B. Sc. (Programme) Syllabus

(Effective from July, 2008)

Introduction

The B.Sc. (Gen.) Course was replaced by the B.Sc. Programme in the year 2005. The first batch of this course will pass out shortly, in 2008. Vice Chancellor had constituted a Committee in August 2007 to look into issues related to B.Sc. (Prog.). Following the recommendations of the Committee, a request was sent to all heads of the Departments to review the syllabus. The modified syllabus was presented before the Academic Council in its meeting held on July 12, 2008. The modifications/redistribution of the content in the following disciplines have been approved by the Academic Council and ratified by the Executive Council in its meeting held on July 29, 2008. The modifications in the syllabus will be implemented in all the three years of B.Sc. Program w.e.f. July, 2008.

1. Physics (PH 101,PH 102; PH 201,PH 202, PH 203; PH 301,PH 302 & PH 303)
2. Chemistry (CH 103, CH 104; CH 201,CH 202, CH 203,CH 204; CH 301, CH 302,CH 303 & CH 304)
3. Mathematics (MA 107a, MA107b, CS 110; MA 201, MA 202, MP 201; MA 301, MA 302 & MP 301)
4. Life Science (BY 105, BY 106; LS 201, LS 202, LS 203, LS 204, LS 205, LS 206; LS 301, LS 302, LS 303, LS 304, LS 305 & LS 306)
5. Environmental studies (ES 111- On line and qualifying)

(For papers other than those mentioned above, the syllabus remains unchanged.)

Structure

Every candidate shall be required to take an examination at the end of the I, II, III years respectively as per the schemes given below:

SCHEME OF EXAMINATION

I YEAR

Course Code	Course Title	Duration (Hours)	Max. Marks	Periods per week
PH 101	Physics	3	100	3
PH 102	Physics and Electronics Laboratory-I	6	100	6
CH 103	Chemistry	3	100	3
CH 104	Chemistry and Analytical Techniques Laboratory	6	100	6
BY 105	Biology	3	100	3
BY 106	Biology Laboratory	4	100	6
MA 107a	Mathematics			
	Or			
MA 107b	Mathematics for Life Sciences	3	100	3
CS 110	Laboratory Computer Science and Informatics	4	50	3
ES 111	Environmental Studies (On-line)	1	50(Qualifying)	1
HU 112	Technical Writing and Communication in English	2	50	2
	Total Marks		**800**	**36**

II Year and III Year

In the II year every student shall opt for three domain courses. The total marks for each domain will be 300. In addition every student shall opt for either an elective course or a project of 50 marks.

In the III year, the student shall continue with the same domains which he had opted in the II year; the overall distribution of marks shall be as follows:

Course Code	*Course Title*	*Duration (Hours)*	*Max. Marks*
D1 201/301	Science Domain (1) I	3	100
D1 202/302	Science Domain (1) II	3	100
D2 203/303	Science Domain (2) I	3	100
D2 204/304	Science Domain (2) II	3	100
D3 205/305	Science Domain (3) I	3	100*
D3 206/306	Science Domain (3) II	3	100*
D1 207/307	Laboratory - I Science Domain (1)	3 to 6**	100
D2 208/308	Laboratory - II Science Domain (2)	3 to 5**	100
D3 209/309	Laboratory - III Science Domain (3)	3 to 6**	100
EL 210/310	Elective/Project	2	50
	Total Marks		**950**

* In courses, where there is no laboratory, theory papers shall be of 150 marks. Similar distribution of marks will be there for III year.
** Practical Examinations in Chemistry/Analytical Chemistry/Industrial Chemistry and Physics shall be of 6 hours duration and in all other subjects of 3 to 4 hours duration.

The following combinations will be available:

A. Physical Sciences

1. Physics, Chemistry and Mathematics

B. Life Sciences

1. Chemistry, Botany and Zoology

C. Applied Physical Sciences

1. Physics, Mathematics and Computer Science
2. Physics, Mathematics and Electronics
3. Chemistry, Industrial Chemistry and Mathophysics
4. Chemistry, Analytical Chemistry and Mathophysics
5. Mathematics, Computer Science and Operational Research
6. Mathematics, Computer Science and Statistics

D. Applied Life Sciences

1. Chemistry, Biology and Environmental Science
2. Chemistry, Biology and Agrochemical & Pest Management
3. Chemistry, Biology and Sericulture
4. Chemistry, Biology and Mathophysics

Scheme of Examination
(for different science domains)

CHEMISTRY

Course Code	*Course Title*	*Duration (Hours)*	*Max. Marks*
II Year Examination			
CH 201	Inorganic Chemistry	2	50 + 17*
CH 202	Organic Chemistry	2	50 + 17*
CH 203	Physical Chemistry	2	50 + 16*
CH-204	Chemistry Laboratory II	6	100
III Year Examination			
CH 301	Inorganic Chemistry	2	50 + 17*
CH 302	Organic Chemistry	2	50 + 17*
CH 303	Physical Chemistry	2	50 + 16*
CH-304	Chemistry Laboratory III	6	100

PHYSICS

II Year Examination			
PH 201	Electricity Magnetism and EM Theory	3	100
PH 202	Thermal Physics	3	100
PH 203	Physics Laboratory-II	6	100
III Year Examination			
PH 301	Physics of Materials and Electronics	3	100
PH 302	Modern Physics	3	100
PH 303	Physics Laboratory-III	6	100

*** Marks for Internal Assessment**

MATHEMATICS

Course Code	*Course Title*	*Duration (Hours)*	*Max. Marks*
II Year Examination			
MA 201	Calculus and Geometry	3	150
MA 202	Algebra and Differential Equations	3	150
III Year Examination			
MA 301	Real Analysis	3	150
MA 302	Algebra and Mechanics	3	150

BOTANY AND ZOOLOGY (Life Sciences I and II)

II Year Examination			
LS 201	Biodiversity I : Plants	3	100
LS 202	Biodiversity II : Animals	3	100
LS 203	Cell Biology, Biochemistry & Immunology	3	100
LS 204	Genetics, Genomics & Molecular Biology	3	100
LS 205	Life Sciences Laboratory	4	100
LS 206	Life Sciences Laboratory	4	100
III Year Examination			
LS 301	Development Biology and Physiology : Plants	3	100
LS 302	Development Biology and Physiology: Animals	3	100
LS 303	Ecology and Environmental Management	3	100
LS 304	Applied Biology and Biotechnology	3	100
LS 305	Life Sciences Laboratory	4	100
LS 306	Life Sciences Laboratory	4	100

COMPUTER SCIENCE

II Year Examination			
CS 201	Programming and Data Structures	3	100
CS 202	Computer System Architecture	3	100
CS 203	Laboratory (Based on CS 201 & CS 202)	4	100

III Year Examination

Course Code	*Course Title*	*Duration (Hours)*	*Max. Marks*
CS 301	Operating Systems and Networks	3	100
CS 302	Software Engineering and Databases	3	100
CS 303	Laboratory (Based on CS. 301 & CS 302)	4	100

STATISTICS

II Year Examination

ST 201	Statistical Methods and Probability Theory	3	100
ST 202	Applied Statistics	3	100
ST 203	Statistics Laboratory-I	4	100

III Year Examination

ST 301	Statistical Inference	3	100
ST 302	Sample Surveys and Design of Experiments	3	100
ST 303	Statistics Laboratory-II	4	100

OPERATIONAL RESEARCH

II Year Examination

OR 201	Optimization	3	150
OR 202	Inventory Management and Queuing Theory	3	150

III Year Examination

OR 301	Reliability and Statistical Quality Control	3	150
OR 302	Forecasting and Case Studies	3	150

ELECTRONICS

II Year Examination

EL 201	Analog and Digital Circuits	3	100
EL 202	Semiconductor Devices and Fabrication	3	100
EL 203	Electronics Lab-I	4	100

III Year Examination

Course Code	*Course Title*	*Duration (Hours)*	*Max. Marks*
EL 301	Electronic Communication	3	100
EL 302	Microprocessors and Micro Controllers	3	100
EL 303	Electronics Lab-II	4	100

INDUSTRIAL CHEMISTRY

II Year Examination

IC 201	Industrial Chemicals & Environment	3	100
IC 202	Fossil Fuels and Fermentation Industries	3	100
IC 203	Industrial Chemistry Lab-I	6	100

III Year Examination

IC 301	Industrial Chemicals in Agriculture and Medicine	3	100
IC 302	Polymers and Instrumental Methods of Analysis	3	100
IC 303	Industrial Chemistry Lab-II	6	100

ANALYTICAL CHEMISTRY

II Year Examination

AC 201	Basic Principles & Laboratory Operation	3	100
AC 202	Quantitative Methods of Analysis	3	100
AC 203	Analytical Chemistry Lab-I	6	100

III Year Examination

AC 301	Separation Methods in Analytical Chemistry	3	100
AC 302	Instrumental Methods Analysis	3	100
AC 303	Analytical Chemistry Lab-II	6	100

ENVIRONMENTAL SCIENCE

II Year Examination

Course Code	*Course Title*	*Duration (Hours)*	*Max. Marks*
ES 201	Concepts in Ecology	3	100
ES 202	Natural Resource Management	3	100
ES 203	Environmental Science Lab-I	4	100

III Year Examination

ES 301	Environmental Concerns and Health	3	100
ES 302	Environmental Protection and Management	3	100
ES 303	Environmental Science Lab-II	4	100

BIOLOGY

II Year Examination

BIO 201	Biology of Animals : Form, Structure and Function	3	100
BIO 202	Biology of Plants : Form, Structure and Function	3	100
BIO 203	Biology Lab-I	3	100

III Year Examination

BIO 301	Cell & Molecular Biology and Development Biology	3	100
BIO 302	Genetics, Biotechnology and Immunology	3	100
BIO 303	Biology Lab-II	3	100

AGROCHEMICALS AND PEST MANAGEMENT

II Year Examination

ACP 201	Agricultural Botany, Plant Pathology and weeds	3	100
ACP 202	Fertilizers, herbicides, fungicides	3	100
ACP 203	Agrochemicals and Pest Management Lab-I	4	100

III Year Examination

Course Code	*Course Title*	*Duration (Hours)*	*Max. Marks*
ACP 301	Applied Entomology	3	100
ACP 302	Insecticides, Pesticide Formulation, Analysis, Quality Control	3	100
ACP 203	Agrochemicals and Pest Management Lab-II	4	100

MATHOPHYSICS

II Year Examination

MP 201	Mathematics-I	3	150
MP 202	Thermal Physics and Electromagnetism	3	100
MP 203	Physics Lab-I	4	50

III Year Examination

MP 301	Mathematics-2	3	150
MP 302	Optics, Electronics and Modern Physics	3	100
MP 303	Physics Lab-II	4	50

SERICULTURE

II Year Examination

SC 201	General Sericulture, Soil Science	3	100
SC 202	Mulberry & Silkworm Studies	3	100
SC 203	Sericulture Lab-I	4	100

III Year Examination

SC 301	Sericulture Crop Improvement and Management	3	100
SC 302	Silkworm Seed Technology and Silk Technology	3	100
SC 303	Sericulture Lab-II	4	100

One Elective subject in II year may be chosen out of the following:

Economics/Entrepreneurship/Organizational Behaviour/Psychology/Financial Accounting/Financial Management or a Project of equivalent weightage in any one of these elective subjects.

One Elective subject in III year may be chosen out of the following:

Green Chemistry/Polymer Science/Biotechnology/Forensic Science/Earth System Science/Intellectual Property Rights/Computational and Discrete Mathematics*/Mathematical Methods in Life Sciences.

*Only for students of B.Sc. Physical Sciences/Applied Physical Sciences.

Promotion Rules

1. The minimum marks required to pass the I year examination shall be 36% in the aggregate of all the Theory papers taken together and 36% in the aggregate of all the Practical papers taken together. The candidate shall have to secure 36% marks separately in the University examination, as well as in the total of the University examination and the internal assessment. However, at the end of the I year, a candidate who does not pass the examination but has secured at least 36% in all the practical papers taken together and at least 36 % marks in all but two theory papers may be allowed to appear in the remaining papers along with the examination in the subjects of part II examination, if otherwise eligible.

2. The minimum marks required to pass the II year or III year examination in the three subjects of Science Domains shall be 36% in the aggregate of the Theory papers taken subject-wise and 36% in the Practical examination in each subject, and 36% in the Elective/Project in each year separately. The criteria will be applied separately to the University examination as well as in the total of the University examination and internal assessment.

3. At the end of II year, a candidate, who has secured pass marks (separately in Theory and Practical) in at least 2 of the Science domains and has secured 25% marks in the aggregate including the elective subject/project may be permitted to proceed to the III Year class, and take subsequently the examination in the remaining subject of II year (in which he has not secured the pass marks) along with the University examination of the III year.

4. At the end of the III year, a candidate, who has not passed the third year examination, but has secured at least 36% marks in any subject/subjects (Theory and Practical separately for each subject) will be exempted for reappearing in those subjects.

5. The successful candidate will be classified on the combined results of I, II and III year examinations as follows :

(a) First Division	:	60% Marks or more in the aggregate
(b) Second Division	:	50% Marks or more in the aggregate
(c) Third Division	:	All others

Note:

Candidates who have failed or have been absent in any year of the B.Sc. Examination may be allowed to reappear at the examination on being enrolled as ex-student in accordance with the rules and regulations

prescribed in that behalf irrespective of whether they had secured the minimum pass marks in the practical papers.

Candidates who have already secured the minimum pass marks in the practical papers and, or Project Report/Field Work Report at a previous examination shall not be allowed to reappear in the practical papers and Project Report/Field Work Report as the case may be.

Attendance

Subject to the provisions of Ordinance VII-Conditions for Admission to Examination : a candidate for the B.Sc. I year Examination shall not be deemed to have satisfied the required conditions of attendance unless he has attended, in all the subjects of I year taken together, not less than two-thirds of the lectures and practicals, held in the college. In the II and III year the student should have attended not less than two-thirds of the lectures and practicals separately, held in the college in each academic year.

Provided that a student of the I year class who does not fulfill the required conditions of attendance as provided in the Clause above, but has attended, in all the subjects taken together, not less than 40 per cent of lectures and practicals, held during the I year, may, at the discretion of the Principal of the College concerned, be allowed to appear at the Part I Examination; but such a candidate shall be required to make up the deficiency of lectures and/or practicals, as the case may be, of the I year, during the II year.

Provided further that a student of the II year class who does not fulfill the required conditions of attendance as above, but has attended in all the subjects taken together, not less than 40 per cent of the lectures and practicals, separately, held during the II year class, may, at the discretion of the Principal of the College concerned, be allowed to appear at the Part II examination provided that he makes up the deficiency of the II year by combining the attendance of the first year class.

Provided further that a student of the II year class, who was short of attendance at the end of I year class, but was allowed to appear at the I year examination, subject to his making up the deficiency of attendance during II year, and who has not been able to make up the deficiency as above, but has attended in all the subjects taken together not less than 55% of the lectures and practicals, separately, held during the I year class and the II year class, taken together, may, at the discretion of the Principal of the College concerned, be allowed to appear at the II year examination, subject to his making of the deficiency of the two years taken together, as above during the third year class.

Provided further that a student of the III year class, who does not fulfill the required conditions of attendance as above, but has attended, in all the subjects taken together not less than 40% of the lectures and practicals, separately held during the III year class, shall be allowed to appear at the III year examination, if by combining the attendance of the III year with the attendance of I and II years, the candidate has put in two-thirds of attendance in all the subjects taken together, separately, in lectures and practicals held during the three years.

Explanation: A student who has failed at the I year or II year or III year Examination and has rejoined the I year or II year or III year class, as the case may be shall be required to put in the requisite

attendance as above, afresh, and the attendance previously put in by him for the respective year will not be taken into account.

I. Notwithstanding anything to the contrary contained in the foregoing provisions:

a. A candidate for the III year examination, appearing at the examination initially, during the pendency of the course, may, with a view to improving his previous performance, be allowed to reappear, once only, at the examination in one or more subject(s) of II year, alongwith the III year examination on foregoing in writing, his earlier performance, in the subject(s) of II year. No candidates shall be allowed to re-appear in the subject(s) of II year after he has passed the III year examination.

b. A candidate who has cleared the papers of the III year examination after having appeared at the Examination initially, during the pendency of the span period, may with a view to improving his earlier performance, be allowed to re-appear, once only, at the examination in one or more subject(s) of III year either at the Supplementary Examination immediately held thereafter or if he fails to appear then at the next Annual Examination on foregoing, in writing, his previous performance in the subject(s) concerned of III year examination.

Explanation: No candidate will be admitted to the examination after the expiry of six years after admission to the I year class, five years after admission to the II year class and three years after admission to the III year class.

Note: In the case of a candidate, who offers to reappear in any subject(s) under the aforesaid provision, on surrendering his earlier performance but fails to re-appear in the subject(s) concerned, for satisfactory reasons, the marks previously secured by the candidate in the subject(s) in which he failed to re-appear may be taken into account while determining the results of the examination held currently, on application by the candidate which should reach the University within a fortnight of the termination of the current examination.

SYLLABI AND READINGS

IST YEAR

FOUNDATION COURSES

PH 101 Essentials of Physics

Unit I: Mechanics (Total Number of Lectures = 13)

Galilean invariance, Newton's laws, Linear Momentum, Impulse and momentum, Conservation of momentum and energy, Work–Energy theorem, Dynamics of a system of particles; forces, Potential energy, Potential energy and force, Conservation of angular momentum, torque, motion of a particle in central force field. Kepler's Laws (Only statement), Satellite in circular orbit and applications (Synchronous satellite, GPS).

Elasticity: Hooke's Law, Stress, Strain, Elastic Constants, Twisting torque on a wire.

Unit II: Special Theory of Relativity (Total Number of Lectures = 11)

Constancy of speed of light, The Michelson-Morley Experiment, Postulates of Special Relativity, Lorentz transformations, Lorentz contraction and time dilation, Relativistic velocity addition, Variation of mass with velocity, Doppler effect, Red shift.

Unit III: Oscillations and Waves (Total Number of Lectures = 14)

Simple Harmonic Motion: Simple Harmonic Oscillator, Motion of simple and compound pendulum (Bar and Kater's pendulum), Loaded spring, Energy in simple harmonic motion. Superposition of two SHM: (i) collinear SHM of same frequency (ii) collinear SHM of different frequencies – phenomenon of Beats (iii) SHM of same frequency but perpendicular to each other and (iv) Lissajous figures.

Damped Harmonic Motion: Equation of motion, Dead beat motion, Critically damped system, Lightly damped system: relaxation time, logarithmic decrement, quality factor.

Forced Oscillations: Equation of motion, Complete solution, Steady state solution, Resonance, Sharpness of resonance, Quality factor.

Coupled Oscillator: Degrees of freedom, Coupled oscillator with two degrees of freedom; Normal modes; General method of finding normal modes for a system of two degrees of freedom.

Wave Motion: One dimensional plane wave; Classical wave equation; Superposition principle; Standing wave on a stretched string (both ends fixed).

Unit IV: Optics (Total Number of Lectures = 12)

Wave Optics: Interference: Essential conditions for observing interference; Division of wave front; Young's double slit experiment,

Diffraction: Difference between Fresnel and Fraunhoffer diffraction; Fraunhoffer Diffraction – single slit (intensity distribution, position of maxima and minima), circular aperture (qualitative).

Resolving power: Rayleigh's criterion; resolving power of telescope and microscope.

Polarization: Polarization of light (plane polarized light), Malus Law, Polarizing materials, Polarizer and Analyzer**.**

Laser : characteristics, principle, population inversion, application of laser in medical science

Unit V: Basic Electronics (Total Number of Lectures = 10)

PN junction diode: PN Junction, I-V characteristics, Diode equation (qualitative approach only), Zener diode, Photodiode, Light Emitting Diode, Solar Cell (qualitative discussion only).

Operational amplifier (op-amp) and applications: block diagram, characteristics of an ideal op-amp, concept of virtual ground, Inverting and Non-inverting amplifier, Application of op-amp: Adder, Subtractor and Comparator .

Fundamentals of Digital Electronics: logic gates, half adder, half subtractor, full adder, full subtractor, Flip Flops: NAND gate latch, RS flip flops.

Timing circuit using 555 timer: Astable and monostable operation.

Unit VI: Applied Physics ((Total Number of Lectures = 10)

Viscosity, Poiseuille's equation, blood flow in human body, Principle for measuring the blood pressure,

Nanoparticles: Importance of Nano-particle, properties: surface to volume effect. Application to medicine. Basic Principles of Drug Delivery, Toxic effects of Nano-particles.

Van der Waal's interaction, Hydrophobic Interactions, Biological importance of Hydrogen Bonding in water.

Neurobiophysics: Resting and action potential, Nerve Conduction (Propagation of action potential in neuron), Capacitance of Axon.

Suggested books for students:

Physics, Volume I and Vol II by Robert Resnick, David Halliday and Kenneth S. Krane, John Wiley and Sons Inc., Fifth Edition.

Physics for scientists and engineers, by Servay and Jewet , Brookes Cole, 6th Edition. **ISBN-10:** 0534408427

Op-amps and linear Integrated Circuits by Ramakant a. Gayakwad. Pearson Education India, ISBN-10: 8131702286

Elementary Biophysics- An Introduction by P. K. Srivastava, Narosa Publishing House. ISBN: 8173196052

Principle of Optics – B. K. Mathur

<u>Additional references</u>

Feynman lectures volume 1. Addison Wesley; 2 edition (July 29, 2005). ISBN-10: 0805390464

Mechanics – Berkley Physics Course, Vol. 1. C. Kittel, Knight W. O. and Ruderman M. A., Tata McGraw Hill.

Waves and Oscillations, Berkeley Physics Course, Vol. 3. F. S. Crawford, Tata McGraw Hill.

Electronic Principles. A. P. Malvino 5th edition, Tata McGraw Hill

PH 102 PHYSICS AND ELECTRONICS LABORATORY-I

(Physical Sciences / Applied Physical Sciences / Life Sciences / Applied Life Sciences)

102.1 (Physics)

1. Determination of acceleration due to gravity using Kater's Pendulum.
2. Determination of the acceleration due to gravity using bar pendulum.
3. Determination of moment of inertia of a Fly wheel.
4. Determination of frequency of an electrically maintained tuning fork by Melde's experiment.
5. Determination of the coefficient of Viscosity of water by capillary flow method (Poiseuille's method).
6. Study of the condition of resonance for a series LCR circuit and determine its resonance frequency and Quality factor.
7. Single slit diffraction using laser.
8. Verification of Malus Law.
9. To determine the modulus of rigidity of a wire by Maxwell's needle.
10. To determine the elastic constants of a wire by Searle's method.
11. To study the motion of a spring and calculate (a) spring constant and (b) the value of g.
12. Q factor of a mechanical oscillator.

102.2: Electricity / Electronics

1. Measurement of Voltage, frequency and Phase using CRO.
2. To design an amplifier of a given gain using an Operational Amplifier in Inverting and Non-inverting modes.
3. To Study Op-amp as an adder.
4. Design an astable oscillator of a given specification using timer IC 555.
5. To design basic logic gates OR, AND, NOT XOR using NAND/NOR gate; Verify truth tables.
6. To design (i) Half adder and full adder, and (ii) half subtractor and full subtractor.
7. Determination of RC time constant using charging and discharging of capacitor through a resistance.
8. To construct the RC differentiator and study the response to time varying signal.
9. To construct the RC integrator and study the response to time varying signal.
10. To study the I-V characteristics of (a) resistances (Ohm and mega ohm range) (b) Tungsten bulb (c) diode or solar cell. (d) zener diode.
11. Determination of Planck's constant using LED's.
12. Determination of Boltzmann's constant using semiconductor diode.

Note

1. Each college should set up at least 10 practicals each from 102.1 and 102.2.
2. Each student is required to perform at least 7 practicals each from 102.1 and 102.2.

References:
For Physics Practicals

1. ***Advanced Practical Physics; Worsnop and Flint,*** Methuen & Co., London,
2. ***Advanced Level Practical Physics; Nelson and Ogborn; English Language Book Society.***
3. ***Indu Prakash vol 1 and 2***

For Electronics Practicals

1. The Art of Electronics, P. Horowitz and W. Hill, Cambridge University Press, 2nd edition, (Cambridge, 1989).
2. Student Manual for The Art of Electronics, T. C. Hayes and P. Horowitz, Cambridge University Press (Cambridge, 1989).
3. Physics Through Experiments 1, EMF Constant and Varying, B Saraf et. al, Vikas Publishing House Pvt. Ltd. (Delhi, 1992).
4. Operational Amplifiers, George Clayton, Steve Winder and G.B. Clayton, Newnes; 5 edition (April, 2003).
5. Operational Amplified Experiment Manual, G. B. Clayton, Butterworth-Heinemann (May, 1983).
6. Data Converters, G. B. Clayton, Halsted Pr (1982).
7. Digital Design, M. Morris Mano, Morris M. Mano, Pearson Higher Education (1990).

8. ***Paul B. Zbar and Albert B. Malvino, Basic Electronics (A Text-Lab Manual), Tata McGraw Hill.***

CH 103 CHEMISTRY

No. of lectures per week - 3

The primary objective of this course is to promote an understanding of the fundamental concepts of Chemistry and their applications while retaining the excitement of Chemistry. The course also emphasizes the development of problem solving skills in students.

Unit I. Atomic Structure

Recapitulation of: Bohr's theory and its limitations, dual behavior of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Need of a new approach to atomic structure.

What is Quantum mechanics ? Time independent Schrodinger equation ($H\Psi = E\Psi$) and meaning of various terms in it. Significance of Ψ and Ψ^2 , Schrodinger equation for hydrogen atom in cartesian coordinates (x,y,z). Need of polar coordinates, transformation of cartesian coordinates (x,y,z) into polar coordinates (r,θ,ϕ). Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals. (only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distances with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m_r and m_s. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s).

Rules for filling electrons in various orbitals , Electronic configurations of the atoms. Stability of half-fillled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbtials, Anomalous electronic configurations.

Unit II. Chemical Bonding and Molecular Structure

Ionic Bonding

General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Lande equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding

VB Approach

Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trivial bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach

Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combination of atomic orbitals, non- bonding combination of orbitals ,MO treatment of homonuclear diatomic molecules of 1^{st} and 2^{nd} periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO+.

Comparison of VB and MO approaches.

Unit III. Chemical Thermodynamics

Recapitulation of: What is thermodynamics? State of a system, state variables, intensive and extensive variables, concept of heat and work, thermodynamic equilibrium, thermodynamic properties, various types of systems and processes . First Law of thermodynamics and important principles and definitions of thermochemistry.

Calculation of work (w), heat (q), change in internal energy (ΔE) and change in enthalpy (ΔH) for expansion or compression of ideal gases under isothermal and adiabatic conditions for both reversible and irreversible processes. Calculation of w, q, ΔE and ΔH for processes involving changes in physical states.

Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthaply of a reaction with temperature – Kirchhoff's equation.

Various statements of Second Law of thermodynamics, concept of entropy, Gibbs free energy and Helmholtz energy, Calculations of entropy change and free energy change for reversible and irreversible processes under isothermal and adiabatic conditions. Criteria of spontaneity. Gibbs – Helmholtz equation. Maxwell's relations.

Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Unit IV. Ionic Equilibria

Recapitulation of: strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water.

Ionization of weak acids and bases, pH scale, common ion effect, Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle

Qualitative treatment of acid – base titration curves (calculation of pH at various stages of HCl – NaOH titration only). Theory of acid – base indicators.

Unit V. Fundamentals of Organic Chemistry

Classification and nomenclature: hydrocarbons and their derivatives. Concept of hybridization of carbon. Cleavage of a covalent bond: homolysis and heterolysis.

Electronic effects and their applications (inductive, electromeric, hyperconjugation and resonance). Structure and stability of reactive intermediates (carbocations, carbanions and free radicals).

Relative strength of carboxylic acids (aliphatic, aromatic and halo-substituted aliphatic), alcohols, phenols and nitro-phenols. Relative basic strength of amines (aliphatic and aromatic) Intermolecular and intramolecular forces: types of intermolecular forces and their characteristics (ion-dipole, dipole-dipole, dipole-induced dipole and dispersion forces). Intermolecular and intramolecular hydrogen bonding. Effect of intermolecular and intramolecular forces on properties such as solubility, vapour pressure, melting and boiling points of organic compounds.

Unit VI. Stereoisomerism

Optical Isomerism: Optical activity, plane polarized light, specific molar rotation. Chirality, enantiomerism, disteroisomerism, racemic mixtures and their resolution by salt formation method.
Writing of Fischer projection and Flying Wedge formulae. Illustrations of interconversion of one type of structural representation into another type of formulae.
Relative and Absolute Configuration: D- and L- system of configuration of carbohydrates. Threo- and erythro- designation. Sequence rules for assigning priority to various groups and R- and S- system of assigning configuration.
Geometrical Isomerism: Cis- and trans- system for geometrical isomers. E-and Z- notations for geometrical isomers.
Newman and Sawhorse formulae for representing conformation of ethane and butane. Energy diagram and relative stability of different conformational forms. Baeyers's strain theory and its limitations. Qualitative treatment of stability of chair and boat comformations of cyclohexane.

CH – 104

Laboratory: Chemistry and Analytical Techniques

No. of periods per week – 6

Note:

1. Theory needed for understanding of Experiments and the basic principles involved in instrumentation may be discussed in the Lab.
2. The Practical examination shall be of 6 hours duration spread over three sessions of two hours each. *Practical examination will include three exercises – one each out of the following inorganic, organic and physical chemistry experiments. Different students should be given different exercises as far as possible. The exercises should be chosen so as to justify the time available for the examination.*

Section A – Inorganic Chemistry

Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe(II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu(II) ions iodometrically using $Na_2S_2O_3$.

Separation of mixtures by chromatography: Measure the R_f value in each case. (Combination of two ions to be given)

(1) Paper chromatographic separation of Fe^{3+}, $A1^{3+}$ and Cr^{3+}

or

Paper chromatographic separation of Ni^{2+}, CO^{2+}, Mn^{2+} and Zn^{2+}

Section B – Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements).
2. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
3. Determination of melting and boiling points of organic compounds.
4. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)
   (a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.
   (b) Identify and separate the sugars present in the given mixture by paper chromatography.
   (c) Separation of ortho- and para-nitroaniline by TLC/Column chromatography.

Section C – Physical Chemistry

Thermochemistry

1.(a) Determination of heat capacity of calorimeter.
(b) Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
2. Determination of enthalpy of ionization of acetic acid.
3. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).

Molecular weight determination of proteins using Electrophoresis

1. Separation of a mixture of 2 or 3 amino acids (glycine, arsine / lysine, aspartic acid /glutamic acid) by electrophoresis.

pH-metry

1. Preparation of buffers of CH_3COOH and CH_3COONa or Citric Acid and Na_2HPO_4 and determination of their pH values using glass electrode.
2. Determination of pH of aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode).
3. pH metric titration of HCl with NaOH.

Suggested Readings:

1. *J.D.Lee : A New Concise Inorganic Chemistry*, E.L.B.S.
2. F.A.Cotton & G. Wilkinson : *Basic Inorganic Chemistry*, John Wiley.
3. T.W.Graham Solomons : *Organic Chemistry*, John Wiley and Sons.
4. Peter Sykes : *A Guide Book to Reaction Mechanism in Organic Chemistry*, Orient Longman.
5. E.L.Eliel : *Sterochemistry of Carbon Compounds*, Tata McGraw Hill.
6. P.W.Atkins : *Physical Chemistry*, Oxford University Press.
7. G.W.Castellan: *Physical Chemistry*, Narosa Publishing House.
8. Douglas, McDaniel and Alexander : *Concepts and Models in Inorganic Chemistry*, John Wiley.
9. G.M.Barrow, *Physical Chemistry*, Tata McGraw Hill.
10. R.T.Morrison & R.N.Boyd : *Organic Chemistry*, Prentice Hall.

BY 105 BIOLOGY

Unit I Biological systems, evolution and biodiversity

a. Introduction to concepts of biology (Ch 1 Campbell)
b. Evolutionary history of biological diversity (Ch 26 Campbell)
c. Classifying the diversity of life (Ch 25 Raven)
d. Darwinian view of life and origin of species (Ch22, 24 Campbell)
e. Genetic approach to Biology (Ch 1 Griffiths 9th edn)

Unit II Chemical context of living systems

a. Chemistry of life (Ch 2 Campbell)
b. Water and life (Ch 3 Campbell)
c. Carbon and life (Ch 4 Campbell)
d. Structure and function of biomolecules (Ch 5 Campbell)

Unit III Cell and Cellular Processes

a. Techniques to study cells: Microscopy-light and electron (Ch 1 Sheeler)
b. Cell as a unit of life (Ch 6 Campbell)
c. Cell wall and cell membrane: structure and function (Ch 7 Campbell, Ch 15 Sheeler, Ch 3 Raven, Biology of plants)
d. Cell cycle- Interphase, Mitosis and Meiosis (Ch 12,13 Campbell)

Readings:

- Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
- Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi
- Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY.
- Sheeler, P and Bianchi, D.E (2006) Cell and Molecular Biology, 3rd edition, John Wiley & sons, NY

BY 106 BIOLOGY LABORATORY

Botany

1. To study the plant cell structure through temporary mounts.
2. To study prokaryotic cells (bacteria), viruses, eukaryotic cells and cell organelles with the help of light and electron micrographs.
3. To study the culture bacterial (*E.coli*) cells.
4. To study the increase in number of *E.coli* cells as a function of time by turbidity method. Draw a growth curve from the available data.
5. To isolate DNA from *E.coli* cells.
6. To separate *E.coli* proteins by SDS- PAGE.
7. To perform quantitative estimation of protein using the Lowry's method.
8. To separate chloroplast pigments by paper chromatography, elute the pigments and determine the absorption maxima/spectrum for each.
9. To prepare temporary stained squash from root tips of *Allium cepa* to study various stages of mitosis. Take microphotographs.
10. To prepare phosphate buffer and study its buffering capacity. Also study the buffering capacity of any plant juice and plot a graph.
11. To separate a mixture of dyes using column chromatography (Sephadex G-25/other).
12. To perform gram staining of bacteria.

Zoology

1. To study the structure of animal cells by temporary mounts.
2. To perform micro-chemical tests for carbohydrates, proteins, lipids and nucleic acids.
3. To study the cytochemical distribution of nucleic acid and mucupolysaccharides with in cells/tissues. (permanent slides).
4. To separate and quantify sugars by thin layer chromatography.
5. To study viability of cells by dye exclusion method.
6. To enumerate cells by hemocytometer.
7. To perform quantitative estimation of DNA using UV spectrophotometer and determine the absorption maxima.
8. To perform acid hydrolysis of DNA and separation of bases by paper chromatography.
9. To isolate plasmid DNA of *E.coli* by alkaline method.
10. To quantify DNA by agarose gel electrophoresis using lambda DNA as standard.
11. To make temporary squash preparation of grasshopper testes and study various stages of meiosis, and take microphotographs.
12. To study mitochondria in striated muscle cells using vital stain Janus Green B.

MA 107a MATHEMATICS

(72 Lectures)

The objective of this course is to lay the foundations of Mathematics required for the study of Physical Sciences. The focus is on introducing mathematical concepts using examples and problems from various science domains. Rigorous approaches including proofs and derivations are exemplified in a few topics. Visual, graphical and application oriented approaches are introduces, wherever appropriate.

Unit I. Matrices (24 L) **25 Marks**

R, R^2, R^3 as vector spaces over R and concept of R^n .Standard basis for each of them. Concept of linear Independence and examples of different bases. Subspaces of R^2, R^3. Translation, Dilation, Rotation, Reflection in a point, line and plane. Matrix form of basic geometric transformations. Eigenvalues and Eigen Vectors for such transformations. Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3. Computation of matrix inverses using elementary row operations. Rank of matrix. Solutions of a system of linear equations using matrices. Illustrative examples of above concepts from Geometry, Physics, Chemistry, Combinatorics and Statistics.

Unit II. Calculus (30 L) **30 Marks**

Sequences to be introduced through the examples arising in Science beginning with finite sequences, followed by concepts of recursion and difference equations. Covergenee of a sequence and algebra of convergent sequences. Illustration of proof of convergence of some simple sequences such as $(-1)^n/n$, $1/n^2$, $(1+1/n)^n$, x^n with $| x | < 1$.

Graphs of simple concrete functions such as polynomial, trigonometric, inverse trigonometric, exponential, logarithmic arising in problems of chemical reaction, simple pendulum, radioactive decay, temperature cooling/heating problem.

Successive differentiation, Leibnitz, theorem, Recursion formulae for higher derivative.

Functions of two variables. Graphs and Level curves of functions of two variables. Partial differentiation upto second order. Verification of known basic solutions of wave equation, heat equation, Laplace equation and diffusion equation.

Computation of Taylor's Maclaurin's series of functions such as e^x, log (1 + x), sin x, cos x. Their use in polynomial approximation and error estimation of elementary functions.

Formation and solution of Differential equations arising in population growth, radioactive decay, administration of medicine and cell division.

Unit III. Statistics (18 L) **20 Marks**

Elementary Probability and basic laws. Discrete and Continuous random variable, Mathematical Expectation, Mean and Variance of Binomial, Poisson and Normal distribution. Sample mean and Sampling Variance. Hypothesis testing using standard normal variate. Curve fitting. Corelation and Regression. Emphasis on examples from Physical Sciences.

Suggested Readings

1. George B. Thomas, Jr., Ross L. Finney : Calculus and Analysis Geometry, Pearson Education (Singapore) ; 2001.

2. D. Waltham : Mathematics, a simple tool for Geologists, Blackwell Science, Inc., Cambridge, Massachusetts, Reprint from Chennai, India (2000).

3. Richard A. Johnson : Miller and Freund's Probability and Statistics for Engineers, Pearson Education; 2005.

4. T.M. Apostal : Calculus, vol. 1, John Wiley and Sons (Asia) : 2002.

MA 107 b Mathematics
(72 Lectures)

The objective of this course is to lay the foundations of Mathematics required for life sciences. The focus is on introducing mathematical concepts using relevant examples and in developing problem solving skills. Visual, graphic and application oriented approaches are used, wherever appropriate.

Unit I. Calculus (24 L) 25 Marks

Sets, Functions and their graphs: polynomial, sine, cosine, exponential and logarithmic functions. Motivation and illustration for these functions through projectile motion, simple pendulum, biological rhythms, cell division, muscular fibers etc. Simple observations about these functions like increasing, decreasing and periodicity. Sequences, followed by concepts of recursion and difference equations. The Fibonacci sequence arising from branching habit of trees and breeding habit of rabbits.

Intuitive idea of discontinuity and continuity.

Differentiation, Concept to be motivated through simple concrete examples as given above from Biological and Physical Sciences. Use of methods of differentiation like Chain rule, Product rule and Quotient rule. Second order derivatives of above functions. Integration as reverse process of differentiation. Integrals of the functions introduced above.

Unit II. Multivariate Calculus (24 L) 25 Marks

Examples of matrices arising in Biological Sciences and Biological Networks. Sum and product of matrices upto order 3.

Functions of two variables. Partial differentiation upto second order. Modeling and verification of solutions of differential equations arising in population growth, administration of medicine and diffusion equation arising from diffusion on Potassium ions in Cells.

Unit III. Statistics (24 L) 25 Marks

Measures of central tendency. Measures of dispersion; skewness, kurtosis. Elementary Probability and basic laws. Sample mean and Sampling variance. Discrete and Continuous Random Variables, Mathematical Expectation, Mean and Variance of Binomial, Poisson and Normal distribution. Hypothesis testing using standard normal variate, Curve Fitting. Correlation and Rregression (only application). Emphasis on examples from Biological Sciences.

Suggested Readings

1. G. Eason, C.W. Coles and G. Gettinby: Mathematics and Statistics for the Bio-Sciences, John Wiley and Sons, 1980.

2. E, Batschelet: Introduction to Mathematics for Life Scientists, Springer Verlag, International Student Edition, Narosa Publishing House, New Delhi (1971, 1975)

3. A. Edmondson and D. Druce: Advances Biology Statistics, Oxford University Press; 1996.

4. W. Danial: Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004.

CS 110 COMPUTER APPLICATIONS

As application of computers plays a central role in the study of science, the course aims at familiarizing the students with basic concepts and applications of computers. The course would enable the student to make use of computers for data analysis and visual interpretation. The student would also be able to develop small programs for solving scientific problems, making use of suitable tools.

Unit I : Introduction : (3T hours)

Computer Fundamentals: Logical organization of a computer–memory: primary, secondary; input-output devices: keyboard, monitor, printers; data representation: bits and bytes, number systems–decimal, binary, octal, hexadecimal; ASCII, Unicode.

Unit II: Data Analysis Using Spreadsheet: (8T+18P hours)

Spreadsheet Handling: Creating a spreadsheet, entering and formatting information, basic functions and formulas, creating charts, tables and graphs, etc.

Unit III : Programming : (13T+30P hours)

Introduction to Scientific Programming Environment: Programming fundamentals– input-output statements, data types, arrays, control structures for selection and looping, functions, introduction to files: opening, closing, reading and writing; use of geometric transformations for 2D and 3D objects.

Use of scientific/statistical functions such as interpolation, roots, mean, median, standard deviation, variance, and histogram. Scientific visualization.

Introduction to molecular modeling tool kit (overview)

Note: Use of Open Office and Python is recommended as there are freely downloadable.

References:

Reference manual for Open Office available at: http://www.openffice.org

Reference manual for Python available at: http://www.python.org

Note: Theory 24 Hours, Practicals 48 Hours

Environmental studies

Unit I- Introduction
The multidisciplinary nature of environmental studies (global and Indian perspective), scope, importance and need for public awareness.

Unit II- Natural resources and biodiversity
Renewable and non-renewable resources.
Natural resources and their problems- forest, water, mineral, food, energy and land resources.
Biodiversity- genetic, species and ecosystem diversity. Biogeogaphical classification in India, value and conservation of biodiversity.

Unit III- Environmental pollution
Causes, effects and control measures of : air, water, soil, marine and noise pollution.
Climate change, global warming, ozone depletion, urban problems, water conservation, waste management.
Environment, human population and health.

Readings:

1.Cunningham, W.P. and Cunningham, M.A 2008 Environmental Science- a global concern. 10th edition McGraw Hill International, Boston
2. Bharucha, E. 2005 Textbook of Environmental Studies for undergraduate courses(for UGC) University Press, Hyderabad.
3.Miller, G.T 2006 Environmental Science 11th edition Brooks/Cole, Australia

IIND YEAR

PH 201 Electricity, Magnetism and Electromagnetic Theory

UNIT I: Vector Calculus (Number of Lectures = 10)

Scalar and vector fields, differentiation of a vector w.r.t. a scalar. Directional derivatives, gradient, divergence, curl and Laplacian operations and their meaning. Line, surface and volume elements in spherical polar coordinates, Gauss's Theorem, Stoke's Theorem.

UNIT II: Electrostatics (Number of Lectures = 15)

Electric Field:- Concept of electric field lines and electric flux, Gauss's law (Integral and differential forms), application to linear, plane and spherical charge distributions. Conservative nature of electric field **E**, irrotational field.

Electric Potential:- Concept of electric potential, relation between electric potential and electric field, potential energy of a system of charges. Energy density in an electric field. Calculation of potential from electric field for a spherical charge distribution.

Electric Field in a medium:- Electric field in a dielectric medium, Polarization vector **P**, electric susceptibility, Displacement vector **D**, relation between **E**, **P** and **D**. Boundary conditions for **E** and **D** at the interface of two homogeneous isotropic dielectrics.

UNIT III: Magnetostatics (Number of Lectures = 10)

Concept of magnetic field **B** and magnetic flux, Biot-Savart's law, **B** due to a straight current carrying conductor. Force on a point charge in a magnetic field. Properties of **B**, curl and divergence of **B**, solenoidal field.

Integral form of Ampere's law, applications of Ampere's law: field due to straight, circular and solenoidal currents. Energy stored in magnetic field. Magnetic energy in terms of current and inductance. Magnetic force between two current carrying conductors. Magnetic field intensity.

Ballistic Galvanometer:- Torque on a current loop in a uniform magnetic field, working principle of B.G., current and charge sensitivity, electromagnetic damping, critical damping resistance.

UNIT IV: Electromagnetic Induction and Electromagnetic waves (Number of Lectures = 25)

Faraday's laws of induction (differential and integral form), Lenz's law, self and mutual Induction, reciprocity theorem.

Continuity equation, modification of Ampere's law, displacement current, Maxwell's equations in vacuum and dielectric medium, boundary conditions, plane wave equation: transverse nature of EM waves, velocity of light in vacuum and in medium, polarization, reflection and transmission.

Polarization of EM waves, Brewster's angle, description of linear, circular and elliptical polarization, Poynting theorem.

Fibre Optics:- Total internal reflection, critical angle, optical fibre, numerical aperture, acceptance angle, types of optical fibres (definition only)

UNIT V: AC Circuits (Number of Lectures = 10)

Kirchoff's laws (mesh and node analysis of ac circuits) , Thevenin and Norton Theorem, T and π conversion, maximum power transfer Theorem, Wheatstone bridge and its application to Wien's bridge and Anderson's bridge.

Reference Books

1. ***Vector Analysis and an introduction to Tensor Analysis by Murray R. Speigel, Schaum's Outline Series, McGraw-Hill International Book Company, Singapore.***
2. ***Electricity and Magnetism by Fewkes and Yarwood, Vol I.*** University Tutorial Press, 1965
3. ***Introduction to Electrodynamics by David J. Griffiths, 3rd Edition, PHI.***
4. ***Electric Circuits Joseph A. Edminister, Schaum's Outline Series.*** Tata McGraw-Hill, New Delhi 2001
5. ***Optics 3rd edition; Ajoy Ghatak;*** Tata Mcgraw Hill Publishing Co Ltd

Additional References

Berkeley Physics Course; Electricity and Magnetism, Ed. E.M. Purcell(McGraw-Hill).

Lectures on Physics volumes 2; R. P. Feynman; Addison Wesley.

PH 202 Thermal Physics and Optics

Unit I: Thermal Physics (Number of Lectures = 25)

Thermodynamic Description of system: Zeroth law and thermodynamic temperature.

First law and internal energy, conversion of heat into work, reversible and irreversible processes.
Second law and Entropy, Carnot's cycle and theorem, entropy changes in reversible and irreversible processes, Entropy – temperature diagrams and equations**,** Unattainability of absolute zero, third law of thermodynamics

Thermodynamic potentials: Enthalpy, Gibbs and Helmholtz functions, Maxwell's relations and applications , Relationship between adiabatic and isothermal elasticity,

Joule-Thomson Effect –production of low temperatures; Clausius-Clapeyron Equation

Unit II: Kinetic Theory of Gases (Number of Lectures = 10)

Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path**.**
Law of equipartition of energy and its application to specific heat of gases; monoatomic and diatomic gases
Transport Phenomena : viscosity, conduction and diffusion**.**

Unit III: Heat Transmission (Number of Lectures=5)

Modes of heat transfer, Searle's & Lee's experiment, black body radiation, Planck's law, Rayleigh Jean's Law, Wein's displacement law, Stefan-Boltzmann Law (no derivation).

Unit IV: Statistical Mechanics (Number of Lectures = 18)

Micro and Macro states, energy states, energy levels, degenerate energy levels, degenerate gas, phase space, concept of entropy and thermodynamic probability.
Classical Statistics: Maxwell-Boltzmann Distribution law, thermodynamics of an ideal monoatomic gas, Classical entropy expression, Gibb's paradox.

Quantum statistics:
Ideas of Bose Einstein statistics and Fermi Dirac Statistics

Unit V: Optics (Number of Lectures = 12)

Interference : colour of thin films, interference filters, anti-reflective coatings, Newton's rings. Fraunhofer diffraction: plane transmission grating, resolving power of grating, Fresnel's class of diffraction: half period zone, rectilinear propagation of light, zone plate.

Suggested Books for Reference

Thermodynamics and Statistical Mechanics, Greiner, Springer

Heat and Thermodynamics, Zemanskay and Dittman, Mc Graw Hill

Statistical Mechanics, R.K. Pathria, Pergamon press, Oxford

Additional Reference

1. M. W. Zemansky, Heat and Thermodynamics, McGraw Hill

3. Berkeley Physics Course Volume 5; Statistical Physics; Frederick Reif. McGraw Hill.

4. A Treatise on Heat; Saha and Srivastava, The Indian Press, Allahabad.

FOR OPTICS:

1. ***A. K. Ghatak, Optics, Tata Mc Graw Hill***
2. ***B. K. Mathur, Optics***

PH 203 PHYSICS LABORATORY-II

(Physical Sciences / Applied Physical Sciences)

203.1 Heat

1. To determine the Coefficient of Thermal Conductivity of Copper by Searle's apparatus.
2. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
3. To determine the Temperature Coefficient of Resistance (α) by Platinum Resistance Thermometer (PRT). Assume $R_t = R_0 (1 + \alpha t)$
4. To draw a calibration curve for a Thermocouple using a Potentiometer.
5. To determine Stefan's Constant.

203.2 Optics

1. To determine wavelength of sodium light using Fresnel Biprism.
2. To determine wavelength of sodium light using Newton's rings.
3. To determine the Cauchy's constant and dispersive power of a prism using mercury light.
4. To determine the wavelength of Sodium light using plane diffraction grating.
5. To study the polarization of light by reflection and to determine the polarizing angle for air-glass interface.

203.3 Electricity and Magnetism

1. To verify the Thevenin, Norton, Superposition, and maximum power transfer theorem.
2. To determine a low resistance by Carey Foster's bridge.
3. To determine the (a) current sensitivity, (b) charge sensitivity, and (c) CDR of a B.G.
4. To determine high resistance by leakage method.
5. To determine the ratio of two capacitances by De Sauty's bridge.
6. To determine self inductance of a coil by Anderson's bridge using AC.
7. To determine self inductance of a coil by Rayleigh's method.
8. To determine coefficient of Mutual inductance by absolute method**.**

Note

1. Each college should set up at least 16 practicals from the above list.
2. Each student is required to perform 12 practicals by taking at least 3 practicals from each of the three units 203.1 to 203.3.

Suggested Books for Reference

1. ***B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.***
2. ***Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.***
3. ***Nelson and Jon Ogborn, Practical Physics.***

CH 201 INORGANIC CHEMISTRY
(2 Lectures per week)

Unit I. General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Hydrometallurgy. Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process.

s- and *p*- Block Elements

Periodicity in s- and p- block elements, w.r.t. electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling, Mullikan, and Alred-Rochow scales). Allotropy in C, S, and P. Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.

Compounds of *s*- and *p*- Block Elements

Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of p- block elements. Concept of multicentre bonding (diborane). Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry.

Hydrides of nitrogen (NH_3, N_2H_4, N_3H, NH_2OH)

Oxoacids of P, S and Cl

Halides and oxohalides: PCl_3, PCl_5, $SOCl_2$ and SO_2Cl_2

Unit II. Inorganic Polymers

Comparison between inorganic and organic polymers. Synthesis, structural aspects and applications of borazine, silicates and silicones.

Unit III. Bio-Inorganic Chemistry

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones).

Unit IV. Chemical Toxicity

Toxicity of As, Cd, Pb, Hg, CO, NO_x, SO_x and H_2S, Their sources of contamination. Causes of toxicity (biochemical effects) and antidotes.

CH 202 ORGANIC CHEMISTRY
(2 Lectures per week)

Unit I. Addition reactions

Alkenes and alkynes (upto four carbon atoms): Hydrogenation, halogenation, hydrohalogenation (Markonikov's and anti-Markonikov's), hydration, hydroboration and hydroxylation. Ozonolysis of alkenes and alkynes. Reactivity of alkenes *vs.* alkynes.
Aromatic hydrocarbon (benzene): Hydrogenation, halogen addition and ozonolysis.
Aldehydes and ketones (formaldehyde, acetaldehyde and acetone): Addition reactions with sodium bisulphate, hydrogen cyanide and alcohols. Addition-elimination reactions with ammonia and its derivatives.

Unit II. Substitution reactions

Free radical substitution: Halogenation of alkanes, allylic compounds and alkyl benzenes.
Nucleophillic Substitution: Of alkyl, allyl and benzyl halides (substitution of halogen by important nucleophiles). Mechanism of SN1 and SN2.
Aryl halides: Substitution reactions of chlorobenzene by benzyne mechanism.
Benzenediazoniun chloride: substitution of diazo group.
Benzene sulphonic acid: substitution of sulphonic group.
Alcohols. phenols and amines: substitution of active hydrogen by alkyl and acyl group. Replacement of hydroxyl group of alcohols by reaction with PCl_5, $SOCl_2$ and HI.
Carboxylic acid derivatives: hydrolysis.
Ethers: Cleavage by HI.
Electrophillic substitution (aromatic compounds): General mechanism of electrophillic substitution (nitration, halogenation and sulphonation). Directive influence of substituents.

Unit III. Elimination reactions: Dehydrohalogenation of alkyl halides, dehalogenation of vic dihalides. Dehydration of alcohols. Quaternary ammonium salt (Hofmann's elimination). Mechanism of E1 and E2 reactions.

Unit IV. Oxidation reactions: Oxidation of side chain in aromatic hydrocarbons using potassium permanganate, potassium dichromate, chromium trioxide-acetic anhydride. Etard's reaction.
Oxidation of alcohols using potassium permanganate, potassium dichromate and catalytic dehydrogenation. Oxidation of 1,2-diols by periodic acid and lead tetraacetate.
Oxidation of Aldehydes and ketones: With potassium permanganate and potassium dichromate. Oxidation of aldehydes with Tollen's reagent, Fehling solution and sodium hypohalite (haloform reaction).

Unit V. Reduction reactions: Reduction of aldehydes and ketones by catalytic hydrogenation, sodium borohydride, lithium borohydride. Clemmensen and Wolff-Kishner reduction.
Reduction of carboxylic acid and derivatives with lithium borohydride, sodium borohydride, Stephen's and Rosenmund reduction.

Reduction of aromatic nitro compounds by electrolytic reduction, using reducing agents under acidic, alkaline and neutral conditions.

Unit VI. Rearrangement reactions

Rearrangement Reactions (without mechanism): Pinacol-Pinacolone, Hofmann bromamide, Beckmann, Benzidine and Fries rearrangement.

Unit VII. Reactive Methylene

Reactive methylene group, prepration of ethyl acetoacetate, tautomerism, isolation and estimation of keto and enol form in ethyl acetoacetate. Synthetic applications of ethyl acetoacetate.

Unit VIII. Reaction Mechanisms

Mechanisms of Aldol condensation, Perkin reaction, Cannizzaro's reaction, benzoin condensation, Friedal Crafts alkylation and acylation, Gattermann-Koch, Claisen conensation and Reimer-Tiemann reaction.

CH 203 PHYSICAL CHEMISTRY
(2 Lectures per week)

Unit I. States of Matter

Kinetic Theory of Gases

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal bahaviour, compressibility factor. Causes of deviation. van der Waals equation of state for real gases. Brief mention of various other equations of state of real gases (viz. the Virial equation and the Berthelot equation). Boyle temperature (deviation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO_2. Continuity of states.

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation).

Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

Liquids

Surface tension and its determination using Stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)

Unit II. Systems of Variable Composition and Solutions

Systems of Variable Composition

Partial molar quantities and their physical significance. Chemical potential, variation of chemical potential with temperature and pressure

Solutions

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Concept of activity and activity coefficient. Vapor pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes, Partial miscibility of liquids. Critical solution temperature. Immiscibility of liquids. Principle of steam distillation. Nernst distribution law and its application, solvent extraction.

Colligative Properties of Dilute Solutions

Thermodynamics of dilute solutions : thermodynamic derivations (from chemical potential) of the expressions in terms of molailty for the elevation in boiling point, depression in frezzing point and osmotic pressures of a dilute ideal solution. Relationship between different colligative properties. Determination of molar masses of non-volatile solutes (non-electrolytes). Colligative properties of electrolytic solutions, van't Hoff factor and its applications.

Unit III. Chemical Equilibrium and Phase Equilibrium

Chemical Equilibrium

Thermodynamic derivation of the law of chemical equilibrium, van't Hoff reaction isotherm $\Delta G^{\circ} = -RT \ln K$. Distinction between ΔG and ΔG°, Le Chatelier's principle (Qualitative treatment only). Thermodynamic treatment of temperature dependence of equilibrium constant – van't Hoff equation. Calculation of equilibrium constants from thermodynamic measurements.

Phase Equilibrium

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule ($F=C-P+2$) its thermodynamic derivation, Derivation of Clausius – Clayperon equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two-component systems (lead-silver, $FeCl_3 - H_2O$ and Fe-C only) involving eutectics, congruent and incongruent melting points.

Unit IV. Conductance and Electrochemical Cells

Recapitulation of : conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions. Concept of EMF of a cell. Nernst equation.

Transference number and its experimental determination using Hittorf and Moving boundary methods, Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base).

Reversible and irreversible cells. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data.

Concentration cells with transference and without transference. Liquid junction potential and salt bridge. pH determination using hydrogen electrode and quinhydrone electrode. Potentiometric titrations - qualitative treatment (acid-base and oxidation-reduction only).

CH 204 CHEMISTRY LABORATORY

No. of periods per week – 6

Note: Practical examination will include three exercises – one each out of the following physical, organic and inorganic chemistry experiments. The duration of the examination shall be 6 hours. Different student should be given different exercises. The exercises should be chosen so as to justify time available for the examination.

Physical Chemistry

1. Determination of critical solution temperature for phenol-water system and study effect of impurities.
2. Construction of a phase diagram of a binary system (urea-benzoic acid) by cooling curves method.
3. Determination of surface tension of a liquid using a Stalagmometer.
4. Determination of relative and absolute viscosities of a liquid using Ostwald Viscometer.
5. Determination of cell constant.
6. Determination of equivalent conductance of a strong electrolyte (KCl) and weak electrolyte (acetic acid) at different concentrations.
7. Determination of the strength of the given HCl solution by titrating against NaOH solution (a) conductometrically and (b) potentiometrically.
8. Determination of strength of the given potassium dichromate solution by potentiometric titration with Mohr's salt solution.

OrganicChemistry

9. Preparation of the following compounds:
   a) Carboxylic acids by alkaline hydrolysis of an ester/amide
   b) Benzoyal derivatives of amines and phenols
   c) m-Dinitrobenzene from nitrobenzene
   d) Osazone of glucose/fructose
   e) Oxidation of alcohols, aldehydes and hydrocarbons to carboxylic acids
   f) Oximes and 2,4 dinitrophenylhydrazones of aldehydes and ketones
   g) Amides and anilides of carboxylic acids
10. Carry out following transformations using biocatalysts:
   a) Fermentation of sucrose with yeast and lab test of the alcohol so formed (Iodoform Test)
   b) Hydrolysis of an ester

InorganicChemistry

11. Semi-micro qualitative analysis using H_2S of mixtures not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:
   NH_4^+, Pb^{2+}, Ag^+, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sn^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+, CO_3^{2-}, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-,

SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$, F^-
(*Spot tests should be carried out wherever feasible.*)

12. Preparation of any two of the following complexes and measurement of their conductivity:
    (i) tetraamminecarbonatocobalt (III) nitrate
    (ii) tetraamminecopper (II) sulphate
    (iii) potassium trioxalatoferrate (III) trihydrate
    Compare the conductance of the complexes with that of M/1000 solution of NaCl, $MgCl_2$ and $LiCl_3$.

Suggested Readings:

1. *J.D.Lee : A New Concise Inorganic Chemistry*, E.L.B.S.
2. F.A.Cotton & G. Wilkinson : *Basic Inorganic Chemistry*, John Wiley.
3. T.W.Graham Solomons : *Organic Chemistry*, John Wiley and Sons.
4. Peter Sykes : *A Guide Book to Reaction Mechanism in Organic Chemistry*, Orient Longman.
5. P.W.Atkins : *Physical Chemistry*, Oxford University Press.
6. G.W.Castellan: *Physical Chemistry*, Narosa Publishing Hou
7. James E. Huheey, Ellen Keiter and Richard Keitner, *Inorganic Chemistry : Principles of Structure and Reactivity*, Pearson Publication.
8. D.F.Shriver and P.W.Atkins : *Inorganic Chemistry*, Oxford University Press.
9. G.L.Miessler and Donald A. Tarr, *Inorganic Chemistry*, Pearson Publication.
10. Gary Wulfsberg : *Inorganic Chemistry*, Viva Books Pvt. Ltd.
11. F.A.Carey: *Organic Chemistry*, Tata McGraw Hill.
12. I.L.Finar, *Organic Chemistry* (Vols. I & II), E.L.B.S.
13. Jerry March , *Advanced Organic Chemistry*, John Wiley and Sons.
14. R.T.Morrison & R.N.Boyd : *Organic Chemistry*, Prentice Hall.

LS 201 BIODIVERSITY-I

Unit I Classification of living organisms

Three domain, 6 kingdom, general characteristics, diversity of structure, organization, reproduction and nutrition, understanding the diversity from an evolutionary perspective from prokaryotes to higher plants. (Ch 29 Raven)

Unit II Viruses

Nature, general account of structure and reproduction, methods of culture, common viral diseases. (Ch 26 Raven)

Unit III Prokaryotes

Archaea and eubacteria, general account of cell structure, types of bacteria, characteristics, reproduction, comparative study of *E.coli* and *Nostoc,* role of free living soil bacteria and symbiotic bacteria in nitrogen fixation, bacterial diseases. (Ch 27 Raven)

Unit IV Protists

Autotrophic forms, Algae, classification, characteristic features of different groups in terms of vegetative and reproductive structures with reference to *Oedogonium, Vaucheria,, Polysiphonium, Fucus* (Ch 17Raven, Biology of plants)

Unit V Fungi

Classification, characteristic features of different groups in terms of their diversity of form, structure, reproduction (with reference to *Rhizopus*, *Neurospora* and *Agaricus*), general account of lichens; brief account of common fungal diseases in plants and animals. (Ch 20 Mauseth)

Unit VI Bryophytes and Pteridophytes

Classification , characteristic features of different groups in terms of vegetative and reproductive structures with reference to *Marchantia, Funaria , Selaginella* and *Pteris*. (Ch 22, 23, Mauseth)

Unit VII Gymnosperms

Vegetative and reproductive structures in different groups using examples of *Cycas and Pinus* (Ch 24, Mauseth)

Unit VIII Angiosperms

Characteristics, economic importance, classification into monocots and dicots, structure, variation in types of inflorescence and flowers, initiation and differentiation of floral organs, structure and development of anther, microsporogenesis, pollen development, male sterility, structure and development of ovule, megasporogenesis, embryo sac, fertilization, pollination, pollen pistil interactions, self-incompatibility, double fertilization, types of embryos, functions, types and functions of endosperm, polyembryony and apomixes. (Ch 25 Mauseth)

Angiosperm taxonomy with special reference to Bentham and Hooker and Takhtajan systems; modern methods in plant taxonomy.(Chapter 12, G.Singh)

Readings:

- Raven P.H.et al. (2006) Biology 7th edition Tata Mc Graw Hill Publishers, New Delhi.
- Singh, G (2004) Plant Systematics: Theory and Practice 2nd edition Oxford and IBH Publishing Co. Delhi
- Mauseth, James.D (2003) Botany: An introduction to plant biology. 3rd edition Jones and Barlett Publishers.
- Raven, P.H etal (2005) Biology of plants 7th edition W.H Freeman and Co.

LS 202 BIODIVERSITY II

Unit I Protista

Heterotrophic forms, diversity, habitat, structure, nutrition, general characters, locomotion, reproduction, characteristics of Oomycetes *(Albugo),* Myxomycetes and Protozoa. (Ch 28, Raven)

Unit II Parazoa

Phylum: Porifera
Skeleton, canal system. (Ch 5 Barnes)

Unit III Radiata

Phylum: Cnidaria
Metagenesis, polymorphism, corals and coral reefs.(Ch 7 Barnes)

Unit IV Acoelomates

Phylum: Platyhelminthes
Parasitic adaptations. (Ch 10 Barnes)

Unit V Pseudocoelomates

Phylum: Nemathelminthes
Parasitic adaptations. (Ch 11 Barnes)

Unit VI Coelomate Deutrostomes

Phylum: Mollusca
Torsion and detorsion, shell, respiration. (Ch 12 Barnes)
Phylum: Annelida
Coelom, metamerism, excretion. (Ch 13 Barnes)
Phylum: Arthropoda
Vision, respiration. (Ch 16 Barnes)

Unit VII Coelomate Protostomes

Phylum: Echinodermata
Water vascular system, larval forms. (Ch 28 Barnes)

Unit VIII Invertebrate Chordata

Salient features, affinities.

Unit IX Vertebrate:**Pisces**

Respiration, osmoregulation, migration of fishes.

Unit X Amphibia

Respiration, parental care

Unit XI Reptilia (The first Amniotes)

Terrestrial adaptation

Unit XII Aves
Respiration, flight adaptations

Unit XIII Mammalia
Integument(structure and derivatives), dentition
(Unit VII, VIII, IX, X, XI, XII Marsh and Williams)

Suggested Readings-

- Barnes, R.D. (2001). *Invertebrate Zoology*. Saunders College Publishers, USA.
- Raven, P. H. et al (2006) Biology 7th edition, Tata McGraw Hill Publications. New Delhi.
- Marshall, A.J and Williams, W.D Textbook of Zoology: Vertebrates AITBS publishers

LS 203 CELL BIOLOGY, BIOCHEMISTRY and IMMUNOLOGY

Unit I- Overview of cells and tools of cell biology
Origin and Evolution of cells, subcellular fractionation, plant and animal cell culture, chromatography, electrophoresis, radioisotopic techniques. (Ch 1 Cooper and Hausman, Ch 12, 13, 14 Sheeler)

Unit II- Cell Organelles
Structure and function of cell organelles: mitochondria, chloroplast, golgi apparatus, lysosomes and microbodies (Ch 9, 10 Campbell, Ch 16, 17, 18,19 Sheeler)

Unit III- Enzymes
Reaction kinetics, kinetics of enzyme action, Michaelis-Menton equation, mechanism of enzyme catalysis, regulation of enzyme activity, inhibition. (Ch 5 Horton)

Unit IV- Metabolism
Introduction to metabolism and bioenergetics, carbohydrate metabolism, glycolysis, pentose phosphate pathway, gluconeogenesis, lipid metabolism, nitrogen metabolism .
(Ch 8 Campbell, Ch 10 Sheeler)

Unit V- Immune system
Body's defence mechanisms, Immune response, cells of specific immune system, T and B cells, Components of Immunity, innate immunity, acquired immunity, humoral and cell mediated immune response, allergies, autoimmune and immunodeficiency diseases.
(Ch 43 Campbell)

Readings:

- Sheeler, P and Bianchi, D.E (2006) Cell and Molecular Biology 3rd edition John Wiley & sons, Inc, NY
- Horton, H.R. et al (2006) Principles of Biochemistry 4th edition Pearson Prentice Hall NJ
- Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition Pearson Benjamin Cummings, San Francisco.
- Raven, P.H et al (2005) Biology of plants W.H Freeman and Co.

LS 204 GENETICS AND MOLECULAR BIOLOGY

Unit I Heredity

Mendelian basis of inheritance, predicting mendelian ratios, pedigree analysis, sex determination and sex linked inheritance, cytoplasmic inheritance, gene concept, gene interactions ,modified dihybrid ratios, lethal alleles, complementation, epistasis. (Ch 2, 6 Griffiths)

Unit II Genetic material and its organization

DNA/RNA as the genetic material, Watson & Crick model, chromatin organization and packaging in eukaryotic chromosomes, chromosome theory of heredity, chromosome morphology, special types of chromosomes. (Ch 3, 7 Griffiths)

Unit III Variation in chromosome number and structure

Euploidy, polyploidy, aneuploidy in plants and animals, chromosomal aberrations, deletion, duplication, inversion, translocation. (Ch 15 Griffiths)

Unit IV Linkage and Crossing over

Linkage, recombination and crossing over. (Ch 4 Griffiths)

Unit V Mutation

Types of mutation- point and spontaneous mutations, induced mutations
(Ch 14 Griffiths)

Unit VI DNA replication

Concept of semi-conservative replication, mechanisms of DNA replication in prokaryotes and eukaryotes. (Ch 7 Griffiths)

Unit VII Transfer of genetic information in pro- and eukaryotes

Transcription, types of RNA, role of RNA polymerases, initiation, elongation and termination of transcription, post transcriptional modifications. Translation, post translational modifications, features and deciphering of genetic code. (Ch 8, 9 Griffiths)

Unit VIII Regulation of gene expression

Prokaryotic inducible and repressible systems, positive and negative controls, regulation of gene expression in eukaryotes. (Ch 10 Griffiths)

Readings:

Griffiths, A.J.F et al (2005) 8th edition Introduction to Genetic Analysis W.H. Freeman & Co. NY.

LS 205 LAB

Biodiversity I

Viruses – EM/Models of TMV, bacteriophage and HIV.

Bacteria – Study of bacteria through permanent slides/photographs. Study of bacteria infested plant specimens (crown gall/root nodules/citrus canker). Study of *Nostoc* (w.m. and permanent slides)

Comparative study of the following using temporary preparations and permanent slides:

Body structure : *Oedogonium, Vaucheria*, *Rhizopus, Penicilium/Neurospora, Lichens, Marchantia, Funaria , Selaginella*, *Pteris, Cycas and Pinus.*.

Absorbing and / or anchoring system: Oedogonium holdfast, *Rhizopus* rhizoids, *Marchantia* unicellular rhizoids (two types), *Funaria* branched/ multicellular rhizoids, *Selaginella* rhizophore, dicot and monocot roots

Assimilation (photosynthetic) system: Chloroplasts in *Chlamydomonas, Hydrilla,* photosynthetic lamellae in blue green algae, photosynthetic layer in *Marchantia,* leaves of *Funaria, Pteris, Pinus,* monocot and dicots.

Conducting system: *Marchantia* tuberculate rhizoids for exoconduction, *Funaria,* hydroids and leptoids, *Psilotum* stelar structure, *Selaginella* polystele, Fern dictyostele, Dicot stem macerated tissue to show tracheids, vessels and phloem

Supporting tissue: *Chara* silicified cells, *Marchantia* scales, *Funaria* hypodermis, *Selaginella, Pteris* and *Pinus* sclerenchyma and lignified cells.

Vegetative and/or asexual reproduction: *Volvox* daughter cells, *Penicillium* conidia, *Marchantia* gemmae, *Cycas* bulbuls, Potato tuber.

Sexual reproduction: *Spirogyra* and *Rhizopus* conjugation, *Funaria* antheridia and archegonia, *Pteris* prothallus, *Pinus* male and female cone, *Hibiscus* androecium and gynoecium

Study of floral characters of the following families for their identification according to the Bentham and Hooker's system of classification.

Solanaceae: *Withania/Solanum*

Lamiaceae*: Salvia/Ocimum*

Asteraceae*: Helianthus/Calendula*

Poaceae: Wheat/Rice

Study of Anther, Ovule and embryo, Young and mature anther(permanent slide),mature embryo sac (permanent slide).

Pollen germination using hanging drop culture.

Dissection of developing seeds for studying embryos.

LS 205 Biodiversity II

1. Study of the following groups with representative example (examples given are only suggestive)

Protista:

Myxomycetes – *Stemonitis/Physarum,* Oomycetes – *Albugo,* Amoeboid – *Entamoeba,* Ciliate- *Balantidium,* Flagellate- *Trypanosoma,* Sporozoa –*Plasmodium*

Porifera

Marine with Spicules- *Sycon,* Fresh water with Spongin -*Spongilla*

Cnidaria

Hydrozoa –*Physalia,* Scyphozoa –*Aurelia,* Anthozoa -*Tubipora*

Helminthes

Platyhelminthes –*Taenia,* Nematahelminthes- *Ascaris*

Annelida

With Parapodia –*Aphrodite,* With Suckers- *Hirudinaria*

Arthropoda

Crustacean- Hermit crab, Arachnid –Spider, Insect -Dragon fly

Mollusca

With external Shell –*Chiton,* With internal Shell –*Sepia,* Without shell -*Octopus*

Echinodermata

Free swimming forms –*Asterias,* Sedentary form- *Antedon*

Protochordata- *Amphioxus*

Fish

Cartilagenous- *Pristis and Electric Ray,* Bony- *Labeo*

Amphibia

Aquatic- *Salamandra,* Burrowing- *Uraeotyplus,* Terrestrial- *Bufo*

Reptilia

Ophidia –*Naja,* Squamata –*Hemidactylus,* Crocodilia -Crocodile

Aves

Flying –Crow, Flightless -Ostrich

Mammals

Aerial –Bat, Arboreal –Lemurs, Aquatic –Dolphin, Terrestrial - Horse

Burrowing –Shrew

2. Make temporary mounts of

Protists from pond water, regeneration of hydra, spicules of sponges, taenia from intestine of rat, radula of pila, mouth parts of cockroach, Aristotle lantern from star fish, placoid scales of Scoliodon, hyoid apparatus of frog, pecten of fowl, ear ossicles of rat.

3. Comparative study of disarticulated skeleton of the following

Fish (lakes), Amphibia (frog), Reptile (Varanus), Aves (fowl) and Mammals (rabbit)

LS 206 LAB

Cell Biology, Biochemistry and Immunology

1. Study the effect of temperature, organic solvent on semi permeable membrane.
2. Demonstration of dialysis.
3. Study of plasmolysis and deplasmolysis.
4. Cell fractionation and determination of enzyme activity in organelles using sprouted moong (or any suitable source source).
5. Effect of pH, temperature on the activity of salivary amylase enzyme activity.
6. To determine ABO blood group and Rh-factor.
7. Isolation, staining and counting of mononuclear cells from peripheral blood.
8. To perform ouchterlony double diffusion assay.
9. To demonstration of primary and secondary immune organs in rat.
10. To study activity of enzyme pancreatic trypsin under optimum conditions.
11. To separate serum from blood.

Molecular Biology and Genetics

1. Study of monohybrid and dihybrid crosses in *Drosophila*.
2. Study of polytene chromosomes through temporary preparations.
3. Study of recombination in *Neurospora.*
4. Study of the karyotype and idiogram by photographs
5. Permanent slides of salivary glands and lampbrush chromosomes, laggards, multivalents and bridges.
6. Study of sex chromosomes, banding patterns, aneuploids and inherited characters through photographs and slides.
7. Effect of chemical mutagens on the growth of *E. coli.*
8. To conduct Ames test for screening substances for mutagenicity.
9. Separation of single and double stranded DNA.
10. Screening for natural drug resistance in *E. coli*.

MA 201 CALCULUS AND GEOMETRY

Unit 1:Geometry of complex numbers and polynomial equations 25

Geometrical representation of addition, subtraction, multiplication and division of complex numbers. Lines half planes, circles, discs in terms of complex variables. Statement of the Fundamental Theorem of Algebra and its consequences, relation between roots and coefficients for polynomial equation. Results about occurrence of repeated roots, rational roots, surd roots and complex roots. De Moiver's theorem for rational indices and its simple applications.

Unit II: Calculus 60

Limit and continuity of a function: (ε, δ) and sequential approach. Properties of continuous functions including intermediate value theorem. Differentiability. Darboux's theorem, Rolle's theorem, Lagrange's mean value theorem, Cauchy mean value theorem with geometrical interpretations. Uniform continuity.

Definitions and techniques for finding asymptotes singular points, concavity, convexity, points of inflexion for functions. Tracing of standard curves.

Integration of irrational functions. Reduction formulae. Rectification. Quadrature. Volumes Surface of revolution.

Unit III: Geometry and Vector Calculus 27

Techniques for sketching parabola, ellipse and hyperbola. Reflection properties of parabola, ellipse and hyperbola. Classification of quadratic equations representing lines, parabola, ellipse and hyperbola.

Differentiation of vector valued functions, gradient, divergence, curl and their geometrical interpretation.

Recommended Books

1. H. Anton, I. Bivens and S. Davis: Calculus, John Wiley and Sons (Asia) Pte. Ltd. 2002.
2. R. G. Bartle and D. R. Sherbert : Introduction to Real Analysis, John Wiley and Sons (Asia) Pte, Ltd; 1982
3. A.I. Kostrikin: Introduction to Algebra, Springer Verlag, 1984.

Further Reference

1. K.A. Ross: Elementary Analysis- the Theory of Calculus Series- Undergraduate Texts in Mathematics, Springer Verlag, 2003
2. G.B. Thomas and R. L. Finney: Calculus and Analytic Geometry, Pearson Education (Singapose), 2001.
3. S. L. Salsa, E. Hille and G.J. Etgen: Calculus of One and Several Variables, John Wiley & Sons, Inc., 1999.

MA 202 ALGEBRA AND DIFFERNTIAL EQUATIONS

Unit I: Groups, Rings and Vector spaces **45**

Groups : Definition and examples of groups, examples of abelian and non-abelian groups: the group Z_n of integers under addition modulo n and the group U (n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, the general linear group GLn (n. R), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, groups of transformations in a plane, the permutation group Sym (n), Group of quaternions.

Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Euler and Fermat's theorem, order of HK where H and K are subgroups. Normal subgroups: their definition, examples, and characterizations, Quotient groups.

Unit II : Ordinary Differential Equations **45**

First order exact differential equations. Integrating factors, rules to find an integating factor. First order higher degree equations solvable for x,y,p=dy/dx. Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order. Linear homogenous equations with constant coefficients. Linear non-homogenous equations. The method of variation of parameters, The Cauchy-Euler equation. Simultaneous differential equations, total differential equations.

Applications of differential equations: the vibrations of a mass on a spring, mixture problem, free damped motion, forced motion, resonance phenomena, electric circuit problem, mechanics of simultaneous differential equations.

Unit III : Partial Differential Equations **22**

Order and degree of partial differential equations. Concept of linear and non-linear partial differential equations. Formation of first order partial differential equations. Linear partial differential equation of first order, Lagrange's method, Charpit's method (without proof). Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

Recommended Books

1. Joseph A Gallian: Contemporary Abstract Algebra, fourth edition, Narosa, 1999.
2. George E Andrews: Number Theory, Hindustan Publishing Corporation. 1984 (Only sections 1-3 of chapter 12)
3. Shepley L. Ross: Differential equations, Third edition, John Wiley and Sons, 1984
4. I. Sneddon: elements of partial differential equations, McGraw-Hill, International Edition, 1967.

MP 201 MATHEMATICS - 1

Unit I: Geometry and vector Calculus (35 L) 38

Techniques for sketching parabola, ellipse and hyperbola, Reflection properties of parabola, ellipse and hyperbola. Classification of quadratic equations representing lines, parabola, ellipse and hyperbola.

Vector-viewed geometrically vectors in coordinate system, vectors determine by length and angle, dot product, cross product and their geometrical properties.

Differentiation of vector valued functions, gradient, divergence, curl and their geometrical interpretation.

Unit II: Calculus (45 L) 58

Defination and techniques for finding asymptotes singular points, concavity, convexity, points of inflexion for functions. Tracing of standard curves.

Integration of irrational functions. Reduction formulae. Rectification. Quadrature. Volumes and Surfaces of revolution.

Limit and continuity of a function: (ε,δ) and sequential approach. Properties of continuous functions including intermediate value theorem. Uniform continuity. Differentiability. Darboux's theorem(without proof), Rolle's theorem. Lagrange's mean value theorem, Cauchy mean value theorem with geometrical interpretations.

Unit III: Geometry of complex numbers and polynomial equations (16 L) 16

Geometrical representation of algebraic operations on complex numbers. Section formula, Centroid, Incentre, orthocenter and Circumcentre of a triangle in complex form. Lines, half planes, circles, discs in term of complex variables. Statement of the Fundamental theorem of Algebra and its consequences. Relation between roots and coefficients for a polynomial equation. Results about occurrence of repeated roots, rational roots, surd roots and complex roots. De Moivre's theorem for rational indices and its simple applications.

Recommended Readings

1. H. Anton. I. Bivens and S. Davis, Calculus, John Wiley and Sons Pvt. Ltd. 2002.
2. Frank Ayres, Jr. & Elliott Mandelson, Calculus, Fourth Edition, Tata McGraw Hill, 2005.

3. E.Fischer, Intermediate Real Analysis, Springer Verlag, 1983.
4. A. I. Kostrikin: Introduction to Algebra, Springer Verlag, 1984.
5. K.A.Ross, Elementary Analysis – The Theory of Calculus Series-Undergraduate Texts in Mathematics, Springer Verlag, 2003.
6. S. L. Salsa, E. Hille and G.J. Etgen: Calculus of One and Several Variables, John Wiley & Sons, Inc., 1999.
7. Murray R. Spiegel, Vector Analysis, Tata McGraw Hill, 2005.
8. G.B. Thomas and R. L. Finney: Calculus and Analytic Geometry, Pearson Education (Singapore), 2001.

IIIRD YEAR

PH-301 PHYSICS OF MATERIALS AND ELECTRONICS

(Physical Sciences / Applied Physical Sciences)

Unit I: Physics of Materials (Number of Lectures = 35)

Solids :- Amorphous and Crystalline Materials. Lattice translation vectors. Unit Cell. Reciprocal Lattice. Crystal diffraction: Bragg's law. X-rays Diffraction of crystals.

Lattice vibrations. Linear monoatomic and diatomic chains. Acoustical and optical phonos. Qualitative description of the phonon spctrum in solid. Brillouin zones.

Dielectric Properties of Matter:- Electric susceptibility, polarizability, Clausius-Mosotti equation, Classical theory of electronic polarizability.

Magnetic Properties of Matter:- Diamagnetic, paramagnetic, ferrimagnetic, and ferromagnetic materials. Classical Langevin theory of dia- and paramagnetic materials. Curie's law. BH curve. Hysterisis, and energy loss.

Superconductivity :- Experimental results. Critical temperature. Critical magnetic field. Meissner effect. Type-I and Type-II superconductors

Elementary Band Theory of Solids. Energy band diagram in conductor, insulator & semiconductor. Hall Effect and resistivity.

Unit II: Electronics (Number of Lectures = 35)

Theory and Physics of Semi conductor, p-n junction power supply : **(1)** Half-wave rectifiers., Centre-tapped and bridge full-wave rectifiers Calculation of ripple factor and rectification efficiency. Qualitative idea of C, L and π-filters. Zener Diode Regulation. **(2)** Series and parallel Clippers. **(3)** Clampers.

Bipolar Junction transistors:- npn and pnp transistors. Characteristics of CB, CE and CC configurations. Current gains α, β and γ and relations between them. Load line analysis of transistors. DC Load line and Q-point. Active, cut-off and saturation regions. Transistor biasing and Stabilization, Fixed Bias, Voltage divider bias. Class A, B, and C amplifiers. RC-Coupled amplifiers and its frequency response of voltage gain, push pull amplifier.

Feedback in Amplifiers :- Positive and negative feedback.

Sinusoidal Oscillators :- Barkhauson's criterion for self-sustained oscillations. RC phase shift oscillator, Determination of frequency. Hartley oscillator. Colpitt's Oscillator.

UJT and FETs :- Chararacteristics of UJT JFET characteristics and its advantages, MOSFET (Qualtiative Discussion only).

Filters:- Idea about (i) Low Pass , (ii) High Pass , and (iii) Band pass filters and plots of their Filter Transfer functions. Circuit realization of Low Pass and High Pass filters using Passive Elements. First order passive and active filters.

Modulation and demodulation:- Types of modulation. Amplitude Modulation. Modulation Index. Analysis of amplitude modulated wave. Sideband frequencies in AM wave. CE amplitude modulator. Demodulation of AM wave using Diode Detector. Idea of frequency, phase, and digital modulation.

Suggested books for Reference

1. ***Introduction to Solid State Physics 7th edition; Charles Kittel; John Wiley and Sons.***
2. ***Elementary Solid State Physics ; Dekker, Pearson.***
3. ***R. Boylestad, L. Nashelsky, Electronic Devices and Circuit Theory, P H I***
4. ***A. P. Malvino, Electronic Principles. Tata McGraw Hill.***

Additional References

a. ***Introduction to Condensed matter physics K. C. Barua; Narosa.*** **ISBN:** 978-81-7319-762-8
b. ***Elements of Solid State Physics J P Srivastava; PHI***

PH-302 MODERN PHYSICS

(Physical Sciences / Applied Physical Sciences)

Unit I: Quantum Mechanics (Number of Lectures = 24)

Recapitulation of inadequacies of Classical Mechanics. Compton's effect.

Wave-particle duality, de Broglie waves, Davisson and Germer's experiment.
Group and Phase velocities and relation between them.

Wave Packets. Heisenberg's uncertainty principle: Derivation from wave-packets,
γ-ray microscope experiment, Electron two-slit experiment.
Wave function

Schrodinger wave equation for a free particle and in a force field (1 dim).

Boundary and continuity conditions. Operators in Quantum Mechanics,
Conservation of probability, Normalization condition, Expectation values (definition only).

Time-independent one dimensional Schrödinger wave equation, Stationary states.

Applications of Schrödinger wave equation:-
(1) Recapitulation of Particle in a box (1 dimensional case),
(2) Step potential
(3) Rectangular Potential barrier and tunnel effect.

Applications of tunneling (qualitative description only): alpha decay, tunnel diode,
scanning tunnel microscope, Atomic Force Microscope.

Unit II: Atomic Physics (Number of Lectures = 10)

Atoms in electric and magnetic fields:- Electron spin, Spin and Orbital angular momentum, Space quantization and Larmor's theorem, Stern-Gerlach experiment, Magnetic moment of the atom, Gyromagnetic ratio and Bohr Magneton.

Atoms in external magnetic fields:- Zeeman effect (Normal and Anomalous)

Many electron atoms:- Pauli's exclusion principle. Symmetric and Antisymmetric wave functions Atomic Shell Model. Periodic table.

Spin orbit coupling. Fine structure.

Unit III: Lasers (Number of Lectures = 6)

Principle of Lasers. Properties of Lasers. Einstein's A and B coefficients. Spontaneous and induced emission. Optical pumping and population inversion. Principle of three-level and four-level lasers. Working of He-Ne Gas laser with rate equations.

Laser Applications (qualitative only): Information storage, Bar Code Scanner, Laser welding and Hole Drilling, Laser Cutting, Laser Tracking , LIDAR, Laser in Medicine.

Unit IV: Nuclear Physics (Number of Lectures = 15)

Structure of nuclei:- Basic properties of nuclei: (i) Mass, (ii) Size (radii), (iii) Charge, (iv) Spin, Electric and Magnetic Moments.(v) Stable and Unstable Nuclei, α-decay: Geiger-Nuttal law, β-decay: energy spectra and neutrino hypothesis. γ-decay: Nuclear Isomerism and Internal conversion.
Binding Energy.

Nuclear cross section, Reaction rate. Nuclear Reactions (Direct and Compound nucleus formation), Q value.

Application of principle of Nuclear Fusion in Tokamak.

Applications of Nuclear Interactions:- (brief explanation)
Application of Nuclear Science in Medicine, Archeology, Art, Crime Detection, Mining and Oil, Search for New Elements.
Industrial Uses: (Tracing, Gauging, Material Modification, Sterlization, Food preservation), Rutherford backscattering, Particle Induced X-ray emission, Accelerator Mass Spectrometry.

Unit V: Particle Physics (Number of Lectures = 5)

Elementary particles, their properties and classification, Leptons and Hadrons (Mesons, Baryons). Exact conservation laws and Symmetry (qualitative only). Fundamental interactions, Approximate conservation laws (qualitative only). Quarks: Color and Flavour. Idea of Standard Model.

Unit VI: Atmospheric Physics (Number of Lectures = 10)

General structure of atmosphere-Hydrostatic and diffusive equilibrium, Vertical variation of physical parameters like temperature, wind, relative humidity, Stability in the different layers of atmosphere, absorption of solar radiation, Atmospheric Ozone, Ozone loss, Tropospheric ozone, Ozone depletion problem. Global warming. Aerosols, sources and classification of aerosols

Suggested books for reference:

1. ***Arthur Beiser, Concepts of Modern Physics, 5th Edition, McGraw-Hill, Inc.***
2. ***H. S. Mani and G. K. Mehta, Introduction to Modern Physics, Affiliated East-West Press.***
3. ***A. Ghatak and S. Lokanathan, Quantum Mechanics. Kluwer Academic Pub.***

4. ***For applications of Nuclear Science: S.T. Thornton & A. Rex, Physics for Scientists and Engineers, (Art. 13.7), Third edition, Thomson Brooks/ Cole.***
5. ***Industrial and analytical applications of Nuclear Physics: J. Lilley, Nuclear Physics Principles and Applications, (Chapter 8, 9) John Wiley & Sons Ltd.***
6. ***For Applications of Lasers: A. Ghatak and K. Thyagarajan, Fiber Optics and Lasers.*** Macmillan India, 2006
7. ***Theory & problems of Modern Phys., Gautreau & William, Schaum outline series, Tata McGraw-Hill***
8. ***The Physics of Atmosphere: John T. Houghton (Cambridge University Press)***

<u>Additional References</u>

1 Modern Physics Kenneth Krane; John Wiley.

2 Modern Physics for scientists and Engineers; StephenThornton; SBN-10: 0534417817, Brooks/Cole (Cengage).

3 Concepts in Space Science, R.R. Daniel, University Press

4 Introduction to plasma physics and controlled fusion, Franis F. Chen, Springer

5 Integrated electronics, Millman Halkias, Tata McGraw-Hill

6 Principle of fundamental electronics, John D. Ryder, Prentice-Hall of India

7 Introduction to Solid State Physics, Charles Kittel, John Wiley & Sons

PH 303 PHYSICS LABORATORY-III

(Physical Sciences / Applied Physical Sciences)

303.1 General

1. To determine e/m of electron by Bar Magnet or by Magnetic Focusing.
2. To determine the wavelengths of Hydrogen spectrum and hence to determine the value of Rydberg's Constant.
3. To draw the BH curve of iron by using a Solenoid and to determine the energy loss due to Hysteresis.
4. To study the PE Hysteresis loop of a Ferroelectric Crystal.
5. To determine the Hall Coefficient and the Hall angle of a Semiconductor.
6. To study the Resistivity of a Ge Crystal with temperature by Four-Probe Method and hence to determine the Band Gap E_g for it.

303.2 Optics

1. To determine the Wavelength and the Velocity of Ultrasonic Waves in a liquid (kerosene oil, xylene, etc.) by studying the Diffraction of light through an Ultrasonic Grating.
2. To determine the Specific Rotation of cane sugar using Polarimeter.
3. To analyze Elliptically Polarized Light.
4. To determine the Wavelength and the Angular Spread of a He-Ne laser.

303.3 Electronics

1. T- π network conversion.
2. To study (i) Half-wave Rectifier and (ii) Full-wave Bridge Rectifier and investigate the effect of C, L and π filters.
3. Study of diode as clipping and clamping device.
4. To design a CE Amplifier of a given gain (mid-gain) using voltage divider bias.
5. To design an Oscillator of given specifications using transistors.
6. To study Amplitude Modulation and Demodulation.
7. Study of FET characteristics.
8. Study of UJT characteristics and relaxation oscillator.

303.4 Project

1. The students should do one Project of 20 Marks.
2. The topic of the project can be from Physics, Electronics, or Computers.
3. Computer software or hardware can be used for the project.

Note

1. Each college should set up at least 14 practicals from the above list.
2. Each student is required to perform 10 practicals by taking at least 3 practicals from each of the units 303.1 to 303.3.
3. The students should be encouraged to do electronics practicals by using Breadboard or software like PSpice wherever possible.

Suggested books for references:

1. ***Nelson and Jon Ogborn, Practical Physics.***
2. ***Worsnop and Flint: Advanced Practical Physics***
3. ***Paul B. Zbar and Albert B. Malvino, Basic Electronics (A Text-Lab Manual), Tata McGraw Hill.***
4. ***A. P. Malvino, Electronics.***

CH 301 INORGANIC CHEMISTRY
(2 Lectures per week)

Unit I. Transition Elements and Coordination Chemistry

Transition Elements (3d series)

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.

Lanthanoides and actinoides: Electronic configurations. Oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanoides (ion-exchange method only).

Chemistry of 3d metals

Oxidation states displayed by Cr, Fe, Co, Ni and Co, A study of the following compounds (including preparation and important properties).

Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, $K_3[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

Coordination Chemistry

Valency Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT.

IUPAC system of Nomenclature.

Unit II. Crystal Field Theory

Crystal field effect. Octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of **Δ**. Spectrochemical series. Comparison of CFSE for O_h and T_d complexes. Tetragonal distortion of octahedral geometry. Jahn-Teller distortion. Square planar coordination.

Unit III. Organometallic Compounds

Definition and classification with appropriate examples based on nature of metal-carbon bond (ionic, σ, л and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. л – acceptor behaviour of carbon monoxide. Synergic effects (VB approach). (MO diagram of CO can be referred to. For synergic effect refer to ir frequencies.)

CH 302 ORGANIC CHEMISTRY
(2 Lectures per week)

Unit I. Polymers

Definition of monomers and polymers. Classification of polymers. Different types of processes for polymerization and their mechanisms (ionic, free radical and Ziegler-Natta catalyst). Preparation and uses of some polymers viz., nylons, polyesters, polyvinyl chloride, Teflon, Bakelite, urea and melamine-formaldehyde resins. Natural rubber (isolation, structure and vulcanization). Synthetic elastomers – buna S, butyl rubber and polyurethane. Development of biodegradable polymers viz., polylactic acid and polyhydroxybutyric acid.

Unit II. Polynuclear and heteronuclear aromatic compounds

Criterion of Aromaticity: Huckel's rule and its application to homonuclear and hetronuclear compounds. Polynuclear and Hetronuclear Aromatic Compounds: Preparation and properties of the following compounds: naphthalene (including structure elucidation), anthracene, pyrrole, furan, thiophene and pyridine.

Unit III. Amino acids, peptides and proteins

Amino acids, peptides and proteins: Natural amino acids and essential amino acids. Synthesis of simple amino acids by amination of haloacids, Gabriel phthalimide synthesis, using malonic ester and Erlenmeyer azlactone synthesis. Configuration of natural amino acids and their properties.

Determination of primary structure of peptides by degradation, N-terminal (Edman and DNP method), C-terminal (hydrazinolysis) and hydrolysis of peptides. Synthesis of simple peptides (upto tripeptides). Synthesis of peptides by N-protecting groups. (t-butyloxycarbonyl and phthaloyl) C-activating groups, Merrifield solid-phase synthesis.
Importance, primary, secondary, tertiary and quaternary structures (definition only) of proteins.

Unit IV. Carbohydrates

Carbohydrates: Definition, classification and nomenclature of carbohydrates. Determination of configuration of monosaccharides. Ascending and descending in monosaccharides series. Interconversions between aldoses and ketoses. Structure elucidation of glucose and fructose (open chain and cyclic structure). Mutarotation. Structure (excluding structure elucidation) of sucrose, starch and cellulose.

Unit V. Alkaloids

Alkaloids: Definition, structure (excluding structure elucidation), synthesis and uses of nicotine.

Unit VI. Spectroscopy and its Applications to Simple Organic Molecules

Introduction to spectroscopy. Application of visible, ultraviolet and infrared spectroscopy in organic chemistry. Electromagnetic radiations, electronic transitions, λmax, chromophore, auxochrome,

bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating λmax of conjugated dienes and α, β – unsaturated carbonyl compounds.
Infrared radiations (IR) and types of molecular vibrations. Functional groups and finger-print region. IR spectra of alkanes, alkenes and simple alcohols (intermolecular and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).

CH 303 PHYSICAL CHEMISTRY
(2 Lectures per week)

Unit I. Solids

Forms of solids. Bravais lattice types, unit cells, crystal systems, and identification of lattice planes. Miller indices. X – Ray diffraction by crystals, Bragg's law.
Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices and Law of symmetries.
Types of crystals – molecular, ionic, covalent and metallic crystals with examples and their characteristics.
Structures of NaCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

Unit II. Chemical Kinetics and Photochemistry

Chemical Kinetics: The concept of reaction rates, Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order (both for equal and unequal concentrations of reactants) reactions. Half – life time of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Complex reaction such as consecutive reactions, parallel reactions and opposite reactions (with examples) and their differential rate equations only.

Theories of Reaction Rates: Collision theory and Activated complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only). Kinetics of enzyme catalyzed reactions – Michaelis-Menten equation.

Photochemistry: Lambert – Beer law. Laws of photochemistry. Quantum efficiency and reasons for high and low quantum yields. Primary and secondary processes in photochemical reactions. Photochemical and thermal reactions. Photoelectric cells. Fluorescence and Phosphorescence.

Unit III. Quantum Chemistry and Molecular Spectroscopy

Postulates of quantum mechanics. Quantum-mechanical operators. Born – Oppenheimer approximation. Writing of time-indepenent Schrödinger equation for different systems (exactly soluble problems e.g. particle in a box, linear harmonic oscillator, rigid rotator and hydrogen atom). Concept of orthogonal and normalised wave functions.

Spectroscopy and its importance in Chemistry, difference between atomic and molecular spectroscopy. Absorption and emission spectroscopy. Width and intensity of spectral lines. Separation of molecular energies into translational, rotational, vibrational and electronic components.

Translational Motion: Solution of particle in a one-dimensional box. Quantization of the translational energy levels, properties of the solutions. Separation of variables. Extension of the solution to two- and three-dimensional boxes. Concept of degeneracy.

Rotational Motion: Schrödinger equation of a rigid rotator and brief discussion of its results (solution not required). Quantization of rotational energy levels. Microwave (pure rotational) spectra of diatomic molecules. Selection rules. Structural information derived from rotational spectra.

Vibrational Motion: Schrödinger equation of a linear harmonic oscillator and brief discussion of its results (solution not required). Quantization of vibrational energy levels. IR spectra of diatomic molecules. Selection rules. Structural information derived from vibrational spectra.

Unit IV. Surface Chemistry and Polymers

Surface Chemistry

Adsorption by solids. Langmuir theory of adsorption of a gas on a solid. Langmuir adsorption isotherm. BET theory of multilayer adsorption of a gas on a solid. BET equation (derivation not required). Types of adsorption isotherms.

Polymers

Different schemes of classification of polymers. Molar mass of polymers. Number average and mass average molar masses. Methods of determining molar mass by osmotic pressure and viscosity measurements.

CH 304 CHEMISTRY LABORATORY

No. of periods per week – 6

Note: Practical examination will include three exercises – one each out of the following physical, organic and inorganic chemistry experiments. The duration of the examination shall be 6 hours. Different students should be given different exercises. The exercises should be designed, keeping in mind the time available.

Physical Chemistry

1. Determination of partition coefficient of benzoic acid between water and benzene.
2. (a) Determination of partition coefficient of iodine between water and carbon tetrachloride.
   (b) Determination of equilibrium constant for the reaction $KI + I_2 = KI_3$ by studying the distribution of iodine between carbon tetrachloride and an aqueous solution of potassium iodide.
3. Determination of molar mass of a given polymer sample by viscosity measurement.
4. Study of the kinetics of the hydrolysis of methyl acetate in presence of hydrochloric acid using (i) initial rate method and (ii) integrated rate method.
5. Verify Lambert-Beer Law for $CuSO_4$/$KMnO_4$/ $K_2Cr_2O_7$ solutions and determine their concentrations in the given solutions colorimertrically.
6. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a given mixture colorimetrically (Range $0.5x10^{-3}$ – $1.0x10^{-3}$ M). This experiment may be carried out using a spectrophotometer subject to availability.

Organic Chemistry

7. Systematic identification of the given monofunctional organic compounds and preparation of their derivatives.
8. Preparation of the following compounds : acetanilide, aspirin, phenolphthalein and methyl orange.

***Note** : Preparation should be followed by purification and determination of melting point*

Inorganic Chemistry

9. Estimation of the amount of nickel present in a given solution as Bis(dimethylglyoximato) nickel(II) or aluminium as oxinate in a given solution gravimetrically.
10. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
11. Estimation of total hardness of a given sample of water by complexometric titration.
12. To draw calibration curve (absorbance at λmax vs. concentration) for various concentrations of a given coloured compound and estimate the concentration of the same in a given solution.
13. Determination of the composition of the Fe^{3+} - salicylic acid complex / Fe^{2+} - phenanthroline complex in solution by Job's method.
14. Determination of concentration of Na^+ and K^+ using Flame Photometry.

Suggested Readings:

1. *J.D.Lee : A New Concise Inorganic Chemistry*, E.L.B.S.
2. F.A.Cotton & G. Wilkinson : *Basic Inorganic Chemistry*, John Wiley.
3. Peter Sykes : *A Guide Book to Reaction Mechanism in Organic Chemistry*, Orient Longman.
4. P.W.Atkins : *Physical Chemistry*, Oxford University Press.
5. G.W.Castellan: *Physical Chemistry*, Narosa Publishing House.
6. George Odian: *Principles of Polymerization*, Wiley Interscience.
7. Douglas, McDaniel and Alexander : *Concepts and Models in Inorganic Chemistry*, John Wiley.
8. James E. Huheey, Ellen Keiter and Richard Keitner, *Inorganic Chemistry : Principles of Structure and Reactivity*, Pearson Publication
9. I.L.Finar, *Organic Chemistry* (Vols. I & II), E.L.B.S.
10. R.T.Morrison & R.N.Boyd : *Organic Chemistry*, Prentice Hall.
11. C.N.Banwell, *Fundamentals of Molecular Spectroscopy*, Tata McGraw Hill.
12. John R.Dyer : *Applications of Absorption Spectroscopy of Organic Compounds*, Prentice Hall.
13. R.M.Silverstein, G.C.Bassier and T.C.Morrill: *Spectroscopic Identification of Organic Compounds*, John Wiley and Sons.
14. Donald A. McQuarrie: *Quantum Chemistry*, Oxford University Press.

LS 301 DEVELOPMENT BIOLOGY AND PHYSIOLOGY: PLANTS

Unit I Plant structure, growth and development
Structural organization, meristems and their derivatives, primary and secondary growth, morphogenesis and differentiation, leaf initiation and development. (Ch 35 Campbell, Ch 25 Raven- Biology of plants)

Unit II Transport in vascular plants
Physical processes of transport, absorption, transpiration and translocation (Ch 36 Campbell)

Unit III Plant nutrition
Essential elements, criteria of essentiality, main nutrients and their role, plant nutritional adaptations, role of mycorrhiza (Ch 37 Campbell)

Unit IV Photosynthesis
Calvin cycle, C3, C4, and CAM pathways of carbon fixation, photosynthetic responses. (Ch 7, 8,9 Taiz and Zeiger)

Unit V Assimilation of mineral nutrients
Nitrogen compounds utilized by plants, uptake and assimilation of nitrogen, biological nitrogen fixation, assimilation of other nutrients (Ch 12 Taiz and Zeiger)

Unit VI Respiration
Glycolysis, citric acid cycle, Electron transport, respiration in intact plants and tissues (Ch 11 Taiz and Zeiger)

Unit VII- Plants responses to internal and external signals
Signal transduction pathways, plant hormone responses to light and other stimuli, plant defence against herbivores and pathogens (Ch 39 Campbell)

Readings:

- Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition Pearson Benjamin Cummings, San Francisco.
- Raven, P.H et al (2005) Biology of plants 7th edition W.H. Freeman Publishers
- Taiz, L. and Zeiger, E. (2006) Plant Physiology 4th edition Sinnauer Associates, USA

LS-302 DEVELOPMENT BIOLOGY AND PHYSIOLOGY: ANIMALS

Unit I Principles of developmental biology
Anatomical approach to developmental biology, life cycles and evolution of developmental patterns, principles of experimental embryology, genetic core of development [Ch 1,2,3 (Pg 50-62, 66-77), Ch 4 Gilbert]

Unit II Animal development
Gametogenesis, fertilization, cleavage, gastrulation, cell fate, primary embryonic induction(amphibians) [Ch 47 Campbell, Ch 10 (pg 302-308) Gilbert]

Unit III Digestion and absorption of food
Structure and functions of gastrointestinal tract, regulation of gastrointestinal processes, pathophysiology of GIT (Ch 15 Vander)

Unit IV Functioning of excitable tissue (nerve and muscle)
Neural tissue, membrane potential, action potential and synapsis. skeletal muscle- structure, molecular mechanism of contraction. (Ch 6 Sec A,B,C. Ch 9 Sec A Vander)

Unit V Respiratory and renal physiology
Organization of respiratory system, ventilation, principle of exchange of gases and transport of oxygen and carbon dioxide in blood, control of respiration. Functional anatomy of kidney. Water balance and counter current mechanism. Hormonal regulation of kidney function (Ch 13 Vander, Ch 44 Campbell)

Unit VI Cardiovascular physiology
Overall design of cardiovascular system, the heart, heartbeat coordination, cardiac cycle, cardiovascular patterns in health and disease. (Ch 12 Sec A, B, E Vander)

Unit VII Endocrine system and reproduction
Hormones and other signaling molecules, common features of the endocrine system, role of endocrine glands in regulating metabolism, homeostasis, behavior and development. Physiology of human male and female reproduction, contraception, infertility (Ch 45, 46 Campbell)

Readings:

- Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition Pearson Benjamin Cummings, San Francisco.
- Widmaier, E.P.et al (2004) Vander's Human Physiology 9th edition McGraw Hill Intl, Boston
- Gilbert, S.F. (2006) Developmental Biology 8th edition Sinauer Associates Inc., USA

LS 303 ECOLOGY AND ENVIRONMENTAL MANAGEMENT

Unit I Introduction to Ecology, Community and Ecosystem
Inter-relationships between the living world and environment, biosphere and its components (abiotic and biotic). Environmental concepts (theory of tolerance, laws of limiting factors). Community characteristics- organization and succession in different habitats. Bioenergetics and biogeochemical cycles, concept of habitat and niche.(Ch 4 Allaby, Ch 20, 21, 22 Smith, Ch 3 Miller)

Unit II Population and Community Ecology
Population attributes, density, natality, mortality, age ratio, sex ratio, dispersal and dispersion of population, exponential and logistic growth, life history strategies, population interactions, predation-types, predator-prey system, functional and numerical response, host-parasite interactions, social parasitism, symbiosis.(Part 4 and 5 Smith, Ch 6,7 Miller)

Unit III Biogeography
Phytogeography, phytogeographic region of the world, major plant communities of the world, vegetation of India, zoogeography: Barriers for dispersal, means of dispersal, zoogeographic regions of the world. (Part 23,24,25 Smith)

Unit IV Bioresource management
Biodiversity and regional conservation strategies success stories with reference to India and sustainable utilization. Principles of wildlife management, wildlife sanctuaries, parks and biosphere reserves in India, endangered and threatened species of plants and animals in India, germplasm banks. (Unit 4 Mishra, Ch 6 Allaby, Ch 4, 8, 9 Miller)

Unit V Environmental Issues, Policies and regulation
Impact of urbanization and industrialization, Environmental Impact Assessment, restoration of degraded ecosystems, bioremediation, environmental pollution, global climatic change (Unit 8 Mishra, Ch 27, 29 Smith, Ch 11,15,16 Miller)

Recommended readings

- Mishra, A. (2005) Environmental Studies Selective and Scientific Books, New Delhi
- Allaby, M. (2002) Basics of Environmental Science Routledge
- Smith, T.M. and Smith, R.C. (2006) Elements of Ecology Ist edn Pearson Publications
- Miller, G.T (2006) Environmental Science 11th edition Brooks/Cole

LS 304 APPLIED BIOLOGY AND BIOTECHNOLOGY

Unit I Human diseases
Epidimeology of infectious disease, transmission, prevention and control of human diseases- Tuberculosis, Amoebiasis, Dengue, Malaria, Filariasis, Japanese encephalitis. (Ch3, 5 Park)

Unit II Plant resource utilization and development
Crop production- research, development, productivity and sustainability. Crop evolution and new tools to improve crops. (Ch 2,13 Chrispeels)

Unit III Food and industrial microbiology
Microbiology of fermented food, food-borne diseases, Major products of industrial microbiology- antibiotics, amino acids, organic acids, biopolymers, pharmaceuticals. (Ch 28, 29 Pelczar)

Unit IV Introduction to Biotechnology
Fundamentals of biotechnology, emergence and commercialization, introduction to recombinant DNA technology, concerns and consequences. (Ch 1 Glick)

Unit V Recombinant DNA technology
Restriction endonucleases, cloning vectors- plasmids, cosmids, bacteriophages, construction and screening of genomic library, transformation protocols in prokaryotes, nucleic acid hybridization, PCR, DNA sequencing (Ch 4, 5, Glick)

Unit VI Concept of Genomics
Bacterial and eukaryotic genomes, sequencing genomes, structural, functional and comparative genomics (Ch 12 Griffiths)

Unit VII Applications of recombinant DNA technology
Genetic engineering of plants, development of disease resistant and stress tolerant plants, transgenic crops, plants as bioreactors, edible vaccines, transgenic animals, diagnosis of genetic disorders, treating genetic disorders by gene therapy, DNA fingerprinting, regulating the use of biotechnology (Ch 17, 18, 19, 21 Glick)

Unit VIII Bioinformatics
Introduction, bioinformatics sites, genetic databases, sequence analysis, phylogenetic trees. (Ch 15 Walker, Appendix- Griffiths)

Unit IX Study of model organisms
Special features and main contributions of model organisms of prokaryotes and different eukaryotes for research studies- *Escherichia coli, Sachharomyces cerevisiae, Neurospora crassa, Arabidopsis thaliana, Caenorhabditis elegans, Drosophila melanogaster, Mus musculus* (A brief guide- Griffiths)

Readings:

- Glick, B.R and Pasternak, J.J (2003) Molecular Biotechnology- Principles and applications of recombinant DNA, ASM press, Washington
- Chrispeels, M.J and Sadava, D.E(2003) Plants, genes and crop biotechnology 2nd edition Jones and Bartlett publishers, Boston
- Pelczar, M.J. et al (2001) Microbiology 5th edition Tata McGraw-Hill Co.New. Delhi
- Park, K (2007) Preventive and social medicine B.B publishers
- Griffiths, A.J.F et al (2005) Introduction to Genetic Analysis W.H. Freeman & Co. NY.

LS 305 LAB

Developmental Biology and Physiology: Plants

1. Study of plant structures: Preparation of temporary mount of T.S. of monocot and dicot roots, stems and leaves.
2. Secondary growth, apical meristem and tissue- xylem and phloem through permanent slides.
3. Effect of pH on opening and closing of stomata**.**
4. Apical meristems (permanent slides/photograph).
5. Preparation of transverse section of maize/grass root and gram/ sunflower root.
6. Preparation of transverse sections of maize/grass root stem and sunflower stem (primary and secondary growth).
7. Preparation of transverse sections of monocot and dicot leaves. Epidermal peel showing stomata in *Bryophyllum. Crinum* and maize.
8. Determination of osmotic potential of plant cell sap by plasmolytic method.
9. Study of the effect of two environmental factors (light and wind) on transpiration by an excised twig/leaf.
10. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
11. Demonstration of the activity of enzymes (urease, catalase) from various plant sources.
12. Demonstration of dye reduction by isolasted chloroplasts under different light intensities.
13. Study of the 'Law of Limiting factors' (light intensity and bicarbonate concentration) using *Hydrilla.*
14. Comparison of the rate of respiration in different parts of a plant.

Demonstration Experiments

1. Phenomenon of bolting.
2. Inducing fruit ripening by ethylene.
3. Effect of auxins on rooting.

Development Biology and Physiology: Animals

1. Study of developmental stages in frog-whole mounts and sections, cleavage stages, blastula, gastrula, neurula, tail bud tadpole.
2. Study of whole mounts and sections of chick embryo at different stages, primitive streak, 24, 28, 33, 48, 72 and 96 hours.
3. Temporary mounts of striated muscle fibres and nerve cells.
4. Determination of RBC count using haemocytometer.
5. Determination of total and differential WBC count.
6. Estimation of haemoglobin content in blood using haemoglobinometer.
7. Demonstration of perfusion of the excised heart of frog.
8. Detection of abnormal constituents in urine.
9. To perform clinical estimations of glucose, cholesterol by kits.
10. Measurement of blood pressure using a sphygmomanometer.
11. A visit to Poultry farm/Hatchery/Tissue culture laboratory/Animal breeding centers.

LS 306 LAB

Ecology and environment management

Part-I (Botany)

1. Study of following microclimatic variables in different locations: soil and air temperature, wind velocity, relative humidity and light intensity.
2. Determination of pH, field capacity, density and porosity of different soil samples, rapid test for soil texture.
3. Rapid field test of soils for carbonates, sulphates, chlorides, nitrates, organic matter and base deficiency.
4. Determination of minimal quadrate area by species area curve method; quantitative analysis of herbaceous vegetation for frequency and density.
5. Study of ecological adaptations of hydrophytes and xerophytes.

Part-II (Zoology)

1. Study of an aquatic ecosystem-Measurement of total area, locality, temperature and turbidity/penetration of light, determination of pH, dissolved oxygen content (Winkler's method) and dissolved carbon dioxide.
2. Study of biotic community with specials reference to plankton. Plotting of survivorship curves from hypothetical life table data.
3. Study of the ecological significance of phytoplankton, zooplankton, fishes, amphibians, reptiles, aves and mammals (2 representatives from each group).
4. Study of a few endangered reptiles, birds and mammals of India.
5. A visit to National park/ Wildlife sanctuary/Waste management organization/ Mahatma Gandhi Institute for non-conventional energy sources (Bakoli village, Gurgaon, and Sulabh International).

Applied Biology and Biotechnology

Zoology

1. Study of protozoan, helminth parasites and arthropod vectors associated with human diseases.
2. To perform western blotting of proteins from SDS-polyacrylamide gel.
3. To perform southern blotting of DNA fragments from agarose gel.
4. Study of Polymerase Chain Reaction.
5. Demonstration of DNA sequencing and interpretation of sequencing gels (autoradiogram)
6. Useful bioinformatics sites on internet for gene and protein databases, genome and organism specific databases and perform multiple sequence alignment
7. Nucleic acid data base- Homology search (Using 16srRNA gene sequence)
8. Construction of phylogenetic trees.

Botany

1. Transformation of E.coli and screening for recombinant clones.
2. Restriction digestion of DNA using *EcoRI* and *Hind III.*
3. Construction of restriction map of plasmid from the data provided.
4. Study of tissue culture techniques.
5. Analysis of DNA Fingerprint.
6. To study applications of various recombinant DNA techniques by photographs.
7. To perform DNA ligation using T4 DNA ligase.
8. Genetic transformation of plants with *Agrobacterium.*

MA 301 REAL ANALYSIS

Unit I: Real Sequences (30 L) **36**

Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, statement of order completeness property of R, Archimedean property of R, intervals.

Concepts of cluster points and statement of Bolzano Weierstrass' theorem. Cauchy convergence criterion for sequences. Cauchy's theorem on limits(without proof), order preservation and squeeze theorem, monotone sequences and their convergence.

Unit II: Infinite Series (42 L) **48**

Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test. Definition and examples of absolute and conditional convergence.

sequences and series of functions, Pointwise and uniform convergence. Mn-test, M-test, change of order of limits.

Power Series: radius of convergence, Cauchy-Hadamard theorem(without proof), term-by-term differentiation and integration of power series. Definition in terms of Power series and their properties of exp(x), sin(x), cos(x).

Unit III: Calculus of several variables (42 L) **28**

Limit and continuity for real valued functions on R^2, differentiability of real valued functions on R^2, directional derivatives and gradients for these functions. Schwarz theorem, Young's Theorem. Taylor's theorem for functions of two variables(without proof), Maxima and Minima of functions of two variables.

Recommended Books

1. T.M. Apostol, Calculus, Voulme-1, John Wiley and Sons(Asia) pte Ltd.,2002.
2. R.G. Bartle and D.R. Sherbut; Introduction to real analysis, John Wiley and Sons(Asia) Pte.Ltd.2000.
3. E.Fischer, Intermedial Real Analysis, Springer Verlag, 1983
4. K.A.Ross, Elementary Analysis – The Theory of Calculus Series-Undergraduate Texts in Mathematics, Springer Verlag, 2003.
5. Robert T.Smith, Roland B. Minton, Calculus, McGraw Hill International, Edition, 2006,
6. Robert C. Wrede, Murray Spiegel, Advanced Calculus, Second Edition, Schaum's series, Tata McGraw Hill, 2005.

MA 302 ANALYSIS, ALGEBRA AND MECHANICS

Unit I: Analysis (30 L) **35 Marks**

Riemann Integral , conditions of intergrability, Integrability of Continuous and monotonic functions.

Improper integrals, Convergence of Improper integrals, Absolute and conditional convergence of improper Integrals. Beta, Gamma functions and their properties.

Double integrals, repeated integrals, line integrals in R^2, Statement and illustration of Green's theorem.

Unit II: Linear Algebra (30 L) **35 Marks**

Rings: Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, Z_n the ring of integers modulo n, ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields: Zp, Q, R, and C. Field of rational functions.

Vector Spaces: Definition and examples of vector spaces. Subspaces and its properties Linear independence, basis, invariance of basis, size, dimension of a vector space.

Linear Transformations on real and complex vector Spaces: definition, examples, kernel, range, rank, nullity.

Unit III: Mechanics (30 L) **42 Marks**

Conditions of equilibrium of a particle and of coplanar forces acting on a rigid Body, Laws of friction, Problems of equilibrium under forces including friction, Centre of gravity, Work and potential energy.

Velocity and acceleration of a particle along a curve: radial and transverse components (Plane curve), tangential and normal components (space curve). Newton's Laws of motion, Simple harmonic motion, Simple Pendulum, Projectile Motion.

Recommended Books

Unit I

1. Frank Ayres, J. Elliott Mendelson, Calculus, fourth Edition, Schaum series, Tata McGraw Hill, 2005.
2. R.G. Bartle and D.R. Sherbut; Introduction to real analysis, John Wiley and Sons(Asia) Pte.Ltd.2000.
3. E.Fischer, Intermedial Real Analysis, Springer Verlag, 1983
4. K.A.Ross, Elementary Analysis – The Theory of Calculus Series-Undergraduate Texts in Mathematics, Springer Verlag, 2003.

Unit II

1. C.W.Curtis, Linear Algebra, an introductory approach, Springer-Verlag , 1991.
2. David M. Blotin, Linear Algebra and Geometry, Cambridge Press, 1979.
3. Seymour Lipschutz, Linear Algebra, Schauss series, Tata McGraw Hill, 1989

Unit III

1. A.S. Ramsey, Statics, CBS Publishers and Distributors (Indian Reprint), 1998.
2. A.P. Roberts, Statics and Dynamics with background in Mathematics, Cambridge University Press, 2003.
3. J.L. Synge and B.A. Griffiths, Principles of Mechanics, McGraw Hill, 1970.

MP 301 MATHEMATICS – II

Unit I: Infinite Series (24 L) **28**

Convergent Sequences. Statement and illustration of Cauchy convergence criterion for sequences. Cauchy's theorem on limits(without proof), monotone sequences and their convergence.

Definition and a necessary condition for convergence of an infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, limit comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test. Definition and examples of absolute and conditional convergence.

Unit II: Differential Equations (38 L) **44**

First order exact differential equations, Intergrating factors, rules to fine an integrating factor. First order higher degree equations solvable for x, y, p = dy/dx. Methods for solving higher-order differential equations. Solving a differential equation by reducing its order. Linear homogenous equations with constant coefficients. Linear non-homogenous equations. The method of variation of parameters. The Cauchy-Euler equation. Simultaneous differential equations.

Applications of differential equations: the vibrations of a mass on a spring, mixture problem, free damped motion, forced motion, resonance phenomena, electric circuit problem, mechanics of simultaneous differential equations.

Order and degree of partial differential equations. Concept of linear and non-linear partial differential equations. Formation of first order partial differential equations. Linear partial differential equation of first order, Lagrange's method, Charpit's method (without proof), classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

Unit IV: Algebra (34 L) **40**

Real or complex Matrices, eigen values & eigen vectors, Cayley Hamilton theorem. Methods of finding inverse of a non singular matrix.

Groups : Definition and examples of groups, examples of abelian and non-abelian groups: the group Z_n of integers under addition modulo n and the group U (n) of units under multiplication modulo n. Cyclic groups examples of groups from number systems, complex roots of unity, circle group, the general linear group GLn (n. R), groups of symmetries of (i) an isosceles

triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, groups of transformations in a plane, the permutation group Sym (n), Group of quaternions.

Subgroups, cyclic subgroups, examples of subgroups including the center of a group Cosets, Index of a subgroup, Lagrange's theorem, order of an element, Statement and Interpretation of Euler and Fermat's theorem, order of HK where H and K are subgroups. Normal subgroups: The definition, examples, and characterizations.

Recommended Readings

1. Paul Duchateau, David W. Zechmenn, Partial Differential Equations, Tata McGraw Hill, 2005.
2. J. Durbin, Modern Algebra and introduction, Wiley Student Edition, 2005.
3. E.Fischer, Intermedial Real Analysis, Springer Verlag, 1983
4. Joseph A Gallian: Contemporary Abstract Algebra, fourth edition, Narosa, 1999.
5. B. Kolman, D. R. Hill, Introductory Linear Algebra with applications, Pearson Education, 2003.
6. Seymour Lipsdchutz, Linear Algebra, Schaum Series, Tata McGraw Hill, 1989.
7. S. L. Ross, Differential Equations, John wiley and Sons, Third Edition, 1984.
8. I. Sneddon, Elements of Partial Differential Equations, McGraw Hill International Editions, 1967

(For papers other than those mentioned above, the syllabus remains unchanged.)