प्रस्तुत पाठ्यक्रम में जो भी सामान्य नियम दिये गये हैं वे अभ्यर्थियों की सुविधा हेतु दिये गये हैं। किसी भी प्रकरण में असंगति, सन्देह अथवा अपूर्णता एवं व्याख्या में मदभेद होने की स्थिति में परिनियम, अधिनियम एवं अध्यादेशों द्वारा विहित प्राविधान ही मान्य एवं सर्वोपरि होंगे।

– कुल सचिव

BUNDELKHAND UNIVERSITY
JHANSI

विज्ञान संकाय

BUNDELKHAND UNIVERSITY , JHANSI

CONTENTS

ORDINANCES

For Undergraduate and Graduate Programmes In Bachelor of Science (B.Sc.) And Scheme of Examination

The University offers three years regular course for the Bachelor of Science in the Institute of Basic Science. This academic program shall be executed in the University campus basesd on annual scheme of examination.

1. Eligibility for admission :

(a) A candidare who has qualified/Passed the 10+2 or Intermediate in Bio. or Math's group in aggregate from C.B.S.C. of I.C.S.E. or state education board or any other school/board/Institute, which is recognized by central or state goverment is eligible to seek admission in B.Sc. Part I.

(b) The candidates, who are interested to seek admission in B.Sc. II and B.Sc. III shall also be eligible to apply, provided that they have produced the specific proof of passing the B.Sc. I and B.Sc. II examination respectively from the recognized Indian University/Institute.

(c) A candidate who passed B.Sc. I or B.Sc. II examination from affiliated college of this University may also be eligible to get admission in B.Sc. II or B.Sc. III respectively in the University Campus.

(d) A candidate who has passed B.Sc. I or B.Sc. II from any other University or Institute may also be eligible to get admission in B.Sc. II or B.Sc. III provided that the course structure which he/she opted should have an equivalent with the syllabus of this University.

2. Procedure of Admission : Admission to eligible candidate will be given strictly on merit, drawn on the basis of qualifying examination marks or through Entrance Test examination conducted by the University, as per procedure decided by appropriate authorities of the University.

3. Normal Intake : The intake for these undergraduate program will be as provided in the academic bulletin of each academic year. Statutory reservation, as applicable, shall be applied as per rules.

4. Medium of Instruction : Shall be English/Hindi.

5. **Method of teaching :** These course will be taught by the regular faculty, in house visiting faculty and visiting faculty from other academic institutions/organizations. Baside this, the experiments/exercises for the respective course as per the syllabus are alsoconducted in different laboratories for practical work.

6. **Attendance :** Minimum attendance required to be eligible to appear in the examination shall be 75% of all class lecture (theory & practical), seminars, tests, tours and project work may taken together for all paper and also for each paper and extracurricular activities etc. the following shall apply :

(a) A shortage of upto 5% shall be condoned by the Convener/Director of Institute Basic Science on the specific recommendations of the class teacher.

(b) A shortage of upto 10% shall be condoned by the Vice-Chancellor on the specific recornmendations of the Convener/Director of Institute Basic Sciences.

(c) A Shortage of upto 25% may be condoned by a committee constituted by the appropriate authority of the University, on medical grounds.

7. **Subject In B.Sc. Course :** As prescribed by the ministry of Higher Education, Uttar Pradesh Goverment this course will be run in three academic years. The course contents/structure for each subject/paper will be same as formulated by a committee appointed by Uttar Pradesh Government for unified syllabus for its college and universities. The three subject are offered separately for Bio or Math's group in B.Sc. I and B.Sc. II. But only two subjects will be provided in the B.Sc. Final year. Beside this, the students are free to opt one of the professional/applied subject offered by university for each group.

   Under this program, the course structure shall be broadly divided in to two groups.

   (A) B.Sc. in Bio Group (B) B.Sc. in Math's Group

   A candidate got admission in one of the above group is free to choose any three subjects allocated in the following groups, provided that two subjects among them were opted by him/her in 10+2 or intermediate or equivalent examination, conducted by C.B.S.C./I.C.S.E./State Board/or any other recognized school or Institute in India.

(A) **Subjects offered for B.Sc. Bio Group**

Zoology, Botany, Chemistry & Geology

(B) **Subjects offered in B.Sc. Math's Group**

Physics, Chemistry, Mathematics, Statistics & Geology

(C) Qualifying Optional subjects for B.Sc.

Math's Group : Computer Sciences

Bio Group : Microbiology, Biotechnology & Biochemistry

(D) Subject Combinations

Math's Group :

(i) Physics, Math's and Chemistry

(ii) Physics, Math's and Statistics

(iii) Physics, Math's and Geology

(iv)

Bio Group :

(i) Zoology, Botany and Chemistry

(ii) Geology, Botany and Chemistry

(Economics & Geography cannot be offered in Bio-Group)

There are limited numbers of seats for each combination of subjects in each group. The combination of the subjects shall be offered to the candidate exclusively on the basis of merit list scrutinized by the admission committee or the percentage of marks/score secured by the candidate in the entrance test conducted by the university.

The change for the subject and subject combination will be allowed only after the closing date of admission and if the seats, are found vacant in the desired subject/subject combination. For this, the candidates may send their request to Convener/Director of Institute of Basic Sciences up to the prescribed date scheduled for it. This change in subject/subject combination shall be provided purely on the basis of merit and the recommendation of the admission committee. No change will be allowed after the closing date.

8. Scheme of Examinations :

Bachelor of Science :

The duration of B.Sc. course shall be for three academic years. The degree will be awarded to the student after his/her evaluation in theory and corresponding practical examinations in each academic year. Each academic year shall consist of 180 days of

teaching work including theory, practical, Sessional and educational/field tour. Educational training and field tour programmes will also be conducted at specified local areas. The pattern of question paper will be of 20% objective type, 40% short answer and 60% essay type and will be based on the unified syllabus provided by Uttar Pradesh Government for each subject.

(a) Annual Examination : It shall be conducted by the University, normally after completion of 180 days of teaching. The question paper will be set by the Examiners appointed by the Vice-Chancellor on the basis of the recommendations of the Board of Studies in the respective subjects.

(b) Practical Examination : A Practical Examination except in mathematics (including practical records/sessional and viva-voice), based on course contents offered to each subject in unified syllabus shall be conducted for each course in each academic year.

A student must clear the both theory and practical papers, separately with 33% marks in individual and 40% marks in aggregate. In case he/she fails to clear any one or more of the papers, a second chance shall be given to him/her to clear the backing by taking a back-paper examination, which shall be conducted separately or along with the annual examination at the end of academic year. In the meantime, such student may be promoted and provisionally admitted in the subsequent academic year.

9. Minimum Pass Marks :

(a)	33%	II Division
(b)	45% and above	II Division
(c)	60% and above	I Division
(d)	75% and above	Distinction

(a) In the B.Sc. Part I and II a student shall opt three subjects from the offerecd subject combination in each group (Math's and Bio). Each shall carry 150 marks and will have three theory papers and one practical except mathematics. A maximum 100 marks are awarded to each subject and 50 marks to practical. To qualify for the subsequent year, each candidate must have secured at least 33% marks in theory as well as in practical separately in each subject. If a candidate has obtained 33% marks from his/her grand total and has also obtained 33% marks in all paper (including practical) except one paper, then

he/she may be promoted to get admission in the subsequent academic year provided that he/she has secured at least 25% marks in that paper.

If a candidate has secured less than 25% marks in one subject and at least 33% marks in all other two subject as well as in grand total then he/she may be allowed to appear in the back paper examination which will be conducted along with the annual examination of the subsequent year. In the mean time he/she may be provisionally promoted in the subsequent academic year (B.Sc. II & III).

(b) In order to qualify the optional subject a candidate must pass it at least with 30% marks. These marks will not be added with his/her grand total and will not affect his/her divisional rank.

(c) In the B.Sc. final year a candidate will have to choose only two subject among the three subject which he/she had opted in B.Sc. II year. Each subject will carry 225 marks and will have three theory papers and one practical except mathematics. A maximum total of 150 marks are awarded to each subject and 75 marks to each practical.

To qualify for B.Sc. degree a candidate must have secured at least 33% marks in the final year (B.Sc. III) examination in theory as well as in practical. If a candidate has secured 33% marks from his/her grand total but fails to get it (33%) in one paper of theory or practical and only secured at least 25% marks in this paper, Then in such condition the degree in Bachelor of Science (B.Sc.) may also be awarded to him/her.

10. Course Structure :

B.Sc. Part I

Three complusory subjects along with one optional qualifying subject (Candidate may or may not opt).

Eacha subject consists three theory papers and one practical (No practical in Math subject).

Each subject shall be 150 marks where 100 marks for theory papers and 50 marks for practical. The grand total of three subjects will be maximum of 450 marks.

B.Sc. Part II

Three compulsory subjects along with one optional qualifying subject (Candidate may or may not opt).

Each subject consists three three theory papers and one practical. Grand total 450.

Each subject consists three theory papers and one practical (No practical in Math subject).

Each subject shall be 150 marks where 100 marks for theory papers and 50 marks for praetical. The grand total of three subjects will be maximum of 450 marks.

B.Sc. Part III

Two compulsory subjects along with one optional qualifying subject (Candidate may or may not opt the qualifying subjects).

The chosen subject for the B.Sc. should be among the subjects offered in the B.Sc. Part I and II.

Each subject consist three theory papers and one practical

Grand total 450

11. A candidate who has discontinued the academic program during any year/semester, may on the recommendation of the HOD be permitted by the Vice-Chancellor to take readmission in the academic program at the beginning of the semester/year concerned, in a subsequent year, not however beyond a gap of two years, under the condition that the maximum period to stay in a course shall not exceed 4-7 years from the time of initial admission. Fee once paid shall not be adjusted or refunded during subsequent admissions.
12. The course fee and examination fee shall be decided by the University from time to time and will have to be deposited by the candidate, as and when asked for.
13. The academic programs may be conducted in collaboration with any institution where nexessary facilities are available.
14. Above rules are subject to amendment by appropriate authorities of the University from time to time, as and when deemed necessasry.
15. In view of the need in the actual implementation of the course, the adaptations and amendments, if any, by the Board of Studies, or the Expert Committee appointed by the Vice-Chancellor for the respective course/subject, for the first ordinances, shall be deemed passed and hence incorporated.
16. Grace Marks : A maximum of 5 marks may be awarded in every final examination in aximum of two papers and/or aggregate to those candidate who by the award of these marks can be declared to have passed in all subject and aggregate.

B.Sc. (Botany)

FIRST YEAR

		M.M.	Practical
Paper I.	Diversity of microbes and Lower cryptogams	33	
II.	Higher Cryptogams	33	
III.	Cell biology and genetics	34	
	Total -	100	50

SECOND YEAR

		M.M.	Practical
Paper I.	Diversity of Gymnospermic plants and their systematics	33	
II.	Diversity of Angiospermic and their systematics	33	
III.	Structure, development and reproduction of flowering plants	34	
	Total -	100	50

THIRD YEAR

		M.M.	Practical
Paper I.	Plant Physiology & Biochemistry	50	
II.	Plant Ecology	50	
III.	Biotechnology & utilization of plants	50	
	Total -	150	75

B.Sc. Part - I

PAPER - I

DIVERSITY OF MICROBES AND CRYPTOGAMS

Time - 3 Hrs. ***M.M. 33.***

Viruses and Bacteria : General account of viruses and Mycoplasma; Bacteria - structure, nutrition, reproduction and economic importance; General of Cyanobacteria.

Algae : General characters, classification and economic importance; Important features and life history of Chlorophyceae - *Volvox, Oedogonium, Coleochaete;* Xanthophyceae - *Vaucheria;* Phaeophyceae - *Ectocarpus, Sargassum*; Rhyodophyceae - *Polysiphonia*.

Fungi : General characters, classification and economic importance; Important features and life history of Mastigomycotina - *Pythium, Phytophthora;* Zygomycotina - *Mucor;* Ascomycotina - *Saccharomyces, Eurotium, Chaetomium, Peziza*; Basidiomycotina - *Puccinia, Agaricus;* Deuteromycotina - *Cercospora, Colletotrichum;* General account of Lichen.

B.Sc. Part - I

PAPER - II

HIGHER CRYPTOGAMS

Time - 3 Hrs M.M. - 33

Bryophyta : Amphibians of plant kingdom displaying alternation of generation; Structure, reproduction and classification of Hepaticopsida (e.g. *Marchantia*); Anthocerotopsida (e.g. *Anthoceros*), Bryopsida (e.g. *Funaria*).

Pteriodophyta: The first vascular plants; Important characteristics of Psilopsida, Lycopsida, Sphenopsida and Pteropsida; Structure, reproduction in *Rhynia, Lycopodium, Selaginella, Equisetum, Pteris* and *Marsilea.*

Evolution of stels, Heterospory and origin of seed habit.

B.Sc. Part - I

PAPER - III

CELL BIOLOGY AND GENETICS

Time - 3 Hrs. ***M.M. - 34***

Structure and function of nucleus : Ultrastructure; Nuclear membrane; Nucleolus.

Chromosome organization: Morphology Centromere and telomere, chromosome alteration; Deletions, duplications, translocation, inversions; Variations in chromosome number; Aneuploidy, polyploidy; Sex chromosomes.

DNA the genetic material : DNA structure; Replication; DNA - Protein interaction, nucleosome model; Genetic code; Satellite and repetitive DNA.

Cell division: Mitosis; Meiosis.

Genetics inheritance: Mendelism; Laws of segregation and independent assortment; Linkage analysis; allelic and non-allelic interaction.

Gene expression: Structure of gene; Transfer of genetic information; Transcription, translation, protein analysis; t-RNA; Ribosomes; Regulation of gene expression in prokaryotes and eukaryotes; Protien, 1D, 2D and 3D structure.

Genetic variations: Mutations, spontaneous and induced; Transposable genetic elements, DNA damage and reapair.

Extranuclear genome: Presence and function of mitochondrial and plastid DNA; Plasmids.

Structure and function of other organelles : Golgi, E.R., Peroxisomes and vacuoles.

The cell envelopes: Plasma membrane; Bilayer lipid structure; Functions; the cell wall.

B.Sc. Part - II

PAPER - I

Diversity of Gymnospermic Plants and their Systematics

Time - 3 Hrs ***M.M. - 33***

1. Characteristics of seed plants; Evolution of seed habit; Seed plants with (Angiosperms) and without (Gymnosperms) fruits; Fossil and living seed plants.
2. General features of Gymnosperms and their classification; Evolution and diversity of Gymnosperms; Geological time scale, fossilization and fossil Gymnosperms.
3. Morphology of vegetative and reprocuction parts; Anatomy of root, stem and leaf; Reproduction and life cycle of Pinus, Cycas and Ephedra. With their economic importance.

B.Sc. Part - II

PAPER - II

Diversity of Angiospermic Plants and their Systematics

Time - 3 Hrs. ***M.M. - 33***

1. Angiosperms; Origin and evolution. Some examples of primitive angiosperms.
2. Angiosperm taxonomy; Brief history, aims and fundamental components (O-taxonomy, holotaxonomy); Identification, keys, taxonomic literature.
3. Botanical nomenclature; Principles and rules; Taxonomic ranks; Type concept, principle of priority.

4. Classification of angiosperms; Salient features of the systems proposed by Bentham and Hooker and Engler and Prantl.

5. Major contributions of cytology, phytochemistry and taximetrics to taxonomy.

6. Diversity of flowering plants as illustrated by members of the families Rannuculaceae, Brassicaceae, Malvaceae, Rutaceae, Fabaceae, Apiaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Chenopodiaceae, Euphorbiaceae, Liliaceae and Poaceae.

B.Sc. Part - II

PAPER - III

Structure, Development and reproduction of Flowering plants

Time - 3 Hrs ***M.M. - 34***

1. The basic body plant of a flowering plant - modular type of growth.

2. Diversity in plant form in annuals, biennials and perennials; Convergence of evolution of tree habit in gymnosperms, monocotyledons and dicotyledons; Trees - largest and longest - lived organism.

3. **The shoot system:** The shoot apical meristem and its histological organization, Vascularization of Primary shoot in monocotyledons and dicotyledons; Formation of internodes, branching pattern; Monpodial and sympodial growth; canopy architecture; Cambium and its functions; Formation of secondary xylem; A general account of wood structure in relation to conduction of water and minerals; Characteristics of growth rings, sap wood and heart wood; Role of woody skeleton; Secondary phloem - structure function relationships; Periderm.

4. **Leaf :** Origin, development, arrangement and diversity in size and shape; internal structure in relation to photosynthesis and water loss; Adaptations to water stress; Senescence and abscission.

5. **The root system :** the root apical meristem; differentiation of primary and secondary tissues and their roles; structural modification for storage, respiration, reproduction and for interaction with microbes.

6. **Flower :** a modified shoot; structure, development and varieties of flower functions; structure of anther and pistil; the male and female gametophytes; type of pollination; attractions and rewards for pollinators; pollen - pistil interaction, self incompatibility; double fertilization; formation of seed - endosperm and embryo; fruit development and maturation.

7. **Significance of seed -** suspended animation; ecological adaptation; until of genetic recombination and replenishment; dispersal strategies.

8. **Vegetative reproduction :** vegetative propagation, grafting, economic aspects.

B.Sc. Part - III

PAPER - I

PLANT PHYSIOLOGY & BIOCHEMISTRY

Time - 3 hrs. ***M.M. - 50***

Basics of enzymology: Discovery and nomenclature; characteristics of enzyme; concept of holoenzyme, apoenzyme, conezyme and cofactors; regulation of enzyme activity; mechanism of action.

Plant - water relations : Importance of water to plant life; physical properties of water; diffusion and osmosis; absorption, transport of water and transpiration; physiology of stomata.

Mineral nutrition: Essential macro - and micro - elements and their role; mineral uptake; deficiency and toxicity symptoms.

Transport of organic substances: Mechanism of phloem transport; source - sink relationship; factors affecting translocation.

Photosynthesis : Significance; historical aspects; photosynthetic pigments; action spectra and enhancement effects; concept of two photosystems; Z - scheme; photophosphorylation; Calvin cycle; C4 pathway; CAM plants; photorespiration.

Respiration : ATP - the biological energy currency; aerobic and anaerobic respiration; Kreb's cycle; electron transport mechanism (chemi - osmotic theory); redox potential; oxidative phosphorylation; pentose phosphate pathway.

Nitrogen and lipid metabolism : Biology of nitrogen fixation; importance of nitrate reductase and its regulation; ammonium assimilation; structure and function of lipids; fatty acid biosynthesis; b -oxidation; saturated and unsaturated fatty acids; storage and mobilization of fatty acids.

Growth and development : Definitions; phases of growth and development; kinetics of growth; seed dormancy, seed germination and factors of their regulation; plant movements; the concept of photoperiodism; physiology of flowering; florigen concept; biological clocks; physiology of senescence fruit ripening; plant hormones - auxins, gibberellins, cytokinins, abscisic acid and ethylene, history of their discovery, biosynthesis and mechanism of action; photomorphogenesis; phytochromes and cryptochromes, their discovery, physiological role and mechanism of action.

B.Sc. Part - III

PAPER - II

PLANT ECOLOGY

Time - 3 hrs. ***M.M. - 50***

Plants and environment : Atmosphere (gaseous composition), water (properties of water cycle), light (global radiation, photosynthetically active radiation), temperature, soil (development, soil profiles, physico - chemical properties), and biota.

Morphological, anatomical and physiological responses of plants to water (hydrophytes and xerophytes), temperature (thermoperiodicity and vernalization), light (photoperiodism, heliophytes and sciophytes) and salinity.

Population ecology: **Growth curves; ecotypes; ecads.**

Community ecology : Community characteristics, frequency, density, cover, life forms, biological spectrum; ecological succession.

Ecosystems : Structure; abiotic and biotic components; food chain, food web, ecological pyramids, energy flow; biogeochemical cycles of carbon, nitrogen and phosphorous.

Biogeographical regions of India.

Vegetation types of India : Forests and grasslands.

B.Sc. Part - III

PAPER - III

Biotechnology & Utilization of plants

Time - 3 hrs ***M.M. - 50***

Biotechnology : Functional definition; basic aspects of plant tissue culture; cellular totipotency differentiation and morphogenesis; biology of Agrobacterium; vectors for gene delivery and marker genes; salient achievements in crop biotechnology.

Genetic engineering : Tools and techniques of recombinant DNA technology; cloning vectors; genomic and cDNA library; transposable elements; techniques of gene mapping and chromosome walking.

UTILIZATION OF PLANTS

Centres of origin distribution, cultivation, harvesting & economic values of the following.

Food plants : **Rice, wheat, maize, potato and sugarcane.**

Fibers : Cotton, coir and jute with reference to their sources, characteristic, classification & uses.

Vegetable oils : Groundnut, mustard and cocount with reference to properties, extraction & classification.

General account of sources of firewood, timber and bamboos.

Spices : General account.

Medicinal plants : General account with special reference to *Rauwolfia, Cinchona,* Neem & Opium.

Beverages : Tea and coffee with reference to cultivation, harvesting & processing & utility.

Rubber : Technique for manufacture, properties & uses.

B.Sc. (Zoology)

FIRST YEAR

		M.M.	Practical
Paper	I. Life and Diversity of Invertebrates	33	
	II. Life and Diversity of Chordates	33	
	III. Cytology and Development Biology	34	
	Total -	100	50

SECOND YEAR

		M.M.	Practical
Paper	I. Genetics	33	
	II. Animal Physiology	33	
	III. Molecular Biology	34	
	Total -	100	50

THIRD YEAR

		M.M.	Practical
Paper	I. Applied Zoology	50	
	II. Ecology and Environment	50	

III. Evolution and Microbiology 50

Total - 150 75

B.Sc. Part - I

PAPER - I

LIFE AND DIVERSITY OF INVERTEBRATES

Time - 3 Hrs. ***M.M. 33***

Functional morphology of the types with special emphasis on the adaptations to their modes of life and environment. General characters and classification of all phyla upto classes with examples emphasizing their biodiversity, economic importance and conservation measures.

1. Introduction to Invertebrates,
2. Protozoa - Paramoecium, Plasmodium.
3. Porifera - Sycon.
4. Coelenterata - Obelia, Coral and Coral reefs.
5. Helminthes - Liverfluke, Parasitism.
6. Annelida - Nereis, Metamerism.
7. Arthropoda - Prawn, Social insects.
8. Mollusca - Pila, Pearl formation.
9. Echinodermata - Starfish, Echinoderm larvae.
10. Hemichordata - Balanoglossus.

B.Sc. Part - I

PAPER - II

LIFE AND DIVERSITY OF CHORDATES

Time - 3 Hrs. ***M.M. - 33***

Functional morphology of the types with special emphasis on the adapations to their modes of life and environment. General characters and classification of all classes upto orders with examples emphasizing their biodiversity, economic importance and conservation measures.

1. Origin of Chordata.
2. Protochordata - Herdmania, Amphioxus.

3. Cyclostomata - Petromyzon.
4. Pisces - Scoliodon, Scales and fins of fishes, Fish migration and parental care.
5. Amphibia - Frog - Parental care and origin of Amphibia.
6. Reptilia - Uromastix - Skeleton of varanus, Extinct Reptiles, Poisonous and nonpoisonous snakes and poison apparatus.
7. Aves - Pigeon, flight adaptation and bird migration.
8. Mammals - Rabbit, evolution of man, dentition in mammals.

B.Sc. Part - I

PAPER - III

CYTOLOGY AND DEVELOPMENTAL BIOLOGY

Time - 3 Hrs. ***M.M. 34***

1. Methods in cell Biology.
2. Organisation of Cell - Nuclear and Extranuclear.
3. Cell Reproduction.
4. An elementary idea of cell transformation, Cancer and Cellular basis of immunity.
5. Gametogenesis.
6. Fertilization.
7. Types of patterns of cleavage.
8. Blastulation and Fate map construction in frog and Chick.
9. Gastrulation in frog and Chick upto the formation of three germinal layers.
10. Elementary knowledge of Primary organizer and extra embryonic membranes and regeneration.

B.Sc. Part - II

PAPER - I

GENETICS

Time - 3 Hrs. ***M.M. - 33***

1. Elements of Heredity and variation.
2. Gene Expression.
3. Linkage, Sex chromosome and Sex linkage.
4. Chromosomal aberrations.
5. Haman genetics.
6. Cyroplasmic Inheritance
7. Applied Genetics.

B.Sc. Part - II

PAPER - II

ANIMAL PHYSIOLOGY

Time - 3 Hrs. ***M.M. - 33***

1. Nutrition, Metabolism & Enzymes.
2. Respiration, Organs of Respiration, Properties & function of respiratory pigments.
3. Regulatory mechanisma.
4. Neuromuscular co-ordination.
5. Endocrine and reproductive system.

B.Sc. Part - II

PAPER - III

MOLECULAR BIOLOGY

Time - 3 Hrs. ***M.M. - 34***

1. Nucleic acids, structure, Nature and function of genetic material.
2. Regulation of Protein synthesis.
3. Genetic Code.
4. Genetic Engineering and its applications.
5. Mutation - Molecular basis of mutation.

B.Sc. Part - III

PAPER - I

APPLIED ZOOLOGY

Time - 3 Hrs. ***M.M. - 50***

1. Principles of Aquaculture.
2. Sericulture.
3. Apiculture,
4. Lac culture.
5. Pisciculture and Aquarium fish keeping.
6. Poultry keeping.
7. Toxicology

B.Sc. Part - III

PAPER - II

ECOLOGY AND ENVIRONMENT

Time - 3 Hrs. ***M.M. - 50***

1. Brief introduction of the major ecosystems of the world.

2. Communities and Ecosystems.
3. Trophic structure, energy flow, ecosystem pyramids.
4. Basic types of biochemical cycles (Nitrogen, Phosphorus, Sulphur).
5. Conservation of Natural resources.
6. Ecology in relation to climate in India.
7. Morphological physiological and behavioural adaptations to external factors such as temperature, moisture, salinity and light.
8. Competition, Predation, Parasitism, commensalisms and mutualism.
9. Environmental pollution.

B.Sc. Part - III

PAPER - III

EVOLUTION AND MICROBIOLOGY

Time - 3 Hrs. ***M.M. - 50***

1. Concept and Evidences of Organic Evolution.
2. Theories of organic evolution.
3. Origin of life.
4. Concept of micro - macro and migaevolution.
5. Concept of origin of species.
6. Fossils.
7. Phylogemy of horse.
8. Evolution of Man.
9. Introduction of Microbiology.
10. Structure and classification of Micro - organism.
11. Bacterial and Viral diseases.
12. Management of Micro - organism.

ZOOLOGY

B.Sc. (Part I)

M.M.

Ist Paper	-	Life and Diversity of Invertebrates	33
IInd Paper	-	Life and Diversity of Chordates	33
IIIrd Paper	-	Cytology and Developmental Biology	34
		Practical	50

Life and Diversity of Invertebrates

Paper - I ***M.M. 33***

Functional morphology of the types with special emphasis on the adaptations to their modes of life and environment. General characters and classification of all phyla upto classes with examples emphasizing their biodiversity, economic importance and conservation measures.

1. Introduction of Invertebrates.
2. Protozoa - Paramecium, Plasmodium
3. Porifera - Sycon
4. Coelenterate - Obelia, Coral and Coral reefs.
5. Helminthes - Liverfluke, Parasitism
6. Annelida - Nereis, metamerism
7. Arthropoda - Prawn, Social insects
8. Mollusca - Pila, Pearl formation
9. Echinodermata - Starfish - Echinoderm larvae
10. Hemichordata – Balanoglossus

Books Recommended :

1. Hickman C.P. Jr., F.M. Hickman and L.S. Roberts, Integrated Principles of Zoology, Mosby College Publication, St. Louis.
2. Ayyar, E.K. and T.N. Ananthakrishnan, Manual of Zoology, Vol. I (Invertebrata), Parts I & II, S. Viswanathan (Printers and Publishers) Pvt. Ltd., Madras.
3. Jordan, E.L. and P.S. Verma, Invertebrate Zoology, S. Chand & Co. Ltd. Ram Nagar, New Delhi.
4. Parker and Haswell, Text Book of Zoology, Vol. I, (Invertebrata), A.Z.T.B.S. Publishers and Distributors, New Delhi - 110 051
5. Ismail, S.A., Vermicology : The Biology of Earthworms, Orient Longman, India.
6. Kotpal, R.L., Invertebrates, Rastogi Publications, Meerut.

Life and Diversity of Chordates

Paper - II ***M.M. 33***

Functional morphology of the types with special emphasis on the adaptations to their modes of life and environment. General characters and classification of all classes upto orders with examples emphasizing their biodiversity, economic importance and conservation measures.

1. Origin of Chordata
2. Protochordata - Herdmania,Amphioxus
3. Cyclostomata - Petromyzon
4. Pisces - Scoliodon, Scales and fins of fishes, Fish migration and parental care.
5. Amphibia - Frog - Parental care and origin of Amphibia
6. Reptilia - Uromastix - Skeleton of Varanus, Extinct Reptiles, Poisonous and non-poisonous snakes and poison apparatus
7. Aves - Pigeon, flight adaptation and bird migration
8. Mammals - Rabbit, evolution of man, dentition in mammals

Books Recommended :

1. Ayyar, E.K. and T.N. Ananthakrishnan, Manual of Zoology, Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt. Ltd., Madras
2. Jordan, E. L. and P.S. Verma, Chordate Zoology and Elements of Animal Physiology, S. Chand & Co. Ltd. Ram Nagar, New Delhi
3. Nigam, H.C., Zoology of Chordates, Vishal Publications, Jalandhar - 144008
4. Parker and Haswell, Text Book of Zoology, Vol. II (Chordata), A.Z.T.B.S. Publication and Distributors, New Delhi - 110 051
5. Waterman, Allyn J. et.al., Chordate Structure and Function, McMillan & Co, New York.
6. Kotpal R.L. - Vertebrate - Rastogi Pub-Meerut.

Cytology and Develomental Biology

Paper III ***M.M. - 34***

1. Methods in Cell Biology
2. Organisation of Cell - Nuclear and Extranuclear
3. Cell Reproduction
4. An elementary idea of cell transformation, Cancer and Cellular basis of immunity.
5. Gametogenesis
6. Fertilization
7. Types of patterns of cleavage

8. Blastulation and Fate map construction in Frog and Chick
9. Gastrulation in Frog and Chick upto the formation of three germinal layers
10. Elementary knowledge of Primary organizer and extra embryonic membranes and regeneration

Books Recommended :

1. Alberts, Bray, Lewis, Raff, Roberts & Watson, Molecular Biology of the Cell (Garland)
2. Balinsky, An Introduction to Embryology (CBS College Publishers)
3. Grant : Biology of Developing Systems (Holt, Reihart and Winston)
4. Gilberts : Developmental Biology (Sinauer)
5. Karp G-Cell & Mol. Biol - John wiley.
6. Lodish, H. et. al., Molecular Cell Biology (Freeman)

Practical ***M.M. 50***

1-Lal SS - Test Book of Practical Zoology

Vol - I, Rastogsi Pub - Meerut

ZOOLOGY

B.Sc. (Part II)

Ist Paper	Genetics	33
IInd Paper	Animal Physiology	33
IIIrd Paper	Molecular Biology	34
	Practical	50

GENETICS

Paper I ***M.M. 33***

1. Elements of heredity and variation.
2. Gene Expression
3. Linkage, Sex chromosome and Sex linkage
4. Chromosomal abberrations
5. Human genetics
6. Cytoplasmic Inheritance
7. Applied Genetics

Books Recommended :

1. Verma, P.S. and V. K. Agarwal, Genetics, S. Chand & Co., New Delhi
2. Lewis, C.D. and Lewin, R., Biology of Gene, McGraw Hill, Toppan Co. Ltd.
3. Gunther S. Stent, Molecular Genetics, Macmillan Publishing Co. Inc.
4. Goodenough, V., Genetics, New York Holt, Rinchart and Winston
5. Gardner, Principles of Genetics, Wiley Eastern Pvt. Ltd.
6. Winchester, Genetics, Oxford IBH Publications
7. Stickberger, Genetics, Macmillan Publications
8. Pai, A.C., Foundations of Genetics, McGraw Hill Publications
9. Gupta P. K. - Genetics - Rastogi Pub, Meerut.
10. Arora, Gurusharan, Sandhu - Genetics - Himalaya Pub New Delhi.

ANIMAL PHYSIOLOGY

Paper - II ***M.M. 33***

1. Nutrition, Metabolism & Enzymes
2. Respiration, Organs of Respiration, Properties & functions of respiratory pigments
3. Regulatory mechanisms
4. Neuromuscular co-ordination
5. Endocrine and reproductive system

Books Recommended :

1. William S. Hoar, General and Comparative Physiology, Prentice Hall of India Pvt. Ltd.
2. Wood, D.W., Principles of Animal Physiology
3. Prosser, C.L., Comparative Animal Physiology, Satish Book Enterprise
4. Eckert, Animal Physiology, W.H. Freeman
5. Hadley - Endocrinology - Prentice Hall New Jersy.

MOLECULAR BIOLOGY

Paper III ***M.M. 34***

1. Nucleic acids, structure, Nature and function of genetic material
2. Regulation of Protein synthesis
3. Genetic Code
4. Genetic Engineering and its applications
5. Mutation - molecular basis of mutation

Books Recommended :

1. Gunther S. Stent, Molecular Genetics, Macmillan Publishing Co. Inc.
2. Goodenough, V., Genetics, New York Holt, Rinchart and Winston
3. Gardner, Principles of Genetics, Wiley Eastern Pvt. Ltd.
4. Gupta, P.K., Molecular Biology, Rastogi Publishers, Meerut
5. Verma, P.S., Molecular Biology, S. Chand & Co.
6. Lewin, Genes IX, Pearson Pub.

Practical MM 50

1. A tet book of Practical Zoology Vol. II
   Rastogi Pub. Meerut.
2. Rana SVS, Biological Techniques,

ZOOLOGY

B.Sc. (Part Three) **M.M.**

Ist Paper	Applied Zoology	50
IInd Paper	Ecology and Environment	50
IIIrd Paper	Evolution and Microbiology	50
	Practical	75

APPLIED ZOOLOGY

Paper I ***M.M. 50***

1. Principles of Aquaculture
2. Sericulture
3. Apiculture
4. Lac Culture
5. Pisciculture and Aquarium fish keeping
6. Poultry keeping
7. Toxicology

Books Recommended :

1. Jhingran, V.G., Fish and Fisheries of India, Hindustan Publishing Corporation, New Delhi
2. Kovaleve, P.A., Silkworm Breeding Stocks, Central silk Board, Merine Drive, Bombay
3. Roger, A. Morse, The ABC and XYZ of Bee Culture, A. I. Root & Co., Medina, Ohio 44256
4. Metcalf, C.L. and W. P. Flint, Destructive and Useful Insects, Tata McGraw Hill Publishing Co. Ltd., New Delhi - 110 051

5. Harbans singh and Earl N. Moore, Livestock and Poultry Production, Prentice Hall of India, New Delhi
6. Mills, Dick, Aquarium Fish, DK Publishing Book, DK Publishing Inc., New York 10016
7. Bal, D.V. and K.V. Rao, Marine Fisheries, Tata McGraw Hill, New Delhi.
8. Shukla, Upadhyay - Economic Zoology, Rastogi Pub. Meerut.
9. Rana SVS - Environmental Toicology

ECOLOGY AND ENVIRONMENT

Paper II ***M.M. 50***

1. Brief introduction to the major ecosystems of the world
2. Communities and Ecosystems
3. Trophic structure, energy flow, ecosystem pyramids.
4. Basic types of biochemical cycles (Nitrogen, Phosphorus, Sulphur)
5. Conservation of Natural resources
6. Ecology in relation to climate in India
7. Morphological physiological and behavioural adaptations to external factors such as temperature, moisture, salinity and light
8. Competition, Predation, Parasitism, commensalism and mutualism
9. Environmental pollution

Books Recommended :

1. Odum, Ecology, Amerind
2. Odum, Fundamentals of Ecology, W.B. Saunders
3. Ricklefy, Ecology, WH Freeman
4. Turk and Turk, Environmental Science, W.B. Saunders
5. Verms, P.S., Ecology, S. Chand & Co., New Delhi
6. Sharma P.D. - Environmental Biology - Rastogi Pub. Meerut.

EVOLUTION AND MICROBIOLOGY

Paer III ***M.M. 50***

1. Concept and Evidences of Organic evolution
2. Theories of organic evolution
3. Origin of life
4. Concept of micro-macro and mega evolution
5. Concept of origin of species
6. Fossils

7. Phylogemy of horse
8. Evolution of Man
9. Introduction to Microbiology
10. Structure and classification of Micro-organism
11. Bacterial and viral diseases
12. Management of Micro-organism

Books Recommended :

1. Dobzhansky, Ayala, Stebbins & Valentine, Evolution, WH Freeman
2. Dobzhansky, Genetics and Origin of species, Columbia University Press
3. White, Animal Cytology & Evolution, Cambridge univ. Press, Melbourne.
4. Strickberger - Evolution (3rd ed.) CBS, New Delhi
5. Sharma P.D. Microbilogy - Rastogi Pub. Meerut.

Practical M.M. 75

1. Lal, SS, A test book of Practical Zoology, Vol III, Rastogi Pub. Meerut.

B.Sc. (Geology)

FIRST YEAR

			M.M.	Practical
Paper	I.	Physical Geology	33	
	II.	Structural Geology	33	
	III.	Crystallography, Mineralogy & Optical Mineralogy	34	
		Total -	100	50

SECOND YEAR

			M.M.	Practical
Paper	I.	Stratigraphy and Palaeontology	33	
	II.	Economic Geology and Indian Distribution	33	
	III.	Petrology	34	
		Total -		100 50

THIRD YEAR

			M.M.	Practical
Paper	I.	Petrology	50	
	II.	Environmental Geology and Applied Geomorphology	50	
	III.	Engineering Geology and Hydrogeology	50	
			Total - 150	75

B.Sc. Part - I

PAPER - I

PHYSICAL GEOLOGY

Time - 3 Hrs. ***M.M. - 33***

UNIT - I

Elementary ideas about Solar System. Geology and subdivisions, modern concepts of origin and age earth, radiometric dating methods of rocks - (K/Ar, Rb/Sr, U/Pb and C^{14}), Geological time scale, Isostasy.

UNIT - II

Mechanical and Chemical weathering, Geological work by River, Wind and Glacial, and related landform.

UNIT - III

Coastal landforms & processes, Relief of ocean floor, Coral reefs, Lakes, their types and origin. Volcanoes - their types & distribution.

UNIT - IV

Interior of the earth, Earthquakes and Seismisity; Wilson cycle, Continental Drifting; Orogeny and Mountain Building Processes.

B.Sc. Part - I

PAPER - II

STRUCTURAL GEOLOGY

Time - 3 Hrs. M.M. - 33

UNIT - I

Introduction to Structural geology; Crustal processes, nature and behavior of the crust during deformation; Basic concept of stress and strain; Basic concept of plate tectonics, Sea-floor spreading.

UNIT - II

Bedding, outcrop, dip, strike and thickness of beds; criteria for recognition of top and bottom of beds Unconformities - their classification and recognition.

UNIT - III

Folds, their classification and recognition; Forms concordant and discordant igneous bodies; Linear structure; Planar structures.

UNIT - IV

Faults and their classification - normal, reverse and strike - slip faults; Recognition of faults in the field and in the map; Joints, their classification.

B.Sc. Part - I

PAPER - III

CRYSTALLOGRAPHY, MINERALOGY & OPTICAL MINERALOGY

Time - 3 Hrs. ***M.M. - 34***

UNIT - I

Basic idea about crystal, crystal growth and crystallization; Laws of crystallography, crystal morphology, crystallographic axes, elements of symmetry, crystallographic notation, crystal forms, Habit and classification; Crystal aggregate; Twinning and common twin laws.

UNIT - II

Crystal System - cubic, tetragonal, hexagonal, orthorhombic, monoclinic and triclinic; symmetry and forms of galena type, pyrite type, zircon type, beryl type, barites type, gypsum type and axinite type.

UNIT - III

Definition of mineral; atomic bonding; Physical properties of minerals - colour, luster, form, pseudomorphism, polymorphism, hardness, fracture, cleavage, specific gravity, and characters based on heat, electricity and magnetism; Silicate structure. Polarized light, Isotropic and anisotropic minerals; Optical properties of minerals - pleochrosm, relief, twinkling, interference colours, and extinciton; Uniaxial and biaxial minerals.

UNIT - IV

Physical properties, chemical composition, occurrences, and uses of the minerals belonging to the silica, feldspar, amphibole, pyroxene, mica and garnet groups.

LABORATORY WORK

Problems on dip. strike and thickness of beds; Contour maps and completion of outcrops; Geological maps and scetions including geological history; Use of clinometer compass.

Graphical construction of crystallographic axes of cubic system; Clinographic projections of typical crystals of Cube. Rhombdodecahedron. Tetrahexahedron, Octahedron. Trapezohedron, Pyritohedron, Tetrahedron, Zircon, Beryl, Calcite, Barites and Gypsum,

Determination of hardness; study of forms, colour, lustre, cleavage, fracture, Identification of rock forming minerals in hand specimens; Study of optical properties of quartz microcline, plagioclase, calcite, biotite, muscovite and garnet.

B.Sc. Part - II

PAPER - I

STRATIGRAPHY AND PALAEONTOLOGY

Time - 3 Hrs. ***M.M. - 33***

UNIT - I

General Principles of Stratigraphy and correlation; Principles of lithostratigraphic classification, Brief idea of Archaean sequences of Peninsular India with special reference to Dharwar and Aravalli Supergroups.

UNIT - II

Unmetamorphosed Proterozoic sequences - Cuddapah Supergroup and Vindhyan Supergroup. Gondawana Supergroup and Siwalik Group.

UNIT - III

Introduction and applications of palaeontology; Fossil, definition, modes of fossilization; Distribution of organisms in marine environment, their modes of life, Index fossils and their uses.

Bivalvia Gastropoda and Brachiopoda - their morphology, modes of life and geological history.

Unit - IV

Cephalopoda Echinodermata (Echinoidea) and Arthropoda (Trilobita) - their morphology, mode of life and geological history.

Important Gondwana Plant fossils.

B.Sc. Part - II

PAPER - II

ECONOMIC GEOLOGY & INDIAN DISTRIBUTION

Time - 3 Hrs. ***M.M. - 33***

UNIT - I

Historcal introduction to economic geology. Definition of ore and terminology, Structure and form of ore deposits.

Control of ore depositions, classification of ore deposits.

UNIT - II

Processes of formation and transformation of ores; Endogenous; Magmatic, Pegmatitic, Contact, metasomatic and hydrothermal deposits.

Exogenons : Sedimentary residual and Mechanically, concentrated deposit superentichment.

UNIT - III

Introduction to coal and petroleum and distribution in India

UNIT - IV

Distribution and mode of occurrences of important metallic minerals (Iron, Copper, Lead, Zinc, Aluminum, Gold) in India.

B.Sc. Part - II

PAPER - III

PETROLOGY

Time - 3 Hrs. ***M.M. - 34***

UNIT - I

Introduction to petrology Magma and its characteristic - temperature, viscosity, density, gas contents; Textures of igneous rocks; Crystallization of magma - unicomponent (Silica system), Bicomponent (Sphene - Anorthite system and Albite - Anorthite system), Bowen's reaction principles.

UNIT - II

Type of classification of igneous rocks with special reference to the IUGS classification for plutonic and volcanic igneous rocks; Elementry ideas of petrogenesis, differentiation and assimilation; Mode of occurrence and genesis of granite, gabbro, dolerite, pegmatite, nepheline syenite, peridetite, rhyolite and basalt.

UNIT - III

Nature and origin of sedimentary rock; Texture of sedimentary rocks; Classification of sedimentary rocks; Classification of sandstones and carbonate rocks; Sedimentary structures; diagenesis.

UNIT - IV

Definition and types of metamorphism; Texture, fabric and structure in metamorphic rocks; concepts of metamorphics zones, facies and grades; Metamorphism of the following types impure carbonates, argillaceous sediments, arenaceous sediments, acidic and basic rocks Anatexis.

Laboratory Work - Study of the morphology of representative invertebrates.

Study of important Gondwana plant fossils.

Study of the optical properties of alkali feldspars, sodic and calcic plagioclases, muscovite, hypersthene, kyanite, sillimanite, andalusite, staurolite, actinolite. tremolite, chlorite, zircon, sphene, apatite, epidote, magnetite, hematite, chromite and ilmenite.

Study of the following rock types in hand specimens and thin section: granite, rhyolite, syenite, diorite, dolerite, gabbro, basalt, dunite, quartz - arenite, arkose, greywacke, micrite, oolitic limestone, fossiliferous limestone, quartzite, marble, schist, and charnockite.
Study of the following rock types in hand speciments: pegmatite, conglomerate, breccia and gneiss. Study of important economic minerals in hand specimens.

B.Sc. Part - III

PAPER - I

PETROLOGY

Time - 3 Hrs. ***M.M. – 50***

UNIT - I

abundance of elements in the cosmos and earth, composition of earth with special reference to upper mantle and the crust; Goldschmidt's geochemical classification; Geochemical terentiation of the earth; Geochemical cycle; Elementary idea of the laws of thermodynamics.

UNIT - II

Phase rules lever rule; study of phase diagrams - Leucite - Silica system, Anorthite - Sphene ollastoni systom, ALbite - Anorthite - Diopside system; Variation diagrams.

UNIT - III

Meteorites and their classification; Magma characteristics and generation, Important igneous association in plate tectonic settings; Use of stable isotopes of strontium and carbon.

UNIT - IV

Metamorphic index minerals, and their stability fields; pressure divisions of metamorphic significance of aluminosilicates, polymorphs in metamorphism, Facies of low temperature metamorphism (zeolite - perhnite - pumpelltine facies); Facies of medium and high pressure regional metamorphism (greenschist, amphibolite and granulite facies); Facies of very pressure metamorphism (blue schist and eclogite facies).

B.Sc. Part - III

PAPER - II

ENVIRONMENTAL GEOLOGY AND APPLIED GEOMORPHOLOGY

Time - 3 Hrs. ***M.M. - 50***

UNIT - I

Basic concept of Environmental geology, study of Earthquakes, Volcanoes, Floods, Landslides and dry land as hazardous phenomena.

UNIT - II

Pollution surface and sub surface (ground water) pollution, sedimentation and water pollution. Atmosphire, atmospheric pollution, green house gases, green house effect and ozone depletion.

UNIT - III

Physiographic and Geomorphic divisions of India, climate and land forms, weathering; physical weathering; Thermal expansion, chemical weathering processes, soil profile, formation of soil, soil group of India.

UNIT - IV

Fluvial processes, Fluvial and aeolian landforms, Desertification, Arid semiarid landforms, Glacial-periglacial and coastal processes and landforms.

PAPER - III Engineering Geology and Hydrogeology

Unit I

Engineering geology and its importance in context to planning, design and construction of projects. Engineering properties of rocks (specific gravity, porosity, absorption value, compression strength, tensile strength, shear strength, modulus of elasticity and modulus of compression).

Unit II

Classification of Dams reservoirs, geological and geotechnical consideration for dam site, terminology and purpose of dams, Geological constraints for tunnel, highways and bridges.

Unit III

Hydrological cycle Groundwater in the Hydrological cycle, Origin of groundwater, meteoric, juvenile and magma tic water. Vertical distribution of groundwater, porosity, permeability, Darcy law.

Unit IV

Ground water reservoirs - A quifers, aquicludes, aquitards and aquifuge. Classification of aquifers, spring and artesian well. Artificial recharge of groundwater, Seawater intrusion in coastal area, and Elementary idea about water balance studies. Basic concepts about quality of groundwater and weater pollution.

Laboratory Work

Study of the following rock types in hand specimens and in thin sections; granodiorite, nepheline syenite, anorthosite, basalt, andesite, peridotite, granophyre, tuff, glauconitic-sandstone, pellet limestone, oolitic-limestone, intraclastic-limestone, bioclastic - limestone, stromato litic-limestone, siltstone shale, amphibolite, slate, phyllite, garnetiferous-schist, staurolite - schist, and charnockite.

Simple survey problems using clinometer, brunton and prismatic compasses.

Plotting of variation diagrams and triangular plots.

Determination of uniaxial, biaxial, positive/negative, length slow/fast character of minerals, order of interference colours; Pleochroic scheme.

Study of Geomorphological maps and Identification of groundwater condition and aquifer in water table contour maps.

BUNDELKHAND UNIVERSITY SYLLABUS

Subject - CHEMISTRY

B.Sc. (Part - I) Exam. 2009-2010 & onwards

Syllabus at a glance (Theory & Pract.)

B.Sc. - I Year

Paper I	**CH-101 Inorganic Chemistry**	**60 Hrs (2 Hrs/week) 33 MM.**	
I	Atomic Structure	6 Hrs	
II	Periodic Properties	5 Hrs	
III	Chemical Bonding	20 Hrs	
IV	s-Block Elements	6 Hrs	
V	p-Block Elements	20 Hrs	
VI	Chemistry of Noble Gases	3 Hrs	
Paper II	**CH-8-102 Organic Chemistry**	**60 Hrs (2 Hrs/week)**	
		2\34 MM.	
I	Structure and Bonding	5 Hrs	
II	Mechanism of Organic Reactions	8 Hrs	
III	Stereochemistry of Organic Compounds	12 Hrs	
IV	Alkanes and Cycloalkanes	7 Hrs	
V	Alkenes, Cycloalkenes, Dienes and Alkynes	12 Hrs	
VI	Arenes and Aromaticity	8 Hrs	
VII	Alkyl and Aryl halides	8 Hrs	
Paper III		**CH-103 Physical Chemistry**	**60 Hrs (2 Hrs/week) 33 MM.**
I	Mathematical Concepts and Computers	16 Hrs	
II	Gaseous State	8 Hrs	
III	Liquid State	6 Hrs	
IV	Solid State	11 Hrs	

V	Colloidal state	6 Hrs
VI	Chemical Kinetics and Catalysis	13 Hrs

Practical CH-104 Laboratory Course

180 Hrs (6 Hrs/week) 50 MM.
(Inorganic, Organic, Physical)

Details of Chemistry Syllabus (Theory)

B.Sc. (Part One) Exam. 2009 - 2010 & onwards

Paper I - CH-101 Inorganic Chemistry **60 Hrs (2 Hrs/week) 33 MM**

I Atomic Structure 6 Hrs

Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of ψ and $\psi 2$, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p and d orbitals, Aufbau and Pauli exclusion principles, Hund's multiplicity rule, Electronic configurations of the elements, effective nuclear charge

II Periodic Properties 5 Hrs

Atomic and ionic radii, ionization energy, electron affinity and electronegativity, definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behaviour.

III Chemical Bonding 20 Hrs

(A) Covalent Bond - Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, CIF_3, ICl^-_2 and H_2O. MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

(B) Ionic Solids - Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle,

solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond-free electron, valence bond and band theories.

(C) Weak Interactions - Hydrogen bonding, Van der Waals forces

IV s-Block Elements 6 Hrs

Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, and introduction to alkyls and aryls.

V p-Block Elements 20 Hrs

Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13-16, hydrides of boron-diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides.

VI Chemistry of Noble Gases 3 Hrs

Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.

Paper II

CH-102 Organic Chemistry **60 Hrs (2 Hrs/Week) 34 MM**

I Structure and Bonding 5 Hrs

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

II Mechanism of Organic Reactions 8 Hrs

Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, homolytic and heterolytic bond breaking. Types of reagents-electrophiles and nucleophiles. Types of organic reactions, Energy considerations.

Reactive intermediates - carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species.

Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).

III Stereochemistry of Organic Compounds 12 Hrs

Concept of isomerism, types of isomerism.

Optical isomerism - elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization.

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

Geometric isomerism - determination of configuration of geometric isomers E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

Conformational isomerism - conformational analysis of ethans and n-butane, conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives. Newman projection and Sawhorse formulae, Fischer and Flying wedge formulae. Difference between configuration and conformation.

IV Alkanes and Cycloalkanes 7 Hrs

IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation (with special reference to Wurtz reaction, Kolbe's reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and chemical reactions of alkanes.

Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity. Cycloalkanes- nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring: banana bonds.

V Alkenes, Cycloalkenes, Dienes and Alkynes 12 Hrs

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

Chemical reactions of alkenes -- mechanisms involved in hydrogenation. electrophilic and free radical additions. Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$

Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene.

Methods of formation, conformation and chemical reactions of cycloalkenes.

Nomenclature and classification of dienes : isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reaction --1, 2 and 1, 4 additions, Diels-Alder reaction.

Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration - oxidation, metal-ammonia reductions, oxidation and polymerization.

VI Arenes and Aromaticity 8 Hrs

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

Aromaticity the Huckel rule, aromatic ions.

Aromatic electrophilic substitution--general pattern of the mechanism, role of σ - and π - complexes. Mechansim of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Birch reduction.

Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl.

VII Alkyl and Aryl Halides 8 Hrs

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution reactions of alkyl halides, SN_2 and SN_1 reactions with energy profile diagrams.

Polyhalogen compounds: chloroform, carbon tetrachloride.

Methods of formation of aryl halides, nuclear and side chain reactions.

The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions.

Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides. Synthesis and uses of DDT and BHC.

Paper III

CH-103 Physical Chemistry **60 Hrs (2 Hrs/week) 33 MM**

I Mathematical Concepts and Computers 16 Hrs

(A) Mathematical Concepts

Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like a^x, e^x, x^n, sin x, log x; maxima and minima, partial differentiation and reciprocity relations. Integration of some useful/relevant functions; permutations and combinations. Factorials. Probability.

(B) Computers

General introduction to computers, different components of a computer, hardware and software, input-output devices; binary numbers and arithmatic; introduction to computer languages. Programming, operating systems.

II Gaseous State 8 Hrs

Postulates of kinetic theory of gases, deviation from ideal behavior, Van der Waals equation of state.

Critical Phenomena : PV isotherms of real gases, continuity of states, the isotherms of Van der Waals equation, relationship between critical constants and Van der Waals constants, the law of corresponding states, reduced equation of state.

Molecular velocities : Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquification of gases (based on Joule-Thomson effect).

III Liquid State 6 Hrs

Intermolecular forces, structure of liquids (a qualitative description).

Structural differences between solids, liquids and gases.

Liquid crystals: Difference between liquid crystal, solid and liquid. Classification, structure of nematic and cholestric phases. Thermography and seven segment cell.

IV Solid State 11 Hrs

Definition of space lattice, unit cell.

Laws of crystallography - (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg equation. Determinaion of crystal structue of NaCl, KCl and CsCl (Laue's method and powder method).

V Colloidal State 6 Hrs

Definition of colloids, clasification of colloids.

Solids in liquids (sols): properties - kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number. Liquids in liquids (emulsions): types of emulsions, preparation. Emulsifier. Liquids in solids (gels): classification, preparation and properties, inhibition, general applications of colloids.

VI Chemical Kinetics and Catalysis 13 Hrs

Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction - concentration, temperature, pressure, solvent, light, catalyst. Concentration dependence of rate, mathematical characteristics of simple chemical reactions - zero order, first order, second order, pseudo order, half life and mean life. Determination of the order of reaction - differential method, method of integration, method of half life period and isolation method.

Radioactive decay as a first order phenomenon.

Expriemental methods of chemical kinetics: conductometric, potentiometric, optical methods, polarimetry and spectrophotometer. Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects.

Catalysis, characteristics of catalysed reactions, classification of catalysis, miscellaneous examples.

Syllabus for Practicals
B.Sc.

CH-104 Laboratory Course **180 Hrs (6 Hrs/week) 50 MM**

Inorganic Chemistry

Semimicro Analysis - cation analysis, separation and identification of ions from Groups I, II, III, IV, V and VI. Anion analysis.

Organic Chemistry

Laboratory techniques

Calibration of Thermometer

80-82^0 (Naphthalene), 113.5-114^0 (Acetanilide).

132.5-133^0 (Urea), 100^0 (Distilled Water)

Determination of melting point

Naphthalene 80-82^0, Benzoic acid 121.5-122^0

Urea 132.5-133, Succinic acid 184.5-185^0

Cinnamic acid 132^0, Salicylic acid 157.5-158^0

Acetanilide 113.5-114^0, m-Dinitrobenzene 90^0

p-Dichlorobenzene 52^0, Aspirin 135^0

Determination of boiling points

Ethanol 78^0, Cyclohexane 81.4^0, Toluene 110.6^0, Benzene 80^0

Mixed melting point determination

Urea-Cinnamic acid mixture of various compositions (1:4, 1:1, 4:1)

Distillation

Simple distillation of ethanol-water mixture using water condenser

Distillation of nitrobenzene and aniline using air condenser

Crystallization

Concept of induction of crystallization

Phthalic acid from hot water (using fluted filter paper and stemless funnel)

Acetanilide from boiling water

Naphthalene from ethanol

Benzoic acid from water

Decolorisation and crystallization using charcoal

Decolorisation of brown sugar (sucrose) with animal charcol using gravity filtration.

Crystallization and decolorisation of impure naphthalene (100g of naphthalene mixed with 0.3g of Congo Red using 1g decolorising carbon) from ethanol.

Sublimation (Simple and Vacuum)

Camphor, Naphthalene, Phthalic acid and Succinic acid.

Qualitative Analysis

Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.

PHYSICAL CHEMISTRY

Chemical Kinetics

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
2. To study the effect of acid strength on the hydrolysis of an ester.
3. To compare the strengths of HCl and H_2SO_4 by studying the kinetics of hydrolysis of ethyl acetate.
4. To study kinetically the reaction rate of decomposition of iodide by H_2O_2.

Distribution Law

1. To study the distribution of iodine betwen water and CCl_4

2. To study the distribution of benzoic acid between benzene and water.

Colloids

1. To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi- and trivalent anions.

Viscosity, Surface Tension

1. To determine the percentage composition of a given mixture (non interacting systems) by viscosity method.
2. To determine the viscosity of amyl alcohol in water at different concentrations and calculate the excess viscosity of these solutions.
3. To determine the percentage composition of a given binary mixture by surface tension method (acetone & ethyl methyl ketone).

BUNDELKHAND UNIVERSITY SYLLABUS

Subject - CHEMISTRY

B.Sc. (Part - II) Exam. 2009-2010 & onwards

Syllabus at a glance (Theory & Pract.)

B.Sc. - II Year

Paper I	**CH-201 Inorganic Chemistry**	**60 Hrs (2 Hrs/week) 33 mm.**
I	Chemistry of Elements of First Transition Series	10 Hrs
II	Chemistry of Elements of Second and Third Transition Series	10 Hrs
III	Oxidation and Reduction	8 Hrs
IV	Coordination Compounds	10 Hrs
V	Chemistry of Lanthanide Elements	6 Hrs
VI	Chemistry of Actinides	4 Hrs
VII	Acids and Bases	6 Hrs

VIII	Non-aqueous Solvents	6 Hrs

Paper II CH-202 Organic Chemistry **60 Hrs (2 Hrs/week) 34 MM.**

I	Electromagnetic Spectrum; Absorption Spectra	10 Hrs
II	Alcohols	6 Hrs
III	Phenols	6 Hrs
IV	Ethers and Epoxides	6 Hrs
V	Aldehydes and Ketones	14 Hrs
VI	Carboxylic Acid	6 Hrs
VII	Carboxylic Acid Derivatives	3 Hrs
VIII	Organic Compounds of Nitrogen	12 Hrs

Paper III CH-203 Physical Chemistry **60 Hrs (2 Hrs/week)** **33 MM.**

I	Thermodynamics - I	12 Hrs
II	Thermodynamics - II	13 Hrs
III	Chemical Equilibrium	5 Hrs
IV	Phase Equilibrium	10 Hrs
V	Electrochemistry - I	10 Hrs
VI	Electrochemistry - II	10 Hrs

Practical CH-204 Laboratory Course

(Inorganic, Organic, Physical) **180 Hrs (6 Hrs/ week) 50 MM.**

Details of Chemistry Syllabus (Theory)
B.Sc. (Part Two) Exam. 2009 - 2010
& onwards

Paper I

CH-201 Inorganic Chemistry **60 Hrs (2 Hrs/week) 33 MM.**

I Chemistry of Elements of First Transition Series 10 Hrs

Characteristic properties of d-block elements.

Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.

II Chemistry of Elements of Second and Third Transition Series 10 Hrs

General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry.

III Oxidation and Reduction 8 Hrs

Use of redox potential data-analysis of redox cycle, redox stability in water - Frost, Latimer and Pourbaix diagrams. Principles involved in the extraction of the elements.

IV Coordination Compounds 10 Hrs

Warner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

V Chemistry of Lanthanide Elements 6 Hrs

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.

VI Chemistry of Actinides 4 Hrs

General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides.

VII Acids and Bases 6 Hrs

Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases.

VIII Non-aqueous Solvents 6 Hrs

Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2

Paper II

CH-202 Organic Chemistry 60 Hrs (2 Hrs/week) 34 MM

I Electromagnetic Spectrum : Absorption Spectra 10 Hrs

Ultraviolet (UV) absorption spectroscopy - absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transition, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones.

Infrared (IR) absorption spectroscopy--molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds.

II Alcohols 6 Hrs

Classification and nomenclature.

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

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

Trihydric alcohols -- nomenclature and methods of formation, chemical reactions of glycerol.

III Phenols 6 Hrs

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

IV Ethers and Epoxides 3 Hrs

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

V Aldehydes and Ketones 14 Hrs

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1, 3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties.

Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Witting reaction. Mannich reaction.

Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction. MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions. Halogenation of enolizable ketones.

An introduction to α, β unsaturated aldehydes and ketones.

VI Carboxylic Acids 6 Hrs

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. Mechanism of decarboxylation.

Methods of formation and chemical reactions of unsaturated monocarboxylic acids.

Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents.

VII Carboxylic Acid Derivatives 3 Hrs

Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution.

Preparation of carboxylic acid derivatives, chemical reactions. Mechanisms of esterification and hydrolysis (acidic and basic).

VIII Organic Compounds of Nitrogen 12 Hrs

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid. Halonitroarenes : reactivity. Structure and nomenclature of amines, physical properties. Stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salt as phase-transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction. Hofmann bromoamide reaction.

Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

Paper III

CH-203 Physical Chemistry **60 Hrs (2 Hrs/week) 33 MM**

I Thermodynamics - I 12 Hrs

Definition of thermodynamic terms : system, surroundings etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work.

First Law of Thermodynamics : Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule - Thomson coefficient and inversion temperature. Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process. Thermochemistry: standard state, standard enthalpy of formation-Hess's Law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo chemical data, temperature dependence of enthalpy. Kirchoff's equation.

II Thermodynamics - II 13 Hrs

Second law of thermodynamics : need for the law, different statements of the law. Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature.

Concept of entropy : entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases.

Third law of thermodynamics : Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions ; Gibbs function (G) and Helmholtz functon (Z) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of G and A with P, V and T.

III Chemical Equilibrium 5 Hrs

Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle.

Reaction isotherm and reaction isochore - Clapeyron equation and Clausius - Clapeyron equation, applications.

IV Phase Equilibrium 10 Hrs

Statement and meaning of the terms - phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system - water, CO_2 and S systems.

Phase equilibria of two component system - solid -liquid equilibria, simple eutectic - Bi-Cd, Pb-Ag systems, desilverisation of lead.

Solid solutions - compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCl-H_2O), $Fecl_3$-H_2O) and $CuSO_4$-H_2O) system. Freezing mixture, acetone-dry ice.

Liquid - liquid mixtures - Ideal liquid mixtures, Raoult's and Henry's law. Non-ideal system-azeotropes - HCl-H_2O and ethanol - water systems. Partially miscible liquids - Phenol-water, trimethylamine-water, nicotine-water systems. Lower and upper consolute temperature. Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law - thermodynamic derivation, applications.

V Electrochemistry – I 10 Hrs

Electrical transport - conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific coductance with dilution.

Migration of ions and Kohlrausch law Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law its uses and limitations.

Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf method and moving boundary method.

Applications of conductivity measurements : determination of degree of dissociation, determination of K_a of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

VI Electrochemistry - II 10 Hrs

Types of reversible electrodes - gas - metal ion, metal-metal ion, metal - insoluble salt - anion and redox electrodes. Electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode-reference electrodes- standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells - reversible and irreversible cells, conventional representation of electrochemical cells.

EMF of a cell and its measurements. Computation of cell EMF. Calcuation of thermodynamic quantities of cell reactions (DG, DH and K), polarization, over potential and hydrogen overvoltage.

Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations.

Definition of pH and pKa determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiometric methods.

Buffers - mechanism of buffer action, Henderson - Hazel equation. Hydrolysis of salts.
Corrosion - types, theories and methods of combating it.

PRACTICAL

CH-204 Laboratory Course **180 Hrs (6 Hrs/Week) 50 MM**

Inorganic Chemistry

Calibration of fractional weights, pipettes and burettes. Preparation of standard solutions.

Dilution - 01 M to 0.0001 M solutions.

Quantitative Analysis

Volumetric Analysis

(a) Determination of acetic acid in commercial vinegar using NaOH

(b) Determination of alkali content - antacid tablet using HCl.

(c) Estimation of calcium content in chalk as calcium oxalate by permanganometry.

(d) Estimation of hardness of water by EDTA

(e) Estimation of ferrous and ferric by dichromate method.

(f) Estimation of copper using thiosulphate.

Gravimetric Analysis

Analysis of Cu as CuSCN and Ni as Ni (dimethylgloxime).

Organic Chemistry

Laboratory Techniques

A. Thin Layer Chromatography

Determination of R_f values and identification of organic compounds.

(a) Separation of green leaf pigments (spinach leaves may be used).

(b) Preparation and separation of 2, 4-dinitrophenylhydrazones of acetone, 2-butanone, hexan-2-and 2-one using toluene and light petroleum (40:60).

(c) Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5).

B. Paper Chromatography : Ascending and Circular

Determination of R_f values and identification of organic compounds.

(a) Separation of a mixture of phenylalanine and glycine. Alanine and aspartic acid. Leucine and glutamic acid. Spray reagent - ninhydrin.

(b) Separation of a mixture of D, L - alanine, glycine, and L-Leucine using n-butanol:acetic acid:water (4:1:5). Spray reagent - ninhydrin.

(c) Separation of monosaccharides - a mixture of D-galactose and D-fructose using n-butanol:acetone:water (4:5:1). Spray reagent - aniline hydrogen phthalate.

Qualitative Analysis

Identification of an organic compoud through the functional group analysis, determination of melting point and preparation of suitable derivatives.

Physical Chemistry

Transition Temperature

1. Determination of the transition temperature of the given substance by thermometric/dialometric method (e.g. $MnCl_2$. $4H_2O$/$SrBr_2$.$2H_2O$).

Phase Equilibrium

1. To study the effect of a solute (e.g. NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system) and to determine the concentration of that solute in the given phenol-water system.
2. To construct the phase diagram of two component (e.g. diphenylamine-benzopehenone) system by cooling curve method.

Thermochemistry

1. To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.
2. To determine the enthalpy of neutralisation of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base.
3. To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber cycle.

BUNDELKHAND UNIVERSITY SYLLABUS

Subject - CHEMISTRY

B.Sc. (Part - III) Exam. 2009-2010 & onwards

Syllabus at a glance (Theory & Pract.)

B.Sc. - III Year

Paper I CH-301 Inorganic Chemistry 60 Hrs (2 Hrs/week) 50 MM.

I	Hard and Soft Acids and Bases (HSAB)	7 Hrs
II	Metal-ligand Bonding in Transition Metal Complexes	10 Hrs
III	Magnetic Properties of Transition Metal-complexes	7 Hrs
IV	Electron Spectra of Transition Metal-Complexes	7 Hrs
V	Thermodynamic and Kinetic Aspects of Metal-Complexes	5 Hrs
VI	Organometallic Chemistry	10 Hrs
VII	Bioinorganic Chemistry	10 Hrs
VIII	Silicones and phosphazenes	4 Hrs

Paper II CH-302 Organic Chemistry 60 Hrs (2 Hrs/week) 50 MM.

I	Spectroscopy	10 Hrs
II	Organometallic Compounds	4 Hrs
III	Organosulphur Compounds	4 Hrs

IV	Heterocyclic Compounds	8 Hrs
V	Organic Synthesis via Enolates	6 Hrs
VI	Carbohydrates	8 Hrs
VII	Amino Acids, Peptides, Proteins and Nucleic Acids	6 Hrs
VIII	Fats, Oils and Detergents	2 Hrs
IX	Synthetic Polymers	4 Hrs
X	Synthetic Dyes	8 Hrs

Paper III CH-303 Physical Chemisty 60 Hrs (2 Hrs/week) 50 MM.

I	Elementary Quantum Mechanics	20 Hrs
II	Spectroscopy	20 Hrs
III	Photochemistry	8 Hrs
IV	Physical Properties and Molecular Structure	5 Hrs
V	Solutions, Dilute Solutions and Colligative Properties	7 Hrs

Practical CH-304 Laboratory Course 180 Hrs (6 Hrs/week) 75 MM.
(Inorganic, Organic, Physical)

Details of Chemistry Syllabus (Theory)
B.Sc. (Part Three) Exam. 2009 - 2010
& onwards

Paper I

B.Sc. III - CH - 301 Inorganic Chemistry 60 Hrs (2 Hrs/week) 50 MM.

I Hard and Soft Acids and Bases (HSAB) 7 Hrs

Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.

II Metal-ligand Bonding in Transition Metal Complexes 10 Hrs

Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.

III Magnetic Properties of Transition Metal Complexes 7 Hrs

Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula. L-S coupling, correlation of μs and μen values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.

IV Electron Spectra of Transition Metal Complexes 7 Hrs

Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series, Orgel-energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)6]^{3+}$ complex ion.

V Thermodynamic and Kinetic Aspects of Metal Complexes 5 Hrs

A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes.

VI Organometallic Chemistry 10 Hrs

Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn and Ti, a brief account of metal-ethylenic complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

VII Bioinorganic Chemistry 10 Hrs

Essential and trace elements in biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metai ions with special reference to Ca^{2+} Nitrogen fixation.

VIII Silicones and Phosphazenes 4 Hrs

Silicones and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

Paper II

CH-302 Organic Chemistry **60 Hrs (2 Hrs/week) 50 MM**

I Spectroscopy 10 Hrs

Nuclear magnetic resonance (NMR) spectroscopy.

Proton magnetic resonance (1_H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as etyl bromide, ethanol, acetaldehyde, 1, 1, 2-tribromoethane, ethyl acetate, toluene and acetophenone.

Problems pertaining to the structure elucidation of simple organic commpounds using UV, IR and PMR spectroscopic techniques.

II Organometallic Compounds 4 Hrs

Organomagnesium compounds : Grignard reagents-formation, structure and chemical reactions.

Organozinc compounds: formation and chemical reactions.

Organolithium compounds: formation and chemical reactions.

III Organosulphur Compounds 4 Hrs

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

IV Heterocyclic Compounds 8 Hrs

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

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

V Organic Synthesis via Enolates 6 Hrs

Acidity of a - hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesi of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate.

Alkylation of 1, 3-dithianes. Alkylation and acylation of enamines

VI Carbohydrates 8 Hrs

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

Structures of ribose and deoxyribose.

An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

VII Amino Acids, Peptides, Proteins and Nucleic Acids 6 Hrs

Classification, structure and stereochemistry of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation and reactions of α-amino acids.

Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Structures of peptides and proteins. Levels of protein structure. Protein denaturation/renaturation.

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

VIII Fats, Oils and Detergents 2 Hrs

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

IX Synthetic Polymers 4 Hrs

Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers.

Condensation of step growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes.

Natural and synthetic rubbers and useful trade terminology.

Miscellaneous polymer reactions and its technique.

X Synthetic Dyes 8 Hrs

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

Paper III

CF-303 Physical Chemistry **60 Hrs (2 Hrs/week) 50 MM**

I Elementary Quantum Mechanics 20 Hrs

Black-body radiation, Planck's radiation law, photoelectric effect. heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect.

De Broglie hypothesis, the Heisenberg's uncertainty principle, Sinusoidal wave equation, Hamiltonian operator, Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box.

Schrodinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions.

Molecular orbital theory, basic ideas - criteria for forming M.O. from A.O, construction of M.O's by LCAO - H_2+ ion, calculation of energy levels from wave functions, physical picture of bonding and antibonding wave functions, concept of σ, σ^*, π, π^* orbitals and their characteristics. Hybrid obitals - sp, sp^2. sp^3, calculation of coefficients of A.O.'s used in these hybrid orbitals. Introduction to valence bond model of H_2, comparison of M.O. and V.B. Modes

II Spectroscopy 20 Hrs

Introduction: electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom.

Rotational Spectrum

Diatomic molecules. Energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope effect.

Vibrational Spectrum

Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of an harmonic motion and isotope on the spectrum, idea of vibrational frequencies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.

Raman Spectrum: concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

Electronic Spectrum

Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle.

Qualitative description of σ, π and n M.O., their energy levels and the respective transitions.

III Photochemistry 8 Hrs

Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus - Drapper law, Stark - Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples).

IV Physical Properties and Molecular Structure 5 Hrs

Optical activity, polarization - (Clausius - Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties - paramagnetism, diamagnetism and ferromagetics.

V Solutions, Dilute Solutions and Colligative Properties 7 Hrs

Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient.

Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of bolling point and depression of freezing point. Experimental methods for determining various colligative properties.

Abnormal molar mass, degree of dissociation and association of solutes.

Practical

CH-304 Laboratory Course **180 Hrs (6 Hrs/week) 75 MM**

Inorganic Chemisty

Synthesis and Analysis

(a) Preparation of sodium trioxalato ferrate (III), Na_3 $[Fe(C_2O_4)_3]$ and determination of its composition by permagnometry.

(b) Preparation of Ni-DMG complex, $[Ni(DMG)_2]$.

(c) Preparation of copper tetraammine complex. $[Cu(NH_3)_4]SO_4$.

(d) Preparation of cis- and trans-bisoxalato diaqua chromate (III) ion.

Instrumentation

Colorimetry

(a) Job's method (b) Mole-ratio method

Adulteration - Food stuffs.

Effluent analysis, water analysis.

Solvent Extraction

Separation and estimation of Mg (II) and Fe (II)

Ion Exchange Method

Separation and estimation of Mg (II) and Zn (II).

ORGANIC CHEMISTRY

Laboratory Techniques

Steam Distillation

Naphthalene from its suspension in water

Clove oil from cloves

Separation of o-and p-nitrophenols

Column Chromatography

Separation of fluorescein and methylene blue

Separation of leaf pigments from spinach leaves

Resolution of racemic mixture of (+) mandelic acid

Qualitative Analysis

Analysis of an organic mixture containing two solid components using water, $NaHCO_3$, NaOH for separation and preparation of suitable derivatives.

Synthesis of Organic Compounds

(a) Acetylation of salicylic acid, aniline, glucose and hydroquinone. Benzoylation of aniline and phenol

(b) Aliphatic electrophilic substitution

Preparation of iodoform from ethanol and acetone

(c) Aromatic electrophilic substitution

Nitration

Preparation of m-dinitrobenzene

Preparation of p-nitroacetanilide

Halogenation

Preparation of p-bromoacetanilide

Preparation of 2, 4, 6-tribromophenol

(d) Diazotization/coupling

Preparation of methyl orange and methyl red

(e) Oxidation

Preparation of benzoic acid from toluene

(f) Reduction

Preparation of aniline from nitrobenzene

Preparation of m-nitroaniline from m-dinitrobenzene.

Stereochemical Study of Organic Compounds via Models

R and S configuration of optical isomers.

E, Z configuration of geometrical isomers.

Conformational analysis of cyclohexanes and substituted cyclohexanes.

Physical Chemistry

Electrochemistry

(a) To determine the strength of the given acid conductometrically using standard alkali solution.

(b) To determine the solubility and solubility product of a sparingly soluble electrolyte conductomertically.

(c) To study the saponification of ethyl acetate conductometrically.

(d) To determine the ionisation constant of a weak acid conductometrically.

(e) To titrate potentiometrically the given ferrous ammonium sulphate solution using $KMnO_4/K_2Cr_2O_7$ as titrant and calculate the redox potential of Fe^{++}/Fe^{3+} system on the hydrogen scale.

Refractometry, Polarimetry

(a) To verify law of refraction of mixtures (e.g., of glycerol and water) using Abbe's refractometer.

(b) To determine the specific rotation of a given optically active compound.

Molecular Weight Determination

(a) Determination of molecular weight of a non-volatile solute by Rast method/Beckmann freezing point method.

(b) Determination of the apparent degree of dissociation of an electrolyte (e.g, NaCl) in aqueous solution at different concentrations by ebullioscopy.

Colorimetry

To verify Beer - Lambert law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of the given solution of the substance.

Books Suggested (Theory Courses)

1. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus, Wiley.
2. Concise Inorganic Chemistry, J.D. Lee, ELBS.
3. Concepts of Models of Inorganic Chemistry, B. Douglas, D. McDaniel and J. Alexander, John Wiley.
4. Inorganic Chemistry, D.E. Shriver, P.W. Atkins and C.H. Langford, Oxford.
5. Inorganic Chemistry, W.W. Porterfied Addison - Wesley.
6. Inorganic Chemistry, A.G. Sharpe, ELBS.
7. Inorganic Chemistry, G.L. Miessler and D.A. Tarr, Prentice Hall.
8. Organic Chemistry, Morrison and Boyd, Prentice-Hall.
9. Organic Chemistry, L.G. Wade Jr, Prentice-Hall.
10. Fundamentals of Organic Chemistry, Solomons, John Wiley.
11. Organic Chemistry Vol. I, II & III S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd (New Age International).
12. Organic Chemistry. F.A. Carey, McGraw-Hill, Inc
13. Introduction to Organic Chemistry, Streitwieser, Heathcock and Kosover, Macmilan.
14. Physical Chemistry, G.M. Barrow, International Student Edition, McGraw Hill.
15. Basic Programming with Application, V.K. Jain Tata McGraw Hill.
16. Computers and Common Sense, R. Hunt and Shelly, Prentice Hall.
17. University General Chemistry, C.N.R. Rao, Macmillan.
18. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd.
19. The Elements of Physical Chemistry, P.W. Atkines, Oxford.
20. Physical Chemistry Through problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd.
21. Concise Polymer chemistry, G.S. Niranjan, Anushandhan Prakashan KANPUR.

Books Suggested (Laboratory Courses)

1. Vogel's Qualitative Inorganic Analysis, revised, Svehla, Orient Longman.
2. Vogel's Textbook of Quantitative Inorganic Analysis (revised), J. Bassett.

   R.C. Denney, G.H. Jeffery and J. Mendham. ELBS.
3. Standard Methods of Chemical Analysis, W.W. Scott. The Technical Press.
4. Experimental Inorganic Chemistry, W.G. Palmer, Cambridge.

5. Handbook of Preparative Inorganic Chemistry, Vol I & II, Brauer, Academic Press.
6. Inorganic Synthesis, McGraw Hill.
7. Experimental Organic Chemistry Vol I & II, P.R. Singh, D.S. Gupta and K.S. Bajpai. Tata McGraw Hill.
8. Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern.
9. Vogel's Textbook of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell, ELBS
10. Experiments in General Chemistry, C.N.R. Rao and U.C. Agarwal, East-West Press.
11. Experiments in Physical Chemistry, R.C. Das and B. Behra, Tata McGraw Hill.
12. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.
13. Advanced Experimental Chemistry, Vol. I-Physical, J.N. Gurtu and R. Kapoor, S. Chand & Co.
14. Selected Experiments in Physical Chemistry, N.G. Mukherjee, J.N. Ghose & Sons.
15. Experiments in Physical Chemistry, J.C. Ghosh, Bharati Bhavan.

MATHEMATICS

B.A./B.Sc. (Part One) Exam- 2003-2004 & onwards

Paper I-Algebra and Trigonometry

Time - 3 Hours **M.M. - B.A. 33**

Algebra - Difinition and simple properties of group, Subgroups, cyclic groups, Order of element of a group. Co-sets, Lagranges theorem, Fermats and Euler's theorems, Homo-morphism and Lsomorphism, Normal subgroups, Quotient group, Permutation groups, even and odd permutations, Alternating group An, Cayley's theorem, Rings, subrings, Integral domain, Fields and characteristic of a ring.

Matrix Algebra :- Symmetric, skew symmetric, Hermitian and skew Hermitian matrices, orthogonal and unitary matrices. Rank of a matrix, Eigen values and Eigen vectors and the characteristic equation of a matrix, Cayley-Hamiton theorem, Solution of linear equations by matrix method, Consistency and in-consistency of Linear equations.

Relations between roots and coefficients of polynomial equation in one variable, Transformation of equations, Descartes rule of signs.

Trigonometry :- Circular and hyperbolic functions, Eulers theorem. Logarithm of a complex quantity Gregory's series. Summation of series (C+is method only)

Paper - II - Calculus,

Time - 3 Hours **M.M. B.A. - 33**

B.Sc. - 50

Differential Calculus :- definition of linit of a function, continuity and differentiability of functions, Kinds of discontinities, Succesive differentiation, Leibnitz theorem, Exponsions of functions by aclaurin and Taylor series, Curvature, Asympototes and tracing of curves in cartesion and Polar coordinates, Orinary differential equations (O.D.E.), order and degree of a differential equation, Equations of first order and first degree. Solution of O.D.E. when variables are separable, Homogeneous equations, Linear equations and Bernoulles form of equations, Exact O.D.E. Clairauts form of a O.D.E. and singular solution, Orthogional trajectories, Linear differential equations with constant coefficients, Homogeneous Linear O.D.E.

Paper - III - Vector Analysis and Geometry

Time - 3 Hours **M.M. B.A. - 34**

B.Sc. - 50

Vector Analysis - Scalar and vector product of three and four vectors, Reciprocal vector, Differentiation and integration of vector functions with respect to a scalar, Gradient, Divergence and curl, Theorems of Gauss, Green and stokes and problems based on these theorems.

Geomethy :- Reduction o general equation of second degree to standard forms, Tracing of parabola, Plane, Straight line and plane, phere, cone and cylinder.

Mathematics
B.A./B.Sc. (Part Two)
Paper - I Advanced Calculus & Tensor

Time - 3 Hours **M.M. - B.A. - 33**

B.Sc. - 50

Continuity, Sequential continuity, Uniform continuity, Mean value theorems, Darboux theorem, Taylors theorem with various forms of remainders.

Limits and continuity of functions of two independent variables, Partial differentiation. Change of independent variables, Eulers therorem on homogeneous functions, Taylors theorm for functions of two independent variables, Jacobians.

Envelopes, Evolutes, Maxima and iima of functions of two variables, Lagranges method of multipliers, Indeterminate form, Convergence & Divergence of infinite series, Beta and Gamma functions, Double and tripe integrals, Change of order of intergration in double integrals.

Tensor :- Introduction, Subscripts and Super scripts, Summation convention, Free and dummy suffix, Kronecker delta, n-dimentional space, Contravarient and co-variant vectors, Tensors of second and higher order, addition and subtraction of tensors, prodct of tensors, contraction of mixed tensors, Inner product of tensors, Quotient law, Symmetric and skew-symmetric tensors. Reciprocal symmetric tensors.

Paper II - Differential equation & Integral transform

Time - 3 Hours **M.M.-B.A. - 33**

B.Sc. 50

Partial Differential equation :- P.D.E. of first order, Lagranges method for solution of equations of the type Pp + Qq = R, Charpits method, some special types of equations which, can be solved easily easily by methods other than the general method.

Partial differential equations (P.D.E.) of second and higher order, Classification of linear P.D.E. of second order of the type Rr + Ss + Tt (p, q, z, x, y) = 0 and reduction into canonical form, Homogeneous and non homogeneous equations with constant coefficients, P.D.E. reducible to equations with constant coefficients, Monge's method.

Integral transform :- Laplace transform, Existance theorem, Laplace transforms of derivatives and integrals, shifting theorem, Differentiation and integration of transform, Convolution theorem, Solution of integral equations and system of differential equations using Laplace transformation

Fourier Transform :- Infinite and finite Fouries transforms, Inverse fourier transform, properties and theorems on fourier transform.

Paper III, Mechanics

Time 3 Hour **M.M. B.A. 34**

B.Sc. 50

Statics :- Virtual work, Catenay.

Hydro Statics :- Centre of pressure and equilibrium of floating bodies

Dynamics :- Velocities and acclerations along radial and transverse direction and along tangential and normal directions, simple harmonic motion, Motion on verticle circle and on cycloid central forces and motions in a resisting medium, When resistance varies as velocity and when resistance varies as square of velocity only.

Mathematics
B.A./B.Sc. (Part Three)

Paper I-Analysis

Time - 3 Hours **M.M. B.A. - 50**

B.Sc. 75

Real Analysis :- Riemann integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, Riemann stiltjes (R.S.) integral and simple examples on it.

Improper integrals and their convergence, Cauchy-Riemann equations, Harmonic function, Mobious transformations, Fixed points, cross ration, inverse points and conformal mappings.

Metric Spaces :- Difinition and examples of metric of metric spaces, neighbourhoods, limit points, Interior points,Open and closed set, Closure, Interior and boundary points, Cauchy's sequences and convergent sequence.

Paper - II, Abstract Algebra

Time : 3 Hour **M.M. B.A. - 50**

B.Sc. - 75

Group - Autoorphism, Conjugacy relation, Normalizer, class equation of a finite group, Centre of a group.

Ring theory :- Ring homomorphis, Ideal and quotient ring, Euclidean rings, Polynomial Rings.

Linear Algebra :- Vector Spaces, Sub space, Linear sum and direct sum of subspaces, L.I. and L.D. vectors, Basis and dimension of a vector space, Theorems on dimensions, Quotient space and its dimention theorem, Linearr transformations and their representation as matrices, Rank and nullity theorem, Dual space, Annihilator of a sub space.

Paper - III Numerical analysis and Statistics

Time : 3 Hours **M.M. B.A. - 50**

B.Sc. - 75

Numerical Analysis :- Fundamental theorem of difference calculus, Operators in N.A., Interpolation for equal sub intervals, Interpolation for un-equal interval, Newton-Gregory Forward and backward formula, Divided differences for un-equal intervals, Newtons divided difference formula, Lagranges interpolation formula for un-equal intervals, Central difference interpolation, Stirlings-Bessels and Gauss formula, Numerical differentiation, Numerical integration, Trapezoidal, Simpsons and weddles rule for numerical integration.

Statistics :- Co-rrelation and Regression of two variables, additon and multiplication theorem of probabilities, and their uses in problems.

Binomial, Poissons and Normal distributins, their propertics and problems.

Note : Use of calculator is allowed.

B.Sc. (General) Physics Syllabus

The student will study three subjects with equal weightage in all the three years, along with supporting subjects such as a course on science, Technology and Society, one or two on Languages etc. The course structure for the three years is suggested in Table 1

Table 1 Course pattern for B.Sc. (General)

	Sub 1	Sub 2	Sub 3	Other Components
Ist Year	3	3	3	1
IInd Year	3	3	3	1
IIIrd Year	3	3	3	1

Notes : Each course shall have two contact periods per week for B.Sc. (Gen), In addition to the 3 theory courses every year, there shall be one for laboratory experimental physics.

The Physics courses shall be as in Table 2

Table 2 Physics Course in B.Sc. (General)

Year	Paper	Title of the Course	Max Marks
I	1	Mechanics, Properties of Matter and Vectors	33
	2	Electricity, Magnetism and Electromagnetic theory	34
	3	Oscillations and Special Theory of Relativity	33
		Laboratory I	50
II	4	Optics and Lasers	33
	5	Waves, Acoustics and Statistical Physics	34
	6	Kinetic Theory and Thermodynamics	33
		Laboratory II	50
III	7	Quantum Mechanics and Nuclear Physics	33
	8	Atomic, Molecular and Solid State Physics	34
	9	Solid State Devices and Electronics	33
		Laboratory III	50

The Course contents will be as under

PAPER 1 : MECHANICS, PROPERTIES OF MATTER AND VECTORS

1.1 Mechanics

Laws of motion, motion in a uniform field, components of velocity and acceleration in different coordinate systems, Uniformly rotating frame, centripetal acceleration, Coriolis force and its applications.

Motion under a cental force, Kepler's laws Gravitational law and field, Potential due to a spherical body. Gauss and Poisson equations for gravitational self-energy.

Systems of particles, center of mass, equation of motion, conservation of energy, single-stage and multistage rockets, elastic and inelastic collisions.

Rigid body motion rotational motion, moments of inertia and their products, principal moments and axes, Euler's equations.

1.2 Properties of matter

Elasticity, small deformations, Hooke's law, elastic constants for an isotropic solid, beams supported at both the ends. cantilever, torsion of a cylinder, bending moments and shearing forces.

Kinematics of moving fluids, eqution of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poisseulle's law, Capillary tube flow, Reynold's number, Stokes law.

Surface tension and surface energy, molecular interpretation of sufrace tension, pressure on a curved liquids surface, wetting.

1.3 Vector Calculus

Scalars and vectors, dot and cross products, triple vector product, gradient of a scalar field and its geometrical interpretation, divergence and curl of a vector field, surface and volume integrals, flux of a vector field.

Text and Reference Books

E.M. Purcell, Ed. "Berkeley Physics Course, Vol 1, "Mechanics" (McGraw-Hill).

R.P. Feynman, R.B. Lighton and M Sands, "The Feynman Lectures in Physics", Vol 1 (BI Publication , Bombay, Delhi, Calcutta, Madras)

Paper 2 : Electricity And Magnetism

2.1 Electrostatics

Coulombs law in vacuum expressed in vector forms, calculations of E for simple distributions of charges at rest, dipole and quadrupole fields.

Work done on a charge in an electrostatic field expressed as a line integral, conservative nature of the electrostatic field. Electric potential ϕ E = - Δ ϕ, torque on a dipole in a uniform electric field and its energy,flux of the electric field, Gauss's law and its application for finding E for symmetric charge distributions, Gaussian pillbox, fields at the surface of a conductor, Screening of E field by a conductor, capacitors, electrostatic field energy, force per unit area on the surface of a conductor in an electric field, conducting sphere in a uniform electric field, point charge in front of a grounded infinite conductor.

Dielectrics, parallel plate capacitor with a dielectric, dielectric constant, polarization and polarization vector, displacement vector D, molecular interpretation of Claussius-Mossotti equation, boundary conditions satisfied by and E and D at the interface between two homogenous dielectrics, illustration through a simple example.

2.2 Electric Currents (steady and alternating)

Steady current, current density J, non-steady currents and continuity equation, Kirchoff's law and analysis of multiloop circuits, rise and decay of current in LR and CR circuits, decay constants, transients in LCR circuits, AC circuits, complex numbers and their applications in solving AC circuit problems, complex impedance and reactance, series and parallel resonace, Q factor, power consumed by an AC circuit, power factor, Y and Δ networks and transmission of electric power.

2.3 Magnetostatics

Force on a moving charge: Lorentz force equation and definition of B, force on a straight conductor carrying current in a uniform magnetic field, torque on a current loop, magnetic dipole moment, angular momentum and gyromagnetic ratio.

Bio Savart's Law, calculation of H order in simple geometrical situations, Ampere's Law Δ, B or Δ x B = μ J, field due to a magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as a surface distribution of solenoidal current.

2.4 Time Varying Fields

Electromagnetic induction, Faraday's law, electromotive force $\varepsilon = \int$ E. dr, integral and differential forms of Faraday's law, mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, electromagnetic fields energy density.

2.4 Electromagnetic Waves

The wave equation satisfied by E and B, plane electromagnetic waves in vacuum, poynting's vector, reflection at a place boundary of dielectrics, polarization by reflection and total internal refiection, Faraday effect, waves in a conducting medium, reflection and refraction by the ionosphere.

Text and Reference Books

1. Berkeley Physics Course, Electricity and Magnetism, Ed. E.M. Purcell (McGraw-Hill)
2. Halliday and Resnik, "Physics". Vol. 2.
3. D. J. Griffith, "Introduction to Electrodynamics" (Prentice-Hall of India)
4. Reitz and Milford, "Electicity and Magneism" (Addison-Wesley)
5. A.S. Mahajan and A A Rangwala, "Electricity and Magnetism" (Tata McGraw-Hill)
6. A. M. Portis, "Electromagnetic Fields"
7. Pugh and Pugh, "Principles of Electricity and Magnetism" (Addison-Wesley).
8. Panofsky and Phillips, "Classical Electricity and Magnetism" (India Book House)
9. S. S. Atwood, "Electricity and Magnetism" (Dover)

PAPER 3 : OSCILLATIONS AND SPECIAL THEORY OF RELATIVITY

3.1 Oscillations

Potential well and periodic oscillations, case of harmonic oscillations, differential equation and its solution, kinetic and potential energy, examples of simple harmonic oscillations, spring and mass system, simple and compound pendulum, torsional pendulum, bifilar oscillations, Helmholtz resonator, L C circuit, vibrations of a magnet, oscillations of two masses connected by a spring.

Superposition of two simple harmonic motions of the same frequency along the same line, Interference, superposition of two mutually perpendicular simple harmonic vibrations of the same frequency, Lissajous figures, case of different frequencies.

Two coupled oscillators, normal modes, N coupled oscillators, damped harmonic oscillations, power dissipation, quality factor, examples, driven harmonic oscillator, transient and steady states, power absorption, resonance in systems with many degrees of freedom

3.2 Special Theory of Relativity

Reference systems, inertial frames, Galilean invariance and conservation laws, propagation of light, Michelson-Morley experiment; search for ether.

Postulates for the special theory of relativity, Lorentz transformations, length contraction, time dilation, velocity addition theorem, variation of mass with velocity, mass-energy equivalence, particle with zero rest mass.

Text and Reference Books

D.P. Khandelwal; "Oscillation and Waves" (Himalaya Publising House, Bombay),

R.K. Ghosh, "The Mathematics of Waves and Vibrations" (Macmillan, 1975)

H.S. Mani and G.K. Mehta; "Introduction to Modern Physics" (Affiliated East-West Press, 1989)

A Beiser, "Perspective of Modern Physics"

LABORATORY I

This is a suggested list. Every institution may add any experiment of same standard in the same subject area.

1. 'g' by bar pendulum
2. 'g' by Kater's pendulum
3. Moment of inertia of a fly-wheel
4. Moment of inertia of an irregular body by moment of inertia table
5. Determination of 'η' by Maxwell's needle
6. Determination of 'η' by moment of inertia table
7. Determination of 'y' 'η' and 'σ' by Searle's method
8. Determination of 'Y' by bending (electrical method)
9. Determination of 'Y' by bending (optical method)
10. Determination of 'σ' rubber
11. Determination of 'η' by statical method
12. Determination of surface tension of water by Jager's method
13. Determination of viscosity of water by constant head method
14. Determination of frequency of electrically maintained tuning fork by Melde's experiment
15. Determination of frequency of A.C. mains by Sonometer
16. To study the variation of magnetic field along the axis of a coil
17. To calibrate an ammeter with the help of a potentiometer
18. To calibrate a volt meter with the help of a potentiometer
19. To compare two resistances with the help of a potentiometer
20. To convert a galvanometer into an ammeter
21. To convert a galvanometer in to a voltmeter
22. To find out specific resistance by Carry Foster's bridge
23. To find out angle of dip by earth inductor
24. To find out ballistic constant of a ballistic galvanometer
25. To standardize one ohm coil

Computer Programming I

1. Elementary Fortran programs, flowcharts and their interpretation.
2. To print out all natural even/odd numbers between given limits.
3. To find maximum, minimum and range of a given set of numbers.
4. To complete a frequency distribution and evaluate moments such as mean; standard deviation etc.
5. To evaluate sum of finite series and the area uner a curve.
6. To find the product of two matrices.
7. To find a set of prime numbers and Fibonacci series.
8. Motion of a projective using computer simulation.
9. Numerical solution of equation of motion.
10. Motion of particle in a central force field.
11. To find the roots of a quadratic equation.

Text and Reference Books

B Sarafet al "Mechanical Systems" (Vikas Publishing House, New Delhi)

D P Khandelwal, "A laboratory Manual of Physics for Undergraduate Classes" (Vani Publication House, New Delhi)

C G Lambe, " Elements of Statistics" (Longmans Green and Co. London, New York, Toronto)

C Dixon "Numerical Analysis"

S Lipschutz and A Poe, " Schaum's Outline of Theory and Problems of Programming with Fortran" (McGraw-Hill Book Company. Singapore 1986).

Paper 4: Optics and Lasers

4.1 Geometrical Optics

Fermat's Principle : Principle of extremum path, the aplanatic points of a sphere and other applications.

General theory of image formation: Cardinal points of an optical system, general relationship, thick lens and lens combinations. Lagrange equation of magnification, telescopic combinations, telephoto lenses and eyepieces.

Aberration in images: Chromatic aberrations, achromatic combination of lenses in contact and separated lenses. Monochromatic aberrations and their reductions; aspherical mirrors and Schmidt corrector plates, aplanatic points, oil immersion objectives, eniscus lens.

Optical instruments : Entrance and exit pupils, need for a multiple lens eyepiecs, common types of eyepieces.

4.2 Physical Optics

Interference of a light : The principle of superpositions, two-slit interference, coherence requirement for the sources, optical path retardations, lateral shift of fringes, Rayleigh refractometer and other applications Localised fringes; thin films, applications for precision measurements for displacements.

Haidingerr friges : Fringes of equal inclination Michelson interferometer, its application for precision determination of wavelength, wavelength difference and the width of spectral lines, Twymann-green interferometer and its uses. Intensity distribution in multiple beam interference. Tolansky fringes. Fabry-Perot interferometer and etalon. Fresnel fringes, Fabry Perot interferometer and etalon. Fresnel diffraction : Diffration at a slit, half-period zones, phasor diagrm and integral calculus methods, the intensity distribution, diffraction at a circular aperture and a circular disc, resolution of images, Rayleigh criterion, resolving power of telescope and microscope systems. outline of phase contract microscopy.

Diffrction gratings : Diffraction at N parallel slits, intensity distribution plane diffraction granting, reflection granting and blazed granting. Concave granting and different mountings. Resolving power of a granting and comparison with reolving powers of prism and of a Fabry-Perot etalon.

Double refraction and optical rotation : Refraction, in uniaxial crystals, its electromagnetic the Phase retardation plates. double image image prism. Rotation of plane of polarization, origin of optical rotation in liquids and in crystals.

4.3 Lasers

Lasers systems Purity of a special line, coherence length and coherence time, spatial coherence of a source, Einstein's A and B coefficients, Spontaneous and induced emissions. conditions for laser action, population inversion.

Application of lasers : Pulsed lasers and tunable Lasers, spatial coherence and directionality estimates of beam intensity, temporal coherence and special energy density.

Lasers and nonlinear optics : Polarization (P) including higher order terms in E and generation of harmonics, momentum mismatch and choice of the right crystal and direction for compensation.

Text and Reference Books

1. A. K. Ghatak, "Physical Optics"
2. D. P. Khandelwal, "Optics and Atomic Physics" (Himalaya Pubsishing House, Bombay, 1988)
3. F Smith and J H Thomson, "Manchester Physics series, Optics" (English Language Book Society and John Wiley, 1977)
4. Born and Wolf, "Optics"

5. K. D. Moltev, "Optics" (Oxford University Press)
6. Sears, "Optics"
7. Jenkins and White, "Fundamental of Optics" (McGraw-Hill)
8. B B Laud, Lasers and Non-linear Optics (Wiley Eastern 1985)
9. Smith and Thomson, "Optics" (John Wiley and Sons).

Paper 5 : WAVES, ACOUSTIC AND STATISTICAL PHYSICS

5.1 Waves

Waves in Media : Speed of transverse waves on a uniform string, speed of longitudinal waves in a fluid, energy density and energy transmission in waves, typical measurements. Waves over liquid surface : gravity waves and ripples. Group velocity and phase velocity, their meansurement. Superposition of waves : Linear homogeneous equations and the superposition principle nonlinear superposition and consequences.

Standing waves : Standing waves as normal modes of bounded systems, examples. Harmonics and the quality of sound; examples. Chiadni's figures and vibrations of a drum. Production and detection of ultrasonic and infrasonic waves and applications.

5.2 Acoustics

Noise and Music : The human ear and its responses; limits of human audibility, intensity and loudness, bel and decibel, the musical scale, temperament and musical instruments.

Reflection, refraction and diffraction of sound : Acoustic impedance of a medoum, percentage reflection, refraction and diffraction of sound : Acoustic impedance of a medium, percentage reflection and refraction at a boundary, impedance matching for transducers, diffraction of sound, principle of a sonar system, sound ranging.

Applied acoustics : Transducers and their characteristics. Recording and reproduction of sound, various systems, Measurementy of frequency, waveform, intensity and velocity. The acoustics of halls. reverberation period, Sabine's formula.

5.3 Statistical Physics

Basis of thermodyanmics : Probability and thermodynamic probability, principle of a-priori probabilities, probability distribution and its narrowing with increase in number of the expressions for average properties. Constraints, accessible and inaccessible states distribution of particles with a given total energy into a discrete set of energy states.

Some universal laws. The mu space representation, division of mu space into energy sheets and into phase cells of arbitrary size, applications to one-dimensional harmonic oscillator and free particles. Equilibrium before two systems in thermal contact, bridge with macroscopic physics, Probability and entropy, Boltzmann entropy relation. Statistical interpretation of second

law of thermodynamics. Boltzmann canonical distribution law and its applications; rigorous from of equipartition of energy.

Maxwellian distribution of speeds in an ideal gas: Distribution of speeds and of velocities, experimental verification, distinction between mean, rms and most probable speed values. Doppler broadening of spectral lines.

Text and Reference Books

1. Berjekey Physics Courses vol III "Waves and Oscillation"
2. G Man Vibrations and Waves (Cambridge University Press)
3. H J Pain "The Physics of Vibrations and Waves" (MacMillan 1975)
4. B B Laud, "Introduction to Statistical Mechanics" (Macmillan 1981)
5. F Reif, "Statistical Physics" (Mcgraw-Hill, 1988)
6. K Haung "Statistical Physics" (Wiley Eastern, 1988)

Paper 6 : KINETIC THEORY AND THERMODYNAMICS

6.1 Kinetic Theory of Matter

Ideal Gas : Kinetic model, deduction of Boyle's law, interpretation of temperature, estimation of rms speeds of molecules. Brownian motion, estimate of the Avogadro number, Equiparition of energy, specific heat of monatomic gas, extension gas, extension to di-and triatomic gases, Behaviour at low temperatures Adiabatic expansion of an ideal gas, applications to atmospheric physics.

Real Gas Van der Waals gas, equation of state, natue of Van der Waals forces, comparison with experimental P.V. curves. The critical constants, gas and vapour. Joule expansion of ideal gas, and a Vander Waals gas. Joule coefficient, estimates of J-T cooling.

of gases : Boyle temperature and inversion temperature. Principle of regenerative cooling and of cascade cooling. liquefaction of hydrogen and helium, Refrigeration cycles, meaning of efficiency.

Transport phenomena in gases : Molecular collisions, mean free path and collision cross sections. Estimates of molecular diameter and mean free path. Transport of mass, momentum and energy and interrelationship, dependence on temperatiure and pressure.

6.2 Thermodynamics

The laws of thermodynamics : The Zeroth law, various diagrams, work done by and on the system first law of thermodynamics, internal energy as a state function and other applications. Reversible and irreversible changes, Carnot cycle and its efficiency, Cannot therorem and the second law of thermodynamics. Different versions of the second law, practical cycles used in

internal combustion engines. Entropy, principle of increase of entropy. The thermodynamics scake of temperature; its identity with the perfect gas scale. Impossibility of attaining the zero; third law of thermodynamics.

6.3 Thermodynamics relationships : Thermodynamics variables; extensive and intensive Maxwell's general relationships, application of Joule-Thomson cooling and adiabatic cooling in a general system, Van der Waals gas, Clausius-Clapeyron heat equation. Thermodynamics potential and equilibrium of thermodynamical systems, relation with thermodynamical variables. Cooling due to adiabatic demagnetization, production and measurement of very low temperatures.

6.4 Blackbody radiation: Pure temperature dependence, Stefan - Boltzmann law, pressure of radiation. Special distribution of BB radiation Wien's displacement law, Rayleigh Jean's law, the ultraviolet catastrophy, Planck's quantum postulates, Planck's law. complete fit with experiment interpretation of behaviour of specific heats of gases at low temperature.

Text and Reference Books

Zemansky : Heat and thermodynamics, TMH Publications

C Kittel and H Kroemer, Thermal Physics, CBS Publications

B K Agarwal, Thermodynamics

D P Khandelwal and A K Pandey, Thermodynamics and Statistical Physics, Himalaya Publications

LABORATORY II

This is a suggested lit. Every institution may add any experiment of same standard in the same subject area.

1. To study the variation of refractive index with wavelength by spectrometer
2. To determine wave length of Sodium light by bi-prism
3. To determine wave length of Sodium light by Newton's rings
4. To determine the resolving power of diffraction grating by spectrometer
5. To determine the resolving power of a telescope
6. To find out specific rotation of sugar by polarimeter
7. To verify Newton's formula by Nodal slide
8. To verify Cauchy's formula (spectrometer)
9. To determine refractive index of a liquid by Newton's rings
10. To determine thickness of mica sheet by biprism
11. Determination of mechanical equivalent of heat

12. Deterination of 'Y' by Clement and Desorms's method
13. Determination of thermal conductivity of metal by Searle's method
14. Determination of thermal conductivity of bad conductor by Lee's disc method

Computer Programming II

1. Calculation of days between two dates of a year
2. To check if triangle exists and the type of the triangle
3. To find the sum of the sine and cosine series and print oput the curve
4. To solve simultaneous equations by elimination method
5. To perpare mark-list of polynomials
6. Fitting a straight line or a simple curve a given data
   a given integer into binary and octal systems and vice versa of a matrix
   Spiral array

Text and Reference Books

D. P. Khandelwal "Optics and Atomic Physic" (Himalaya Publishing Houses, Bombay 1988)

D. P. Khandelwal, " A laboratory Manual for Undergraduate Classes" (Vani Publishing House, New Delhi)

S Lipschutz and A Poe, "Schaum's Outline of Theory and Problems of Prgramming with Fortran" (McGraw-Hill Book Company 1986)

O Dixon Numerical Analysis. "

Paper 7 : QUANTUM MECHANICS AND NUCLEAR PHYSICS

7.1 Quantum Mechanics

Origin of the quantum theory : Failure of classical physics to explain the phenomena such as black-body spectrum, photoelectric effect, Ritz combination principle in spectra stability of an atom Plank's radiatioin law, Einstein's explanation of photoelectric effect. Bohr's quantization of angular momentum and its applications to hydrogen atom, limitations of Bohr's theory.

Wave-particle duality and uncertainty principle de Broglie hypothesis for matter waves; the concept of wave and group velocities, evidence for diffraction and interference of 'particles, experimental demonstration of matter waves.

Consequence of de Broglie's concepts; quantisation in hydrogen atom; energies of a particle in a box, wave packets, Heisenberg's uncertainty relation for p and x, its extension to energy and time.

Consequence of the uncertainty relation : gamma ray microscope, diffraction at a slite, particle in a box position of electron in a Bohr orbit.

Quantum Mechanics : Schrodinger's equation, Postulatory basis of quantum mechanics ; operators, expectation values, transition probabilities, applications to particle in a one, three dimensional boxes, harmonic oscillator, reflection at a step potential, transmission across a potential barrier.

Hydrogen atom; natural occurrency of n, l and m quantum numbers, the related physical quantities comparison with Bohr's theory.

Quantum statisitcs 'h' as a natural constant and its implications, cases of particle in a one dimensional box and one-dimensional harmonic oscillator. Indistinguishability of particles and its consequences. Bose-Einstein, and Fermi-Dirac conditions; applications to liquid helium, free electrons in a metal and photons in blackbody chamber Fermi level and Fermi energy.

7.2 Nuclear Physics

Interaction of charge particles and neutrons with matter, working of nuclear detectors, G-M counter proportional counter and scintillantion counter, cloud chambers, spark chamber emulsions.

Structure of Nuclei, basis properties (l, μ, Q and binding energy), deuteron binding energy, p-p and n-p scattering and general concepts of nuclear forces. Beta decay, range of alpha particle. Geiger-Nuttal law. Gamows explanation of beta decay, alpha decay and continuous and discrete spectra.

Nuclear reactions channel compound nucleus, direct reaction (concepts) Shell model : liquid drop model, fission and fusion (concepts), energy production in stars by ? and carbon cycles (concepts)

Text and Reference Books

H. S. Main and G K Mehta, "Introduction to Modern Physics" (Affiliated East-West Press, 1989)

A Beiser "Prospective of Modern Physics"

R P Feymann, R B Leighton and M Sands, "The Feymann Lectures on Physics". Vol III (B I Publications, Bombay Delhi, Calcutta Madras)

T A Littlefield and N Thorley, "Atomic and Nuclear Physics" (Engineering Language Book Society)

H A Enge, "Introduction to Nuclear Physics" (Addision-Welsy)

Eisenberg and Resnik, "Quantum Physics of Atoms, Molecules, Solids, Nuclel and Particles" (John Wiley)

Paper 8 : ATOMIC, MOLECULAR AND SOLID STATE PHYSICS

8.1 Atomic Physics

Spectra of hydrogen deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d, and f states selection rules.

Singlet and triplet fine structure in alkaline earth spectra, L-S and J-J couplings.

Week spectra : Continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law, Characteristics X-rays Moseley's law, doublet structure of X-ray spectra, X-ray absocption spectra

8.2 Molecular Physics

Discrete set of electronic energies of molecules, quantisation of vibrational and rotational energies, determination of internuclear distance, pure rotational and rotation vibration spectra.

Dissociation limit for the group and other electronic states, transition rules for pure vibration and electronic vibration spectra.

Raman effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared specta, experimental arrangements for Raman spectroscopy.

Spectroscopic technique : Sources of excitation, prism and granting spectrographs for visible. UV and IR, absorption spectroscopy, double beam instruments, different recording system.

8.3 Solid State Physics

Overview : Crystalline and glassy forms, liquid crystals, glass transition.

Structure : Crystal structure : periodicity, lattices and bases, fundamental translation vectors, unit cell, Wigner-Seitz cell, allowed rotations, lattice types, lattice planes, common crystal structures. Laue's theory of x-ray diffraction, Bragg's law, Laue patterns.

Bonding : Potential between a pair of atoms : Lennard - Jones potential, concept of cohesive energy, covalent, Van der Walls, ionic, and metallic crystalss.

Magnetism : Atomic magnetic moment, magnetic susceptibility, Dia-Par-and Ferromagnetism, Ferromagnetic domains, Hysteresis.

Thermal properties : Lattice vibrations, simple harminic oscillator, second order expansion of Lennard-Jones potential about the minimum, vibrations of one dimensional monatomic chain under harmonic and nearest neighbour interaction approximation, concept of phonons, density of modes (1-D) Debye model; lattice specific heat, low temperatiure limit, extension.

(conceptual) to 3-D band structure electrons in periodic potenbial, nearly free electron model (qualitatively), energy bands, energy gap, metals insutators semiconductors

of electrons free electrons, conduction electrons, electrons collisions, mean free path, conductivity and Ohm's law Density of states, Fermi energy, Fermi velocity, Fermi-Dirac destribution

Text and Reference Books

H. S. Mani and G. K. Mehta: "Introduction to Modern Physics" (Affiliated East-West Press, 1989)

A. Beiser "Prospective of Modern Physics"

H. E. White, "Introduction to Atomic Physics"

Barrow introduction to Molecular Physics"

R. P. Feymann, R. B. Leightom and M Sands: "The Feyman Lectures on Physics" Vol III (B I Publications, Bombay, Delhi, Calcutta Madras)

T. A Littefield an N. Thorley, " Atomic and Nuclear Physics" (Engineering Language Book Society)

Eisenberg and Resnik, "Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particiles" (Jophn Wiley)

D. P. Khandelwal, "Optics and Atomic Physics" (Himalaya Publishing House, Bombay, 1988)

C. Kittle, "Introduction to Solid State Physics" Vth Edition (John Wiley and Sons, New York, 1976)

J. S. Blackmore, "Solid State Physics" IInd Edition (Cambridge University Press, Cambridge)

N. W. Ascroft and N. D. Mermin, "Solid State Physics"(Holt, Rinehart and Winston, New Yrk, 1976)

Paper 9 : SOLID STATE DEVICE AND ELECTRONICS

9.1 Solid State Devices

Semiconductors : Intrinsic semiconductors, electrons and holes, Fermi level. Temperature dependence of electron and hole concentrations. Doping: impurity states, n and p type semiconductors conductivity. mobility, Hall effect, Hall coefficient.

Semiconductor devices : Metal-semiconductor junction, p-n junction majority and minority carries, diode. Zener and tunnel diodes, light emitting diode, transistor, solar cell.

9.2 Electronics

Power supply : Diode as a circuit element, load line concept, rectification, ripple factor, zener diode, voltage stabilization, IC voltage regulation, characteristics of a transistor in CB, CE and

CC mode, graphical analysis of the CE configuration, low frequency equivalent circuits, h-parameters, bias stability, thermal runaway.

Field effect transistory : JFET volt-ampere curves, biasing JFET, ac operation of JFET, source follower, Depletion and enhancement mode, MOSFET, biasing MOSFET, FET as variable voltage resister digital MOSFET circuits.

Photonic devices Photodiode, photo transistor solar cell and diode laser

Small signal amplifiers : General principles of operation, classification, distortion, RC coupled amplifier, gain frequency response, input and output impedance, multistage amplifiers, transformer coupled amplifiers, Equivalent circuits at low, medium and high frequencies; emitter follower low frequency common-source and common-drain amplifier, Noise in electronic circuits.

Negative feedback and application Oscillators Hartley and Colpitts Oscillators.

Logic Circuit : AND, OR, NOT, NOR, NAND and EX-OR, truth tables, Boolean algebra and K-map Combinational logic circuit : Half adder, full adder, Subtractor and BCD adder

Text and Referebce Books

B G Streetman "Solid State Electronic Devices" IInd Edition (Prentice-Hall of India, New Delhi, 1986)

W D Stanley, "Electronic Devices, Circuits and Application" (Prentice-Hall, New Jersey USA, 1988)

J Ryder, "Electronics Fundamentals and APplications" IInd Edition (Prentice-Hall of India, New Delhi, 1986)

J Millman and A Grabel, "Microelectronics" International Edition (McGraw-Hill Book Company, New York 1988)

Laboratory III

This is a suggested list. Every institution may add any experiment of same standard in the same subject area.

1. To study characteristics curves of Diode and Zener Diode
2. To study common emitter characteristics of NPN transistor
3. To study commoan base characteristics of NPN transistor
4. To study common emitter characteristics of PNP transistor
5. To study common base characteristics of PNP transistor
6. To study hybrid parameters of a transistor
7. To find out band gap of a semiconductor
8. To verify truth tables of logic gates
9. To study characteristic curves of FET

10. To study LCR circuit
11. To determine low resistance with the help of Kelvin's bridge
12. To determine inductance and capacitance by Maxwell's bridge
13. To verify inverse square law by Photo cell

Computer Programming III

1. Find roots of $f(x) = 0$ by using Newton-Raphson method
2. Find roots of $f(x) = 0$ by using secant method
3. Integration by Simpson rule
4. To find the value of y at a given value of x by Runga - Kutta Method
5. Eight Queens Problem
6. Magic Squares
7. String manipulations
8. Towers of Hanoi (Non-recursive)
9. Finding first four prefect numbers
10. Quadratic interpolation using Newton's forward - difference formula of degree two.

Text and Reference Books

B. G. Streetman, "Solid State Electronic Devices", II Edison (Prentice-Hall of India, New Delhi, 1986)

E. D. Stanley, "Electronic Devices, Circuits and Applications" (Prentice-Hall New Jersey, USA, 1988)

S. Lipschutz and A. Poe, "Schaum's Outline of Theory and Problems of Programming with Fortran" (McGraw-Hill Book Company Singapore 1986)