dinitrobenzne from nitrobenzene (use 1:2 conc. HNO_3 - H_2SO_4 mixture if fuming HNO_3 is not available)
iii) p-Bromoacetanilide from acetanilide
iv) Dibenzalacetone from acetone and benzaldehyde
v) Aspirin from salicylic acid
2. Determination of melting point Naphthalene 80-82°, Benzoic acid 121.5-122°urea, 132.5-133°, Succinic acid 184-185° Cinnamic acid 132.5-133°, Salicylic acid 157-5-158° Acetanilide 113-5-114°, m-Dinitrobenzene 90° p-Dichlorobenzene 52°. Aspirin 135°.
3. Determination of boiling points
4. Ethanol 78°, Cyclohexane 81.4°, Toluene 110.6°, Benzne 80°.
5. Distillation Simple distillation of ethanol-water mixture using water Condenser Distillation of nitrobenzene and anilline using air condenser.

Inorganic Chemistry Lab –II

BCHP-303 Semester-III

PRACTICAL   **Marks: 50**

1. **Gravimetric Analysis**
   Quantitative estimations of, Cu^{2+} as copper thiocyanate and Ni^{2+} as Ni–dimethylglyoxime.

2. **Redox titrations**: Determination of Fe^{2+}, $C_2O_4^{2-}$ (using $KMnO_4$, $K_2Cr_2O_7$)
3. **Iodometic titrations:** Determination of Cu^{2+} (using standard hypo solution).
4. **Complexometric titrations:** Determination of Mg^{2+}, Zn^{2+} by EDTA.
5. Preparation of SnI_4 and its complex with pyridine
6. Preparation of $Pb(OOCCH_3)_4$ and its complex $(C_5H_5NH_2) PbCl_6$ Thermal analysis of $Pb(OOCCH_3)_4$

Physical Chemistry -II

1. To determine the enthalpy of neutralisation of a weak acid/weak base vs. strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base.

2. Determination of critical solution temperature for phenol-water system and study effect of impurities.

3. Construction of a phase diagram of a binary system (urea-benzoic acid) by cooling curves method.

Potentiometry

1. Potentiometric titration of monobasic acids (HC & CH_3COOH) with NaOH.

2. Determination of mean ionic activity co-efficients of hydrochloric acid at different concentrations.

3. To study the effect of ionic strength on mean ionic activity coefficient of hydrochloric acid in a given solution and verify Debye-Huckel limiting law.

Thermo Chemistry

1. To determine heat capacity of a calorimeter and heat of solution of a given solid compound.
2. To determine heat of solution of Solid calcium chloride and calculate lattice energy of calcium chloride using Born-Haber cycle.
3. To determine heat of hydration of copper sulphate

Any other experiment carried out in the class.

PRACTICAL

BCHP-403 Semester-IV

A. Crystallization

Concept of induction of crystallization Phthalic acid from hot water (using fluted filter paper and stemless funnel) Acetanilide from boiling water Naphthalene from ethanol Benzoic acid from water.

B. Qualitative Analysis

To perform qualitative analysis of single organic compound (hydrocarbons, aldehydes, ketones, phenols, carboxylic acids/(derivative), amines, amides, nitro compounds and carbohydrates).

I. Test for elements (other than C, H, O).

II. Functional group determination

III. Melting point, derivative preparation and Rf value determination.

C. Synthesis of organic compounds

I. Acetylation/benzolyation of salicylic acid, aniline, hydroquinone and glucose.

II. Preparation of *m*-dinitrobenzene from nitrobenzene.

Section-A (In-Organic)

BCHP-503 Semester-V **Marks: 50**

PRACTICAL

(a) Quantitative Analysis: The following quantitative estimations are to be carried out.

(i) Estimation of nickel (II) using Dimethylglyoxime as the precipitant.
(ii) Estimation of copper as CuSCN
(iii) Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$ through (i) Heterogeneous and (ii) Homogeneous media.

(iv) Estimation of Al (III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminum oxinate).

(b) Inorganic Preparations
(i) Tetraammine copper (II) sulphate, $[Cu(NH_3)_4]SO_4 \cdot H_2O$
(ii) Potassium trisoxalatochromate (III), $K_3[Cr(C_2O_4)_3]$
(iii) Cis and trans $K[Cr(C_2O_4)_2 (H_2O_2]$ Potassium dioxalatodiaquachromate (III)

(iv) Pentaammine carbonato Cobalt (III) ion
(c) Spectrophotometric estimation of Ferrous ions by using 1,10 phenanthroline

Recommended Texts:

1. Vogel, A.I. A text book of Quantitative Analysis, ELBS 1986.

Section-B (Physical)

(I)   To study changes in conductance in the following systems

    (i) strong acid-strong base
    (ii) weak acid-strong base and
    (iii) mixture of strong acid and weak acid-strong base

(II)   Study the kinetics of the following reactions.

    1. Initial rate method: Iodide-persulphate reaction

    2. Integrated rate method:

(a) Acid hydrolysis of methyl acetate with hydrochloric acid, volumetrically or conductometrically.
(b) Iodide-persulphate reaction
(c) Saponification of ethyl acetate.

BCHP-603   **Semester-VI**

A. Crystallization

Concept of induction of crystallization Phthalic acid from hot water (using fluted filter paper and stemless funnel) Acetanilide from boiling water Naphthalene from ethanol Benzoic acid from water.

B. Qualitative Analysis

To perform qualitative analysis of single organic compound (hydrocarbons, aldehydes, ketones, phenols, carboxylic acids/(derivative), amines, amides, nitro compounds and carbohydrates).

I. Test for elements (other than C, H, O).

II. Functional group determination

III. Melting point, derivative preparation and Rf value determination.

C. Synthesis of organic compounds

I. Acetylation/benzolyation of salicylic acid, aniline, hydroquinone and glucose.

II. Preparation of *m*-dinitrobenzene from nitrobenzene.

III. Preparation of *p*-nitroacetanilide from acetanilide.

IV. Preparation of *p*-bromoacetanilide from acetanilide.

V. Preparatin of *m*-nitroaniline from *m*-dinitrobenzene.

VI. Preparation of benzoic acid from toluene/benzyl chloride.

Suggested Books:

1. Svehla G., Vogel's Qualitative Inorganic Analysis (revised); 7th edition, Pubs: Orient Longman, 1996.

2. Bassett, J., Denney, R.C., Jeffery, G.H., Mendham, J., Vogel's Textbook of Quantitative Inorganic Analysis (revised); 4th edition, Pubs: Orient Longman, 1978.

3. Levitt, B.P., Findlays Practical Physical Chemistry; 8th edition, Pubs: Longman Group Ltd., London & New York (1978).

4. Khosla, B.D., Garg, V.C., Gulati, A., Senior Practical Physical Chemistry; 11th edition, Pubs: R.Chand & Co., New Delhi (2002).

5. Fifield F.W. and Kealey D., Principles and Practice of Analytical Chemistry, 5th Edn., Blackwell Science (2000).

6. Vogel A.I., Tatchell A.R., Furnis B.S., Hannaford A.J., Smith P.W.G.,Vogel's Text Book of Practical Organic Chemistry,5th Edn.,Pubs: ELBS, 1989.

7. Pavia D.L., Lampanana G.M., Kriz G.S. Jr., Introduction to Organic Laboratory Techniques, 3rd Edn., Pubs: Thomson Brooks/Cole,2005.

8. Mann F.G., Saunders. P.C.,Practical Organic Chemistry, Pubs: Green & Co. Ltd., London, 1978.

9. Brauer, Handbook of Preparative Inorganic Chemistry; 2nd edition, Pubs: Academic Press, 1963 [Vol. I] & 1965 [Vol. II].

10. Inorganic Experiments. 2nd Edition, D. J. Woollins, Pubs:Wiley-VCH, 2003

11. Synthesis and techniques in inorganic chemistry. R. J. Angelici, Pubs: SGS series London, (1977).

B.SC. (NM) SYLLABUS

Mathematics Papers & Syllabii for B.Sc.(General) Semesters-I to VI

B.Sc.-I year (Semester-I)

Paper No.	Paper Name	External	Internal	Time
MATH-104	Algebra	20 Marks	30 Marks	3 Hours
MATH-105	Calculus	20 Marks	30 Marks	3 Hours

B.Sc.-I year (Semester-II)

Paper No.	Paper Name	External	Internal	Time
MATH-204	Number Theory and Trigonometry	20 Marks	30 Marks	3 Hours
MATH-205	Ordinary Differential Equations	20 Marks	30 Marks	3 Hours
MATH-106	Solid Geometry	20 Marks	30 Marks	3 Hours

B.Sc.–II Year (Semester-III)

Paper No.	Paper Name	External	Internal	Time
MATH -303	Advanced Calculus	20 Marks	30 Marks	3 Hours
MATH -304	Partial Differential Equations	20 Marks	30 Marks	3 Hours
MATH -305	Groups and Rings	20 Marks	30 Marks	3 Hours

B.Sc.-II year (Semester-IV)

Paper No.	Paper Name	External	Internal	Time
MATH -401	Sequences and Series	20 Marks	30 Marks	3 Hours
MATH -402	Special Functions and Integral Transforms	20 Marks	30 Marks	3 Hours

B.Sc.-III Year (Semester-V)

Paper No.	Paper Name	External	Internal	Time
MATH -501	Real & Complex Analysis	20 Marks	30 Marks	3 Hours
MATH -502	Statics	20 Marks	30 Marks	3 Hours
MATH -503	Numerical Analysis	20 Marks	30 Marks	3 Hours

B.Sc.-III (Semester-VI)

Paper No.	Paper Name	External	Internal	Time
MATH -601	Linear Algebra	20 Marks	30 Marks	3 Hours
MATH -602	Dynamics	20 Marks	30 Marks	3 Hours

B.SC. (NM) SYLLABUS

MATH-104   **ALGEBRA**

Max. Marks: 50   **Time 3 Hours**

Note:

The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question. All questions carry equal marks.

Section – I

Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices. Rank of a matrices. Inverse of a matrix. Linear dependence and independence of rows and columns of matrices. Row rank and column rank of a matrix. Eigenvalues, eigenvectors and the characteristic equation of a matrix. Minimal polynomial of a matrix. Cayley Hamilton theorem and its use in finding the inverse of a matrix.

Section – II

Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms.

Section – III

Relations between the roots and coefficients of general polynomial equation in one variable. Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations.

Section – IV

Nature of the roots of an equation Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions.

Books Recommended :

1.   H.S. Hall and S.R. Knight : Higher Algebra, H.M. Publications 1994.
2.   Shanti Narayan : A Text Books of Matrices.
3.   Chandrika Prasad : Text Book on Algebra and Theory of Equations.
        Pothishala Private Ltd., Allahabad.

MATH-105   **CALCULUS**

Max. Marks: 50   **Time 3 Hours**

Note:

The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question. All questions carry equal marks

Section – I

Definition of the limit of a function. Basic properties of limits, Continuous functions and classification of discontinuities. Differentiability. Successive differentiation. Leibnitz theorem. Maclaurin and Taylor series expansions.

Section – II

Asymptotes in Cartesian coordinates, intersection of curve and its asymptotes, asymptotes in polar coordinates. Curvature, radius of curvature for Cartesian curves, parametric curves, polar curves. Newton's method. Radius of curvature for pedal curves. Tangential polar equations. Centre of curvature. Circle of curvature. Chord of curvature, evolutes. Tests for concavity and convexity. Points of inflexion. Multiple points. Cusps, nodes & conjugate points. Type of cusps.

Section – III

Tracing of curves in Cartesian, parametric and polar co-ordinates. Reduction formulae. Rectification, intrinsic equations of curve.

Section – IV

Quardrature (area)Sectorial area. Area bounded by closed curves. Volumes and surfaces of solids of revolution. Theorems of Pappu's and Guilden.

Books Recommended :

1. Differential and Integral Calculus : Shanti Narayan.
2. Murray R. Spiegel : Theory and Problems of Advanced Calculus. Schaun's Outline series. Schaum Publishing Co., New York.
3. N. Piskunov : Differential and integral Calculus. Peace Publishers, Moscow.
4. Gorakh Prasad : Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
5. Gorakh Prasad : Integral Calculus. Pothishala Pvt. Ltd., Allahabad

MATH-204   NUMBER THEORY AND TRIGONOMETRY

Max. Marks: 50   **Time 3 Hours**

Note:

The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question. All questions carry equal marks.

Section – I

Divisibility, G.C.D.(greatest common divisors), L.C.M.(least common multiple) Primes, Fundamental Theorem of Arithemetic. Linear Congruences, Fermat's theorem. Wilson's theorem and its converse. Linear Diophanatine equations in two variables

Section – II

Complete residue system and reduced residue system modulo m. Euler ▢ function Euler's generalization of Fermat's theorem. Chinese Remainder Theorem. Quadratic residues. Legendre symbols. Lemma of Gauss; Gauss reciprocity law. Greatest integer function [x]. The number of divisors and the sum of divisors of a natural number n (The functions $d(n)$ and $\sigma(n)$). Moebius function and Moebius inversion formula.

Section - III

De Moivre's Theorem and its Applications. Expansion of trigonometrical functions. Direct circular and hyperbolic functions and their properties.

Section – IV

Inverse circular and hyperbolic functions and their properties. Logarithm of a complex quantity. Gregory's series. Summation of Trigonometry series.

Books Recommended :

1. S.L. Loney : Plane Trigonometry Part – II, Macmillan and Company, London.
2. R.S. Verma and K.S. Sukla : Text Book on Trigonometry, Pothishala Pvt. Ltd. Allahabad.
3. Ivan Ninen and H.S. Zuckerman. An Introduction to the Theory of Numbers.

MATH-205   **ORDINARY DIFFERENTIAL EQUATIONS**

Max. Marks: 50   **Time 3 Hours**

Note:

The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question. All questions carry equal marks.

Section – I

Geometrical meaning of a differential equation. Exact differential equations, integrating factors. First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations. Equation reducible to Clairaut's form. Singular solutions.

Section – II

Orthogonal trajectories: in Cartesian coordinates and polar coordinates. Self orthogonal family of curves.. Linear differential equations with constant coefficients. Homogeneous linear ordinary differential equations. Equations reducible to homogeneous

Section – III

Linear differential equations of second order: Reduction to normal form. Transformation of the equation by changing the dependent variable/ the independent variable. Solution by operators of non-homogeneous linear differential equations. Reduction of order of a differential equation. Method of variations of parameters. Method of undetermined coefficients.

Section – IV

Ordinary simultaneous differential equations. Solution of simultaneous differential equations involving operators x (d/dx) or t (d/dt) etc. Simultaneous equation of the form dx/P = dy/Q = dz/R. Total differential equations. Condition for Pdx + Qdy +Rdz = 0 to be exact. General method of solving Pdx + Qdy + Rdz = 0 by taking one variable constant. Method of auxiliary equations.

Books Recommended :

1.   D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2.   A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London
3.   E.A. Codington : Introduction to Differential Equations.
4.   S.L.Ross: Differential Equations, John Wiley & Sons
5.   B.Rai & D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House Pvt. Ltd.

B.SC. (NM) SYLLABUS

MATH – 106   **SOLID GEOMETRY**

Max. Marks: 50   **Time 3 Hours**

Note:

The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question. All questions carry equal marks.

Section – I

General equation of second degree. Tracing of conics. Tangent at any point to the conic, chord of contact, pole of line to the conic, director circle of conic. System of conics. Confocal conics. Polar equation of a conic, tangent and normal to the conic.

Section – II

Sphere: Plane section of a sphere. Sphere through a given circle. Intersection of two spheres, radical plane of two spheres. Co-axial system of spheres, Cones, Right circular cone, enveloping cone and reciprocal cone. Cylinder: Right circular cylinder and enveloping cylinder.

Section – III

Central Conicoids: Equation of tangent plane. Director sphere. Normal to the conicoids. Polar plane of a point. Enveloping cone of a coincoid. Enveloping cylinder of a coincoid.

Section – IV

Paraboloids: Circular section, Plane sections of conicoids. Generating lines. Confocal conicoid. Reduction of second degree equations.

Books Recommended :

1. R.J.T. Bill,Elementary Treaise on Coordinary Geometry of Three Dimensions, MacMillan India Ltd. 1994.
    2. P.K. Jain and Khalil Ahmad .
    3. A Text Book of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd. 1999.
    4. Rich, Geometry, Schaum Outline Series, Tata McGraw Hill.

MATH-303   **ADVANCED CALCULUS**

Max. Marks: 50   **Time 3 Hours**

Note:

The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question. All questions carry equal marks.

Section – I

Continuity, Sequential Continuity, properties of continuous functions, Uniform continuity, chain rule of differentiability. Mean value theorems; Rolle's Theorem and Lagrange's mean value theorem and their geometrical interpretations. Taylor's Theorem with various forms of remainders, Darboux intermediate value theorem for derivatives, Indeterminate forms.

Section – II

Limit and continuity of real valued functions of two variables. Partial differentiation. Total Differentials; Composite functions & implicit functions. Change of variables. Homogenous functions & Euler's theorem on homogeneous functions. Taylor's theorem for functions of two variables

Section – III

Differentiability of real valued functions of two variables. Schwarz and Young's theorem. Implicit function theorem. Maxima, Minima and saddle points of two variables. Lagrange's method of multipliers.

Section – IV

Curves: Tangents, Principal normals, Binormals, Serret-Frenet formulae. Locus of the centre of curvature, Spherical curvature, Locus of centre of Spherical curvature, Involutes, evolutes, Bertrand Curves. Surfaces: Tangent planes, one parameter family of surfaces, Envelopes.

Books Recommended:

1. C.E. Weatherburn : Differential Geometry of three dimensions, Radhe Publishing House, Calcutta
2. Gabriel Klaumber : Mathematical analysis, Mrcel Dekkar, Inc., New York, 1975
3. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
4. Gorakh Prasad : Differential Calculus, Pothishala Pvt. Ltd., Allahabad
5. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.
6. Shanti Narayan : A Course in Mathemtical Analysis, S.Chand and company, New Delhi
7. Murray, R. Spiegel : Theory and Problems of Advanced Calculus, Schaum Publishing co., New York

MATH-304   **PARTIAL DIFFERENTIAL EQUATIONS**

Max. Marks: 50   **Time 3 Hours**

Note:

The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question. All questions carry equal marks.

Section-I

Partial differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order: Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. Compatible systems of first order equations, Jacobi's method.

Section-II

Linear partial differential equations of second and higher orders, Linear and non-linear homogenious and non-homogenious equations with constant co-efficients, Partial differential eqution with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients.

Section-III

Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method for partial differential equations of second order.

Section-IV

Cauchy's problem for second order partial differential equations, Characteristic equations and characteristic curves of second order partial differential equation, Method of separation of variables: Solution of Laplace's equation, Wave equation (one and two dimensions), Diffusion (Heat) equation (one and two dimension) in Cartesian Co-ordinate system.

Books Recommended:
1. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
2. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc., New York, 1999
3. A.R. Forsyth : A Treatise on Differential Equations, Macmillan and Co. Ltd.
4. Ian N.Sneddon : Elements of Partial Differential Equations, McGraw Hill Book Company, 1988

B.SC. (NM) SYLLABUS

MATH-305   **GROUPS AND RINGS**

Max. Marks: 50   **Time 3 Hours**

Note:

The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question. All questions carry equal marks.

Section-I

Definition of a group with example and simple properties of groups, Subgroups and Subgroup criteria, Generation of groups, cyclic groups, Cosets, Left and right cosets, Index of a sub-group Coset decomposition, Largrage's theorem and its consequences, Normal subgroups, Quotient groups.

Section-II

Homoomorphisms, isomophisms, automorphisms and inner automorphisms of a group. Automorphisms of cyclic groups, Permutations groups. Even and odd permutations. Alternating groups, Cayley's theorem, Center of a group and derived group of a group.

Section-III

Introduction to rings, subrings, integral domains and fields, Characteristics of a ring. Ring homomorphisms, ideals (principle, prime and Maximal) and Quotient rings, Field of quotients of an integral domain

Section-IV

Euclidean rings, Polynomial rings, Polynomials over the rational field, The Eisenstein's criterion, Polynomial rings over commutative rings, Unique factorization domain, R unique factorization domain implies so is $R[X_1 , X_2……X_n]$

Books Recommended:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2nd edition).
3. Vivek Sahai and Vikas Bist : Algebra, NKarosa Publishing House.
4. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Norsa Publishing House.

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MATH -401   **SEQUENCE AND SERIES**

Max. Marks: 50   **Time 3 Hours**

Note:

The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question. All questions carry equal marks.

Section-I

Boundedness of the set of real numbers; least upper bound, greatest lower bound of a set, neighborhoods, interior points, isolated points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weiestrass theorem, Open covers, Compact sets and Heine-Borel Theorem.

Section-II

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence, Cauchy general principle of convergence, Subsequences, Subsequential limits.Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, Cauchy's general principle of Convergence of series, Convergence and divergence of geometric series, Hyper Harmonic series or p-series.

Section-III

Infinite series: D-Alembert's ratio test, Raabe's test, Logarithmic test, de Morgan and Bertrand's test, Cauchy's Nth root test, Gauss Test, Cauchy's integral test, Cauchy's condensation test.

Section-IV

Alternating series, Leibnitz's test, absolute and conditional convergence, Arbitrary series: abel's lemma, Abel's test, Dirichlet's test, Insertion and removal of parenthesis, re-arrangement of terms in a series, Dirichlet's theorem, Riemann's Re-arrangement theorem, Pringsheim's theorem (statement only), Multiplication of series, Cauchy product of series, (definitions and examples only) Convergence and absolute convergence of infinite products.

Books Recommended:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.
3. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi
4. Murray, R. Spiegel : Theory and Problems of Advanced Calculus, Schaum Publishing co., New York

MATH -402   **SPECIAL FUNCTIONS AND INTEGRAL TRANSFORMS**

Max. Marks: 50   **Time 3 Hours**

Note:

The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question. All questions carry equal marks.

Section-I

Series solution of differential equations – Power series method, Definitions of Beta and Gamma functions. Bessel equation and its solution: Bessel functions and their properties-Convergence, recurrence, Relations and generating functions, Orthogonality of Bessel functions.

Section-II

Legendre and Hermite differentials equations and their solutions: Legendre and Hermite functions and their properties-Recurrence Relations and generating functions. Orhogonality of Legendre and Hermite polynomials. Rodrigues' Formula for Legendre & Hermite Polynomials, Laplace Integral Representation of Legendre polynomial.

Section-III

Laplace Transforms – Existence theorem for Laplace transforms, Linearity of the Laplace transforms, Shifting theorems, Laplace transforms of derivatives and integrals, Differentiation and integration of Laplace transforms, Convolution theorem, Inverse Laplace transforms, convolution theorem, Inverse Laplace transforms of derivatives and integrals, solution of ordinary differential equations using Laplace transform.

Section-IV

Fourier transforms: Linearity property, Shifting, Modulation, Convolution Theorem, Fourier Transform of Derivatives, Relations between Fourier transform and Laplace transform, Parseval's identity for Fourier transforms, solution of differential Equations using Fourier Transforms.

Books Recommended:

1. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc., New York, 1999
2. A.R. Forsyth : A Treatise on Differential Equations, Macmillan and Co. Ltd.
3. I.N. Sneddon : Special Functions on mathematics, Physics & Chemistry.
4. W.W. Bell : Special Functions for Scientists & Engineers.
5. I.N. Sneddon: the use of integral transform, McGraw Hill, 1972

MATH-501   **REAL AND COMPLEX ANALYSIS**

Max. Marks: 50   **Time 3 Hours**

Note:

The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question. All questions carry equal marks.

Section-I

Jacobians, Beta and Gama functions, Double and Triple integrals, Dirichlets integrals, change of order of integration in double integrals

Section-II

Fourier's series: Fourier expansion of piecewise monotonic functions, Properties of Fourier Co-efficients, Dirichlet's conditions, Parseval's identity for Fourier series, Fourier series for even and odd functions, Half range series, Change of Intervals.

Section-III

Extended Complex Plane, Stereographic projection of complex numbers, continuity and differentiability of complex functions, Analytic functions, Cauchy-Riemann equations. Harmonic functions.

Section-IV

Mappings by elementary functions: Translation, rotation, Magnification and Inversion. Conformal Mappings, Mobius transformations. Fixed pints, Cross ratio, Inverse Points and critical mappings

Books Recommended:

1. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
2. R.R. Goldberg : Real analysis, Oxford & IBH publishing Co., New Delhi, 1970
3. D. Somasundaram and B. Choudhary : A First Course in Mathematical, Analysis, Narosa Publishing House, New Delhi, 1997
4. Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi
5. R.V. Churchill & J.W. Brown: Complex Variables and Applications, 5th Edition, McGraw-Hill, New York, 1990
6. Shanti Narayan : Theory of Functions of a Complex Variable, S. Chand & Co., New Delhi.

MATH-502   **STATICS**

Max. Marks: 50   **Time 3 Hours**

Note:

The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question. All questions carry equal marks.

Section-I

Composition and resolution of forces. Parallel forces. Moments and Couples.

Section-II

Analytical conditions of equilibrium of coplanar forces. Friction. Centre of Gravity.

Section-III

Virtual work. Forces in three dimensions. Poinsots central axis.

Section-IV

Wrenches. Null lines and planes. Stable and unstable equilibrium.

Books Recommended:

1. S.L. Loney : Statics, Macmillan Company, London

2. R.S. Verma : A Text Book on Statics, Pothishala Pvt. Ltd., Allahabad

MATH -503   **NUMERICAL ANALYSIS**

Max. Marks: 50   **Time 3 Hours**

Note:

The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question. All questions carry equal marks.

Section-I

Finite Differences operators and their relations. Finding the missing terms and effect of error in a difference tabular values, Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Interpolation with unequal intervals: Newton's divided difference, Lagrange's Interpolation formulae, Hermite Formula.

Section-II

Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula.Probability distribution of random variables, Binomial distribution, Poisson's distribution, Normal distribution: Mean, Variance and Fitting.

Section-III

Numerical Differentiation: Derivative of a function using interpolation formulae as studied in Sections –I & II.Eigen Value Problems: Power method, Jacobi's method, Given's method, House-Holder's method, QR method, Lanczos method.

Section-IV

Numerical Integration: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Chebychev formula, Gauss Quadrature formula.Numerical solution of ordinary differential equations: Single step methods-Picard's method. Taylor's series method, Euler's method, Runge-Kutta Methods. Multiple step methods; Predictor-corrector method, Modified Euler's method, Milne-Simpson's method.

Books Recommended:

1. M.K. Jain, S.R.K.Lyengar, R.K. Jain : Numerical Method, Problems and Solutions, New Age International (P) Ltd., 1996
2. M.K. Jain, S.R.K. Lyengar, R.K. Jain : Numerical Method for Scientific and Engineering Computation, New Age International (P) Ltd., 1999
3. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
4. Melvin J. Maaron : Numerical Analysis-A Practical Approach, Macmillan Publishing Co., Inc., New York
5. R.Y. Rubnistein : Simulation and the Monte Carlo Methods, John Wiley, 1981

MATH-601   **LINEAR ALGEBRA**

Max. Marks: 50   **Time 3 Hours**

Note:

The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question. All questions carry equal marks.

Section-I

Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension.

Section-II

Homomorphism and isomorphism of vector spaces, Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations Dual Spaces, Bidual spaces, annihilator of subspaces of finite dimentional vactor spaces, Null Space, Range space of a linear transformation, Rank and Nullity Theorem

Section-III

Algebra of Liner Transformation, Minimal Polynomial of a linear transformation, Singular and non-singular linear transformations, Matrix of a linear Transformation, Change of basis, Eigen values and Eigen vectors of linear transformations.

Section-IV

Inner product spaces, Cauchy-Schwarz inequality, Orthogonal vectors, Orthogonal complements, Orthogonal sets and Basis, Bessel's inequality for finite dimensional vector spaces, Gram-Schmidt, Orthogonalization process, Adjoint of a linear transformation and its properties, Unitary linear transformations.

Books Recommended:

1.   I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2nd   edition).
3. Vivek Sahai and Vikas Bist : Algebra, NKarosa Publishing House.
4. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Norsa Publishing House.

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MATH -602   **DYNAMICS**

Max. Marks: 50   **Time 3 Hours**

Note:

The examiner is requested to set nine questions in all, selecting two questions from each section and one compulsory question consisting of five or six parts distributed over all the four sections. Candidates are required to attempt five questions in all, selecting at least one question form each section and the compulsory question. All questions carry equal marks.

Section-I

Velocity and acceleration along radial, transverse, tangential and normal directions. Relative velocity and acceleration. Simple harmonic motion. Elastic strings.

Section-II

Mass, Momentum and Force. Newton's laws of motion. Work, Power and Energy. Definitions of Conservative forces and Impulsive forces.

Section-III

Motion on smooth and rough plane curves. Projectile motion of a particle in a plane. Vector angular velocity

Section-IV

General motion of a rigid body. Central Orbits, Kepler laws of motion. Motion of a particle in three dimensions. Acceleration in terms of different co-ordinate systems.

Books Recommended:

1. S.L.Loney : An Elementary Treatise on the Dynamics of a Particle and a Rigid Bodies, Cambridge University Press, 1956

2. F. Chorlton : Dynamics, CBS Publishers, New Delhi

3. A.S. Ramsey: Dynamics Part-1&2, CBS Publisher & Distributors.