

**GOVERNMENT AUTONOMOUS COLLEGE**  
**BHAWANIPATNA**



**COURSES OF STUDIES**

*FOR*

*THREE YEAR DEGREE COURSE*

*IN*

**SCIENCE**

**(PASS & HONOURS)**  
**(Semester System)**

SEMESTER-I	2010	SEMESTER-II	2011
SEMESTER-III	2011	SEMESTER-IV	2012
SEMESTER-V	2012	SEMESTER-VI	2013

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**COURSES OF STUDIES  
+3 SCIENCE  
(Three-Year Degree in Science)**

SEMESTER-I	2010	SEMESTER-II	2011
SEMESTER-III	2011	SEMESTER-IV	2012
SEMESTER-V	2012	SEMESTER-VI	2013

**GENERAL INSTRUCTIONS**

A candidate for Three Year Bachelor's Degree in Science shall be required to pass all the six semester examinations.

The entire course of Three-year Degree Science Honours contains a total of 1800 Marks, which include compulsory course of 300 Marks, elective course of 300 - Marks, Pass course of 400 Marks, and Honours course of 800 Marks.

*The following are the subjects:*

**COMPULSORY COURSES**

1. English	50 Marks
2. M.I.L. (Oriya, Hindi or Alternative English)	50 Marks
3. Environmental Studies	100 Marks
4. Indian Society and Culture	100 Marks

**OPTIONAL HONS AND PASS COURSES**

A candidate in +3 Science (Hons) shall choose one Hons and one Pass subject from the following subjects carrying 800 marks and 400 marks, respectively.

**Hons subjects**

1. Botany,
2. Chemistry,
3. Mathematics,
4. Physics,
5. Zoology.
6. Environmental Pollution & Toxicology
7. Opto-electronics

**Pass subjects**

1. Botany,
2. Chemistry,
3. Mathematics,
4. Physics,
5. Zoology.

Provided that no student shall be allowed to take Mathematics with Botany or Zoology as subject combination.

***Further provided that***

A candidate shall not be allowed to take Mathematics or a subject in which there is practical examination, if he did not pass in that subject in the Intermediate/ Higher Secondary or any other equivalent Examination.

**ELECTIVE COURSE**

A Science student has to choose ONE Minor Elective Paper carrying 100 marks and ONE Major Elective subject carrying 200 marks with two papers of 100 marks each.

**MINOR ELECTIVE**

A student with Botany /Zoology Hons shall take the Minor Elective Paper in Mathematics & Statistics and a student of Physical Science(Chemistry, Mathematics, Physics) Hons stream shall take Biology as the Minor Elective.

**MAJOR ELECTIVE**

A Science Honours student shall choose one subject as Major Elective from among the following subjects, according to suitability and availability of subjects in the College, carrying 200 marks with two papers of 100 marks each, without any Practical components.

1. Physics, 2. Chemistry, 3. Mathematics 4. Life Science

Provided that, a student with any of the subjects like Life Sciences, Physics, Chemistry, Mathematics etc. as Honours or Pass, shall not be allowed to offer corresponding subject as a Major elective course.

Table - I & II gives a clear picture at a glance regarding Course structure and Mark distribution for Three Year Degree Science Honours.

**Table-I****+3 SCIENCE (Hons) (with practical component)**

Semester-I		Semester-II		300+300=600
English	50 Marks	MIL	50 Marks	
Pass-I	75 Marks	Pass-II	75 Marks	
Hons-I	75 Marks	Hons-II	75 Marks	
Minor elective	100 Marks	Practical (Pass)-I	50 Marks	250+350=600
		Practical (Hons)-I	50 Marks	
Semester-III		Semester-IV		
Major elective-I	100 Marks	Environmental Studies	100 Marks	
Pass-III	75 Marks	Pass-IV	75 Marks	300+300=600
Hons-III	75 Marks	Hons-IV	75 Marks	
		Practical (Pass)-II	50 Marks	
		Practical (Hons)-II	50 Marks	
Semester-V		Semester-VI		Total =1800
IS & C	100 Marks	Major elective	100 Marks	
Hons-V	75 Marks	Hons-VII	75 Marks	
Hons-VI	75 Marks	Hons-VIII	75 Marks	
Practical (Hons)-III	50 Marks	Practical (Hons)-IV	50 Marks	

**Table-II****+3 SCIENCE (Hons) (with out practical component)**

Semester-I		Semester-II		350+250=600
English	50 Marks	MIL	50 Marks	
Pass-I	100 Marks	Pass-II	100 Marks	
Hons-I	100 Marks	Hons-II	100 Marks	
Minor elective	100 Marks			300+300=600
Semester-III		Semester-IV		
Major elective	100 Marks	Environmental Studies	100 Marks	
Pass-III	100 Marks	Pass-IV	100 Marks	
Hons-III	100 Marks	Hons-IV	100 Marks	300+300=600
Semester-V		Semester-VI		
IS & C	100 Marks	Major elective	100 Marks	
Hons-V	100 Marks	Hons-VII	100 Marks	
Hons-VI	100 Marks	Hons-VIII	100 Marks	
				Total =1800

In order to clear an examination a candidate is required to secure a minimum of 30 % marks in a subject and 40 % in each practical paper. For passing out the Degree examination, he has also to secure the minimum aggregate marks of 36 %. The aggregate marks for passing the degree examination shall be the sum total of aggregate of all the six semester examinations taken together.

In each of the above examinations for subjects having practical, a candidate, in order to secure Honours, must have secured a minimum of 45 % marks in Theory paper (s) taken together and a minimum of 45 % marks in practical Paper (s) taken together in Honours subject.

Duration of paper (s): The duration of examination for each Theory paper carrying 50 marks shall be two hours, and for each Theory Paper carrying 75 or 100 marks, it shall be Three hours.

\* \* \* \* \*

**COMPULSORY COURSES****ENGLISH  
SEMESTER-I****Full Marks: 50  
Time : 2 hours****Paper-I**

There shall be one paper of compulsory English in Semester-I carrying 50 marks. There shall be one novel from which one long answer type question carrying 20 marks and 03 short answer type questions carrying 05 marks each (5 3 = 15) shall be set. Further students shall answer a question on letter writing (official/personal) carrying 15 marks.

**Test Prescribed**

1. Yamini: Chudamani Raghavan
2. Writing with a purpose: Tickoo and Sashi Kumar

**Distribution of marks**

1. One long answer type question with alternative from "Yamini"	=	20 marks
2. 3 shorts answer type questions (out of 5) carrying 05 marks each from "Yamini"	(3 X 5)	= 15 marks
3. Letter Writing		= 15 marks
Total		= 50 marks

\* \* \* \* \*

**MIL (Odia)  
SEMESTER-II****Full Marks- 50  
Time - 2 hours**

**Unit-I ପଦ୍ୟ ସାହିତ୍ୟ :** **12 Marks**  
ସବିଶେଷ ଅଧ୍ୟୟନ : କବିତାଶ୍ରୀ-ସଂପାଦନା-ଡକ୍ଟର କୃଷ୍ଣଚରଣ ବେହେରା, ବିଦ୍ୟା ପ୍ରକାଶନ, ବାଲୁବଜାର, କଟକ-୨

**ପାଠ୍ୟ :**

- |     |                      |   |                     |
|-----|----------------------|---|---------------------|
| (କ) | ମାଲ୍ୟବନ୍ତରେ ବର୍ଷାକାଳ | - | ବଳରାମ ଦାସ           |
| (ଖ) | କପୋତ ଗୁରୁ            | - | ଜଗନ୍ନାଥ ଦାସ         |
| (ଗ) | ମୂକ ଭଗବାନ            | - | ବୈକୁଣ୍ଠନାଥ ପଟ୍ଟନାୟକ |
| (ଘ) | ବସନ୍ତ ଆସିଛି ସତେ      | - | ଶ୍ରୀନିବାସ ଉଦ୍‌ଗାତା  |

ଉଲ୍ଲିଖିତ କବିତାଗୁଡ଼ିକରୁ ଦୁଇଟି ପ୍ରଶ୍ନ ପଢ଼ିବ । ଗୋଟିକର ଉତ୍ତର ଲେଖାଯିବ ।  
ମୂଲ୍ୟ ୧୨ ନମ୍ବର ।

**Unit-II କ୍ଷୁଦ୍ରଗଳ୍ପ :** **12 Marks**  
ସବିଶେଷ ଅଧ୍ୟୟନ : କାହାଣୀ : ଚଳିତ ଶତାବ୍ଦୀର-ସଂ-ନିମାଇଁ ଚରଣ ପଟ୍ଟନାୟକ, ପ୍ରେକ୍ଷା ପବ୍ଲିଶର୍ସ, ବିନୋଦ ବିହାରୀ, କଟକ-୨

**ପାଠ୍ୟ :**

- |     |                  |   |                      |
|-----|------------------|---|----------------------|
| (କ) | ଝଡ଼              | - | ଭଗବତୀ ଚରଣ ପାଣିଗ୍ରାହୀ |
| (ଖ) | ଗୋଟିଏ କୁକୁରର କଥା | - | ଅଶ୍ୱଳ ମୋହନ ପଟ୍ଟନାୟକ  |
| (ଗ) | ଶୁଗାଳ            | - | ମନୋଜ ଦାସ             |

ଉଲ୍ଲିଖିତ କ୍ଷୁଦ୍ରଗଳ୍ପଗୁଡ଼ିକରୁ ଦୀର୍ଘ ଉତ୍ତର ଲେଖିବା ପାଇଁ ଦୁଇଟି ପ୍ରଶ୍ନ ପଢ଼ିବ । ଗୋଟିକର ଉତ୍ତର ଲେଖିବାକୁ ହେବ । ମୂଲ୍ୟ ୧୨ ନମ୍ବର ।

**Unit-III ସଂକ୍ଷେପକରଣ :** **10 Marks**  
ଆନୁମାନିକ ୩୦୦ ଶବ୍ଦ ବିଶିଷ୍ଟ ଗୋଟିଏ ଅନୁକ୍ଷେପ ଦିଆଯିବ । ଅନୁକ୍ଷେପରେ ଅଭିବ୍ୟକ୍ତ ଭାବକୁ ପାଖାପାଖି ୧୦୦ ଶବ୍ଦରେ ଲେଖିବାକୁ ହେବ । ମୂଲ୍ୟ ୧୦ ନମ୍ବର ।

**Unit-IV ଅନୁବାଦ :** **10 Marks**  
ଇଂରାଜୀ ଭାଷାର ଏକ ଅନୁକ୍ଷେପ (ପାଖାପାଖି ଦଶଟି ବାକ୍ୟର) ଦିଆଯିବ । ତାହାକୁ ଓଡ଼ିଆରେ ଅନୁବାଦ କରାଯିବ । ମୂଲ୍ୟ ୧୦ ନମ୍ବର ।

**Unit-V ସମୋଚ୍ଚାରିତ ଶବ୍ଦ :** **6 Marks**  
ଛଅଯୋଡ଼ା ସମୋଚ୍ଚାରିତ ଶବ୍ଦ ପଢ଼ିବ । ତିନିଯୋଡ଼ାର ଉତ୍ତର ଦିଆଯିବ । ପ୍ରତ୍ୟେକର ସଠିକ୍ ଉତ୍ତର ପାଇଁ ୧ ନମ୍ବର ଲେଖାଏଁ ୬ ନମ୍ବର ରହିବ ।

### M.I.L. (Hindi) SEMESTER-II

There shall be one paper carrying 50 marks of 2 hours duration.

The course shall comprise,

Poetry text	- 15 marks
Non-detail Short Stories	- 10 marks
Grammar	- 10 marks
Translation (English to Hindi)	- 10 marks
Essay	- 10 marks

#### DETAILED COURSE :

- काव्य मञ्जूषा - सं - मुरारी लाल शर्मा  
शवनम पुस्तक महल-कटक- १०  
पठनीय कविताएँ :  
१. रामधारी सिंह दिनकर - वनतंत्र का जन्म  
२. नागार्जुन - काली दास  
३. अज्ञेय - दीप अकेला  
४. दुष्यंत कुमार - गजलें (१,२)
  - कथारश्मी - सं- चक्रधर-सुमित्रा प्रकाशन, इलाहबाद ।  
१. मुलान भगत - प्रेमचन्द  
२. परदा - यशपाल  
३. चीक का दावत - भीष्म सहानी  
४. गर्मियों के दिन - कमलेश्वर
  - व्याकरण - पर्याय बाची शब्द, विलोम शब्द, कहावतें तथा महावरे ।
  - अनुबाद - अंग्रजी गद्यांश का हिन्दी में अनुबाद ।
  - निबन्ध - (लगभग २४० शब्दों में) प्रदत्त बिषय पर निबंध लेखन ।
- पाठनीय पुस्तकें :
- आधुनिक हिन्दी काव्य व्याकरण और रचना :  
डा. वासुदेव नन्दन प्रसाद, भारती भवन, पटना-४ ।
  - हिन्दी भाषा भाग- १. ले.डा. कन्हैया सिंह, डा. कुवेर मिश्रा, डा. सुरेश चन्द्र पाण्डे ।

### ALTERNATIVE ENGLISH

#### SEMESTER-II

Full Marks: 50  
Time : 2 hours

There shall be one paper carrying 50 marks comprising the following

- Novel
- Expansion

Text Prescribed: - Huckleberry Finn :Mark Twain

#### Distribution of Marks

There shall be one long question carrying 20 marks and three short answer type questions carrying 5 marks each from the novel.

Expansion carries 15 marks

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#### SEMESTER-IV

### ENVIRONMENTAL STUDIES FOR SCIENCE

Full Marks: 100  
Time : 3 hours

The paper carries 100 marks and of 03 hours duration. There shall be 10 long and short answer type questions with two questions from each unit. The candidates are required to answer any five questions. All questions carry equal marks.

#### Unit-I

Definition, scope and sub-division of ecology. Constituents and functions of Biosphere, Biome. Nature and composition of soil, types of soil.

#### Unit - II

Ecosystem : Structure and function, types of ecosystem. Food chain, food web, Bio-geochemical cycles (carbon, nitrogen, oxygen). Ecological pyramids, Energy flow models (Lindeman's)

#### Unit -III

Population studies: Basic concept, character & composition, natality, mortality, animal associations: commensalism, parasitism, symbiosis

**Unit - IV**

Pollution: Type of pollutants, causes, effects and control of air pollution. Green house effect and global warming. Carbon trading, Causes, effects and control of water, soil, noise and radio-active pollution.

**Unit - V**

Environmental planning : concept of resource and conservation, resource management (conservation of natural resources, renewable and non-renewable). Conservation of forests and wild life. Guidelines and salient features of Environmental protection act (1986).

**Books Recommended:**

1. Man and Environment : Das and Mishra
2. A Text Book of Plant Ecology : Shukla and Chandel
3. Fundamental of Ecology : M.C.Dash
4. Environmental Studies : S.Swain
5. Text Book of Environmental Studies : S.K.Rout

\* \* \* \* \*

**SEMESTER-V****INDIAN SOCIETY AND CULTURE****Full Marks: 100****Time : 3 hours**

The paper carries 100 marks and of 03 hours duration. There shall be 10 long and short questions with two questions from each unit. Candidates are required to answer any five questions; All questions carry equal marks.

**Unit-I**

- a. Vedic culture -Society and Religion
- b. Cultural attainments during Gupta period.

**Unit-II**

1. Impact of Islam on Indian life.
2. Bhakti Movement- Kabir, Nanak and Chaitanya

**Unit-III**

1. Human Right: Concept; Historical Development, Menace of Ragging in Educational Institutions.
2. Freedom Struggle- Role of Gandhi and Subash

**Unit-IV**

1. Composition of Indian Society, Unity in Diversity
2. Concept of Tribe and Caste: Definition and characteristics, Tribe Caste distinction, continuity and change in Caste and Tribe.

**Unit-V**

1. Impact of sanskritisation, westernization, modernization and secularisation in Indian society.
2. Implication of Liberalization, Globalisation as ingredients of New Economic Reforms and their impact on Indian society and culture.

**Books for the Indian Culture and Society;**

1. A Social, Cultural and Economic History of India : P.N. Chopra, B.N. Puri & M.N. Das in 3 volumes (Macmillan).
2. The History & culture of Indian People, Vol III, IV, IX, XI : Bharatiya Vidya Bhavan Series, Edited - R.C.Majumdar.
3. Social History of India : Romila Thapar.
4. Cultural Heritage of India - In 4 Vols. Published by Ramakrishna Mission.
5. Economic and Social History of Modern India : S.P. Nanda
6. Social Changes in Modern India :M.N.Srinivas.
7. Aspects of Indian Society & Economy in the Nineteenth Century : V.Goutam.
8. A handbook of Sociology : Rakha Sharma.
9. Tribe, Caste & Religion : Thapar.
10. General Sociology : P.K.Kar
11. Social Anthropology: Madan & Majumdar
12. Indian Society: C.N.Shankar Rao

\* \* \* \* \*

**COURSES OF STUDIES****BOTANY (PASS)**

There shall be four semesters in two years with two semesters in each year. In each semester there shall be one theory paper of 75 marks. There shall be an internal assessment of 15 marks and the Term-end Examination of 60 marks. There shall be one question from each unit with alternative from the same unit. Two short notes can be given in place of a long question. The second and fourth semester shall have practical papers with 50 marks each (6 hours duration).

The Mark distribution and Course Structure are as follows :

**SEMESTER-I**

**P - I THEORY** **75 Marks**  
**(15-Internal. 60-Terminal)**

**Microbiology, Algae, Fungi, Plant Pathology**

Unit - I	...	Microbiology I
Unit - II	...	Microbiology II
Unit - III	...	Algae
Unit - IV	...	Fungi
Unit - V	...	Plant Pathology

**Books recommended:**

Botany for Degree Students Algae	:	B.R.Vashista, Singh & Singh
Textbook of Algae	:	O.P.Sharma
Cyanophyta	:	T.V.Desikachary
Textbook of Algae	:	R.K.Kar and N.Mishra
The Structure and reproduction of Algae	:	Fritsch
The Algae	:	V.J.Chapman
An Introduction to Mycology	:	C.J.Alexopolous
Botany for Degree Students Fungi	:	B.R.Vashista & A.K.Sinha
The Fungi	:	P.D.Sharma
Cryptogamic Botany -I	:	G.M.Smith
Microbiology	:	P.K.Gupta
Microbiology	:	Pelzar and Reid
Plant diseases	:	R.S.Singh

**SEMESTER-II**

**P -II: THEORY** **75 Marks**  
**(15-Internal. 60-Terminal)**

**Genetics, Evolution, Plant breeding, Biostatistics**

Unit - I	...	Genetics I
Unit - II	...	Genetics II
Unit - III	...	Genetics III
Unit - IV	...	Evolution and Plant breeding
Unit - V	...	Biostatistics

**Books recommended:**

Genetics	-M.W.Strickberger
Principles of Genetics	-Gardner
Cytogenetics	-P.K.Gupta
Cytogenetics	-Sinha and Sinha
Fundamentals of Genetics	-B.D.Singh
Cytology, Genetics & Evolution	-P.K.Gupta
Principles of Genetics	-Sinnot, Dunn & Dobzhansky
Evolution	-Strickberger
Genetics	-P.K.Gupta
Elements of Biostatics	-S.G.Prasad
Introductory Practical Biostatistics	-Mishra & Mishra
A Textbook of Plant Breeding	-B.D.Singh

**PRACTICAL - I : Practical** **50 Marks (6 Hours)**  
Practicals relevant to Paper I and Paper - II

**SEMESTER-III**

**P-III : THEORY** **75 Marks**  
**(15-Internal. 60-Terminal)**

**Developmental Botany, Anatomy, Economic, Botany & Biotechnology**

Unit - I	...	Developmental Botany
Unit - II	...	Anatomy
Unit - III	...	Economic Botany
Unit - IV	...	Biotechnology I
Unit - V	...	Biotechnology II



**Books recommended:**

Embryology of Plants	:	B.M.Johri
Economic Botany	:	B.P.Pandey
Biotechnology	:	P.K.Gupta
Plant Anatomy	:	K.Esau
Anatomy	:	Eams and Mac Daniels
An Introduction to Embryology of Angiospermi	:	P.Maheswari
Embryology	:	Bhojwani and Bhatnagar
Biotechnology	:	B.D.Singh
An introduction to Biotechnology	:	P.K.Gupta

**SEMESTER-IV****P - IV THEORY**

**75 Marks**  
**(15-Internal. 60-Terminal)**

**Plant Physiology & Techniques**

Unit - I	...	Plant-water relation
Unit - II	...	Mineral nutrition and transport of organic solutes
Unit - III	...	Photosynthesis and respiration
Unit - IV	...	Growth and development
Unit - V	...	Techniques in Biology

**Books recommended:**

Growth and Development of Plants	:	Kozlowski
Plant Physiology	:	Devlin & Barkar
Fundamentals of Plant Physiology	:	V.K.Jain
Plant Physiology	:	R.K.Devlin
Introductory Plant Physiology	:	Noggle and Fritish
Textbook of Plant Physiology	:	V.Verma

**PRACTICAL-II Practical**

**50 Marks (6 hours)**

Practicals relevant to Paper - III and Paper - IV

**Detailed Syllabus (Pass)****SEMESTER-I****P - I Microbiology, Algae, Fungi, Plant Pathology**

**Term-end: 60**  
**Internal : 15**

**Unit-I Microbiology - I**

Concept of microbiology, systematic position of microorganisms in biological world.

Methods in microbiology: microbial culture; culture media; pure culture isolation, maintenance and identification, continuous and synchronous culture; quantitative measurement of growth.

Viruses: Historical account; occurrence, morphology; architecture; nomenclature, classification and symmetry; the envelope and the core structure of typical plant (TMV), animal (Polio) and bacterial (T4) virus; replication of bacteriophage; viroids and prions.

**Unit-II Microbiology - II**

Eubacteria: Structure; endospore formation; nutrition; recombination.

Cyanobacteria: Structure of cell, nutrition and reproduction with special reference to Oscillatoria, Anabaena, Rivularia, Archaeobacteria, Mycoplasma.

Applications of microbes: Role of microorganisms in biogeochemical cycling of nitrogen and carbon; biological nitrogen fixation; industrial applications of microorganisms -organic acids. alcohol, food processing, milk products; antibiotics, biopesticides.

**Unit-III Algae**

General: Thallus organisation; reproduction; evolutionary tendencies; Smith's classification of algae; role of algae in human welfare.

Type study: Characteristics and life cycles of the representative genera of the following classes.

Chlorophyceae: Volvox, Ulothrix, Oedogonium.

Charophyceae: Coleochaete, Chara

Xanthophyceae: Vaucheria

Phacophyceae: Ectocarpus, Fucus

Rhodophyceae: Batrachospermum, Polysiphonia

**Unit-IV Fungi**

General: Structure of a fungal cell, cell wall composition; nutrition; reproduction, classification; role of fungi in human welfare.

Type study: Characteristics and life-cycles of the representative genera of the following classes:

Mastigomycotina: Pythium, Phytophthora  
 Zygomycotina: Rhizopus  
 Ascomycotina: Aspergillus, Penicillium, Erisiphe, Claviceps  
 Basidiomycotina: Puccinia, Ustilago, Agaricus  
 Deuteromycotina: Alternaria, Collectotrichum

**Unit-V Plant pathology**

General account of diseases caused by plant pathogens; physical, physiological, biochemical and molecular aspects of pathogen attack and defence mechanism: chemical, biological. Induced resistance (Immunization); molecular diagnosis; molecular manipulation of resistance.

Plant diseases: symptoms, causative organisms transmission and control measures of viral, bacterial and fungal diseases of plants.

Viral diseases: tobacco mosaic

Bacterial diseases: canker of citrus, red stripes of sugarcane.

Fungal diseases: Damping off by Pythium, late blight by Phytophthora

White rust of Albugo, powdery mildew by Erysiphe, ergot by Claviceps, rust by Puccinia

**SEMESTER-II****P- II Genetics, Evolution and Plant Breeding, Bio-statistics**

**Term-end: 60**

**Internal : 15**

**Unit-I Genetics-I**

Principles of inheritance : Mendel's experiments; gene interactions.

Linkage and crossing over : coupling and repulsion; Morgan's theory of linkage; Cytological basis and molecular mechanism of crossing over; two and three point crosses and their role in chromosome mapping.

**Unit-II Genetics-II**

Sex determination : sex determination in plants and animals.

Sex linked inheritance

Maternal influence and cytoplasmic inheritance : Shell coiling in snails, Plastid inheritance in Mirabilis, inheritance in corn, cytoplasmic inheritance in yeast.

Population genetics : Gene pool and gene frequency Hardy - Weinberg principle and genetic equilibrium.

**Unit-III Genetics-III**

Gene Mutation : Spontaneous and induced mutations; molecular mechanism - transitions, transversions and frame shift mutations; Mutagens - types, mode of action; detection of mutations.

Chromosomal aberrations : Origin types and effects of deletions, duplications, inversions and translocations.

Change in Chromosome number : Origin, types and effects of auto-polyploids and allopolyploids; aneuploidy-origin and meiosis in monosomics and trisomics.

**Unit-IV Plant Breeding and Evolution**

Plant breeding as a technology; basic procedure of plant breeding - introduction, acclimatization; selection procedures; procedures involved in hybridisation; effects of inbreeding, hybrid vigour; maintenance of hybrid; Role of polyploidy and mutation in plant breeding.

Concept of evolution; theories - Lamarkism, Darwinism, Mutation theory and modern synthetic theory; Evidences of evolution with special reference to plants.

**Unit-V Bio-statistics**

Need of statistics in biology; collection of biological data; frequency distribution : frequency, relative frequency and cumulative frequency, central tendency - mean, mode, median and their biological significance; dispersion - range, quartile deviation, mean deviation, variance, standard deviation and their biological importance; estimation and hypothesis testing; student 't' - test and chi-square test, their applications.

**PRACTICAL-I Practical**

**50 Marks (6 Hours)**

1. Study of morphology, anatomy and reproductive structure of genera included under Algae & Fungi.
2. Study of materials and slides available.
3. Emasculation and bagging technique.
4. Experiments related to statistics.
5. Enumeration of Microorganisms.
6. Microbiological quality of milk.
7. Study of microbial growth.
8. Gram staining technique.
9. Study of root nodule bacteria.

**SEMESTER-III****P - III Developmental Botany, Angiosperm Anatomy, Bio technology, Economic Botany**

**Term-end: 60**

**Internal : 15**

**Unit-I Developmental Botany**

Structure and development of microsporangium; Microsporogenesis; structure and development of male gametophyte; structure and development of

megasporangium; structure and development of female gametophyte.

Pollen stigma interaction; self-incompatibility; double fertilization; apomixis; structure, development and morphological nature of endosperms; development of dicot and monocot embryo; experimental embryology - general considerations.

#### Unit-II Angiosperm Anatomy

Tissues : Meristematic tissues, its organization in the shoot and root apices; lateral meristem, simple, complex and secretory tissue; Haberlandt's classification of plant tissue.

Mechanical tissue; types, Principles involved in the distribution; distribution of mechanical tissues in plant organs; Vascular cambium, secondary xylem (basic structure of wood); secondary phloem; periderm, anomalous secondary growth - adaptive and non-adaptive type; root-stem transition.

#### Unit-III Economic Botany

Outline classification of economical important plants; an idea of domestication of plants with special reference to primary and secondary centres of diversity and plant introduction; Economic uses of flowering plants in relation to human welfare (informing short notes) with reference to plant products like food grains (rice, wheat); sugar (sugarcane); oil seeds (groundnut); fibres (jute); and economic importance of the following spices, and condiments - ginger, turmeric, poppy, blackpepper. Botany (botanical name, family brief description) alkaloids, obtained and their role in curing diseases of the following medicinal plants - Rauwolfia, Cinchona, Ocimum, Adhatoda, Vinca.

[Questions demanding short answer (1-3 mark each) only may be set from this unit]

#### Unit-IV Bio-technology-I

Recombinant DNA technology - restriction endonucleases; ligases; linkers; prokaryotic and eukaryotic cloning vectors; formation of DNA fragments and their isolation; introduction of recombinant DNA into the host cell; transformation; selection of recombinant clones; genetic engineering of plants; vectors for gene delivery; transgenic plants. Agrobacterium, the natural genetic engineer.

#### Unit-V Bio-technology-II

Application of recombinant DNA technology : Gelelectrophoresis; Southern, Northern and Western blotting techniques; technology of gene mapping; PCR; DNA finger printing; genomic and cDNA libraries, DNA sequencing;

Plant Bio-technology : Totipotency; culture condition; protoplast isolation and culture; somatic hybridisation; Plant cell culture and its applications; plant tissue culture - anther and pollen culture.

### SEMESTER-IV

#### P-IV Plant physiology and techniques

Term-end: 60

Internal : 15

##### Unit-I Plant Water Relations

Osmosis and imbibition: chemical potential, water potential and its components  $s$ ,  $p$  and  $m$ , plasmolysis, imbibition.

Water relations: Availability of soil water, absorption of water, ascent of sap; transpiration (types, mechanism of stomatal movement and significance)

##### Unit-II Mineral nutrition and transport of organic solutes

Mineral nutrition, essentiality of elements; macro and micro nutrients; role of essential elements; mineral deficiency symptoms.

Absorption of minerals -mechanism of mineral absorption, role of all membrane ion pumps and carriers.

Transport of organic substances: Transport of Photosynthate, source sink relationship; the mechanism of tranlocation in phloem, assimilate partitioning.

##### Unit-III Photosynthesis and respiration

Photosynthesis: Historical background and significance; structure of photosynthetic apparatus. Photosynthetic pigments; accessory pigments and the photoproduative carotenoids; evidences of two light reactions PSI & PSII, reaction centre, photochemical reaction (Photolysis of water), cyclic and non-cyclic electron transport; mechanism of photophosphorycation, formation of NADPH; tracing the path of carbon; C3, and C4 cycle; CAM cycle.

Respiration: Glycolysis, anaerobic pathway; TCA cycle; electron transport system; mechanism of oxidative photophosphorylation; hexose monophosphate shunt as an alternative pathway; photorespiration.

##### Unit-IV Growth and Development

General aspects: Definition, phases of growth, Kinetics of growth; Physiology of seed dormancy and seed germination general account.

Photoperiodism: Mechanism

Vernalization: Mechanism

Senescence and fruit ripening: General account.

Phytohormones: Discovery, Physiological role and mechanism of action of phytohormones: auxins, cytokinins, gibberellins, abscisic acid and ethylene.

Photomorphogenesis: Discovery of phytochromes, their role and mechanism of action.

Signal transduction: basic concept

Plant movements: tropic and nastic

Biological clock: basic idea

Principles of light and electron microscopy, including phase contrast and fluorescence microscopy; TEM and SEM; centrifuge and ultracentrifuge; cell fractionation procedure; chromatography - paper chromatography, TLC, GLC and HPLC, autoradiography; paper electrophoresis and gel electrophoresis.

**PRACTICAL-II Practical 50 Marks**

**I. Experiments on Physiology**

1. Determination of Osmotic Pressure of cell sap by plasmolytic method.
2. Determination of Suction Pressure of stem tuber/ root tuber/ rhizome.
3. Determination of resistance offered by cuticle to loss of water by xerophyte.
4. Determination of relation between absorption and transpiration by T/A apparatus.
5. Determination of rate of photosynthesis under different CO<sub>2</sub> concentration.
6. Effect of wavelength of light on the rate of photosynthesis by Wilmott's bubbler.
7. Determination of rate of imbibitions in starch, proteinaceous and oily seeds.

II. Preparation of temporary slides for the study of normal and abnormal secondary growth in angiosperms.

III. Identification and comments on plants/plant parts/ products with reference to their economic importance.

IV. Identification of embryological slides.

**COURSES OF STUDIES**

**BOTANY (HONOURS)**

There shall be six semesters covering three years, with two semesters in each year. In first four semesters there shall be four theory papers with 75 mark in each theory paper. The last two semesters shall have four theory papers in total. There shall be Internal Assessment of 15 marks out of 75 (i.e. 20% of theory), so that the semester-end examination theory papers shall have 60 marks. There shall be one question from each unit with alternative from the same unit. There can be two short notes in place of one long question. The second, fourth, fifth and sixth semesters shall have one practical each: Practical-I, Practical-II, Practical-III and Practical-IV respectively, carrying 50 marks each. All practical papers shall be of 6 hours duration.

**BOTANY HONOURS**

**SEMESTER-I**

H - I Theory

75 Marks

(15-Internal. 60-Terminal)

**Microbiology, Algae, Fungi, Plant Pathology**

Unit - I	...	Microbiology I
Unit - II	...	Microbiology II
Unit - III	...	Algae
Unit - IV	...	Fungi
Unit - V	...	Plant Pathology

**Books recommended:**

Botany for Degree Students Algae	:	B.R.Vashista, Singh & Singh
Textbook of Algae	:	O.P.Sharma
Cyanophyta	:	T.V.Desikachary
Textbook of Algae	:	R.K.Kar and N.Mishra
The Structure and reproduction of Algae	:	Fritsch
The Algae	:	V.J.Chapman
An Introduction to Mycology	:	C.J.Alexopolous
Botany for Degree Students Fungi	:	B.R.Vashista & A.K.Sinha
The Fungi	:	P.D.Sharma
Cryptogamic Botany -I	:	G.M.Smith
Microbiology	:	P.K.Gupta
Microbiology	:	Pelzar and Reid
Plant diseases	:	R.S.Singh

**SEMESTER-II**

**H-II: Theory** **75 Marks**  
(15-Internal. 60-Terminal)

**Genetics, Evolution, Plant breeding, Biostatistics**

Unit - I	...	Genetics I
Unit - II	...	Genetics II
Unit - III	...	Genetics III
Unit - IV	...	Evolution and Plant breeding
Unit - V	...	Biostatistics

**Books recommended:**

Genetics	-	M.W.Strickberger
Principles of Genetics	-	Gardner
Cytogenetics	-	P.K.Gupta
Cytogenetics	-	Sinha and Sinha
Fundamentals of Genetics	-	B.D.Singh
Cytology, Genetics & Evolution	-	P.K.Gupta
Principles of Genetics	-	Sinnot, Dunn & Dobzhansky
Evolution	-	Strickberger
Genetics	-	P.K.Gupta
Elements of Biostatistics	-	S.G.Prasad
Introductory Practical Biostatistics	-	Mishra & Mishra
A Textbook of Plant Breeding	-	B.D.Singh

**PRACTICAL - I: Practical** **50 Marks (6 Hours)**

Practicals relevant to Paper I and Paper - II

**SEMESTER-III**

**H-III: Theory** **75 Marks**  
(15-Internal. 60-Terminal)

**Developmental Botany, Anatomy, Economic, Botany & Biotechnology**

Unit - I	...	Developmental Botany
Unit - II	...	Anatomy
Unit - III	...	Economic Botany
Unit - IV	...	Biotechnology I
Unit - V	...	Biotechnology II

**Books recommended:**

Embryology of Plants	:	B.M.Johri
Economic Botany	:	B.P.Pandey

Biotechnology	:	P.K.Gupta
Plant Anatomy	:	K.Esau
Anatomy	:	Eams and Mac Daniels
An Introduction to Embryology of Angiosperms	:	P.Maheswari
Embryology	:	Bhojwani and Bhatnagar
Biotechnology	:	B.D.Singh
An introduction to Biotechnology	:	P.K.Gupta

**SEMESTER-IV**

**H - IV Theory** **75 Marks**  
(15-Internal. 60-Terminal)

**Plant Physiology & Techniques**

Unit - I	...	Plant-water relation
Unit - II	...	Mineral nutrition and transport of organic solutes
Unit - III	...	Photosynthesis and respiration
Unit - IV	...	Growth and development
Unit - V	...	Techniques in Biology

**Books recommended:**

Growth and Development of Plants	:	Kozlowski
Plant Physiology	:	Devlin & Barkar
Fundamentals of Plant Physiology	:	V.K.Jain
Plant Physiology	:	R.K.Devlin
Introductory Plant Physiology	:	Noggle and Fritsch
Textbook of Plant Physiology	:	V.Verma

**PRACTICAL-II Practical** **50 Marks (6 hours)**

Practicals relevant to Paper - III and Paper - IV

**SEMESTER-V**

**H- V : Theory** **75 Marks**  
(15-Internal. 60-Terminal)

**Bryophyta, Pteridophyta, Gymnosperms, Paleobotany**

Unit - I	...	Bryophyta
Unit - II	...	Pteridophyta I
Unit - III	...	Pteridophyta II
Unit - IV	...	Gymnosperms
Unit - V	...	Paleobotany

**Books recommended:**

Cryptogamic Botany-Vol-II	:	G.M.Smith
Bryophyte	:	N.S.Parihar
Bryophyte	:	Vasistha, Sinha and Kumar
Interrelationship of Byophyta	:	F.Cavers
Pteridophyta	:	N.S.Parihar
Pteridophyta	:	Vasistha, Sinha and Kumar
Gymnosperms	:	P.Vasistha
Gymnosperms	:	Chamberlain
Morphlogy of Gymnosperms	:	K.R.Sporne
Introduction of Gymnosperms	:	K.R.Sporne
An introduction to paleobotany	:	C.A.Arnold
Primitive Land Plants	:	F.O.Bower
Bryophyta	:	B.P.Pandey
Pteridophyte	:	B.P.Pandey

**SEMESTER-V****H - VI Theory****75 Marks  
(15-Internal. 60-Terminal)****Cell Biology, Molecular Biology**

Unit - I	...	Cell Biology I
Unit - II	...	Cell Biology II
Unit - III	...	Cell Biology III
Unit - IV	...	Molecular Biology I
Unit - V	...	Molecular Biology II

**Books recommended:**

Molecular Biology of the Gene	-	J.D.Watson
Elements of Cytology	-	N.N.Cohn
Cell and Mol. Biology	-	E.J.Dupraw
Cell Biology	-	G.Carb Dc Roberties and Dc Roberties

**PRACTICAL-III Practical****50 Marks (6 hours)**

Practical relevant to paper V &amp; VI

**SEMESTER-VI****H-VII Theory****75 Marks  
(15-Internal. 60-Terminal)****Systematics and Environmental Biology**

Unit - I	...	Systematics I
Unit - II	...	Systematics II
Unit - III	...	Environmental Biology I
Unit - IV	...	Environmental Biology II
Unit - V	...	Environmental Biology III

**Books recommended:**

A Textbook of Plant Ecology	-	Chandel & Sukla
Fundamentals of Ecology	-	M.C.Dash
Concept of Ecology	-	E.J.Kormundy
Ecology	-	E.P.Odum
Man and Environment	-	Dash & Mishra
Environmental Biology	-	P.D.Sharma
Taxonomy of angiosperms	-	B.P.Pandey
Taxonomy of angiosperms	-	Singh and Jain
Taxonomy of vascular plants	-	G.H.Lawrence
Taxonomy of Ecology	-	J.N.Mitra
A Textbook of Systematic Botany	-	D.B.Swingle

**H - VIII Theory****75 Marks  
(15-Internal. 60-Terminal)****Biochemistry and Enzymology**

Unit - I	...	Basic Biochemistry & Enzymology
Unit - II	...	Biochemistry II, Carbohydrate
Unit - III	...	Biochemistry III -Amino Acids and protein
Unit - IV	...	Biochemistry-IV-Lipids and Vitamins
Unit - V	...	Nitrogen and lipid metabolism.

**Books recommended:**

Biotechnology	-	Lehringer
Outlines of biochemistry	-	Cohn and Stumpf
Fundamentals of Biochemistry	-	J.L.Jain

**PRACTICAL-IV Practical****50 Marks (6 hours)**

Practicals relevant to Paper VII and VIII

**SEMESTER-I**

**H - I Microbiology, Algae, Fungi, Plant Pathology** Term-end: 60  
Internal : 15

**Unit-I Microbiology I**

Concept of microbiology, systematic position of microorganisms in biological world. Methods in microbiology: microbial culture; culture media; pure culture isolation, maintenance and identification, continuous and synchronous culture; quantitative measurement of growth.

Viruses: Historical account; occurrence, morphology; architecture; nomenclature, classification and symmetry; the envelope and the core structure of typical plant (TMV), animal (Polio) and bacterial (T4) virus; replication of bacteriophage; viroids and prions.

**Unit-II Microbiology II**

Eubacteria: Structure; endospore formation; nutrition; recombination.

Cyanobacteria: Structure of cell, nutrition and reproduction with special reference to Oscillatoria, Anabaena, Rivularia, Archaeobacteria, Mycoplasma.

Applications of microbes: Role of microorganisms in biogeochemical cycling of nitrogen and carbon; biological nitrogen fixation; industrial applications of microorganisms -organic acids, alcohol, food processing, milk products; antibiotics, biopesticides.

**Unit-III Algae**

General: Thallus organisation; reproduction; evolutionary tendencies; Smith's classification of algae; role of algae in human welfare.

Type study: Characteristics and life cycles of the representative genera of the following classes.

Chlorophyceae: Volvox, Ulothrix, Oedogonium.

Charophyceae: Coleochaete, Chara

Xanthophyceae: Vaucheria

Phacophyceae: Ectocarpus, Fucus

Rhodophyceae: Batrachospermum, Polysiphonia

**Unit-IV Fungi**

General: Structure of a fungal cell, cell wall composition; nutrition; reproduction, classification; role of fungi in human welfare.

Type study: Characteristics and life-cycles of the representative genera of the following classes:

Mastigomycotina: Pythium, Phytophthora

Zygomycotina: Rhizopus

Ascomycotina: Aspergillus, Penicillium, Erisiphe, Claviceps

Basidiomycotina: Puccinia, Ustilago, Agaricus

Deuteromycotina: Alternaria, Collectotrichum

**Unit-V Plant pathology**

General account of diseases caused by plant pathogens; physical, physiological, biochemical and molecular aspects of pathogen attack and defence mechanism: chemical, biological. Induced resistance (Immunization); molecular diagnosis; molecular manipulation of resistance.

Plant diseases: symptoms, causative organisms transmission and control measures of viral, bacterial and fungal diseases of plants.

Viral diseases: tobacco mosaic

Bacterial diseases: canker of citrus, red stripes of sugarcane.

Fungal diseases: Damping off by Pythium, late blight by Phytophthora

White rust of Albugo, powdery mildew by Erysiphe, ergot by Claviceps, rust by Puccinia

**SEMESTER-II**

**H - II Genetics, Evolution and Plant Breeding, Bio-statistics**

Term-end: 60

Internal : 15

**Unit-I Genetics-I**

Principles of inheritance : Mendel's experiments; gene interactions.

Linkage and crossing over : coupling and repulsion; Morgan's theory of linkage; Cytological basis and molecular mechanism of crossing over; two and three point crosses and their role in chromosome mapping.

**Unit-II Genetics-II**

Sex determination : sex determination in plants and animals.

Sex linked inheritance

Maternal influence and cytoplasmic inheritance : Shell coiling in snails, Plastid inheritance in Mirabilis, inheritance in corn, cytoplasmic inheritance in yeast.

Population genetics : Gene pool and gene frequency Hardy - Weinberg principle and genetic equilibrium.

**Unit-III Genetics-III**

Gene Mutation : Spontaneous and induced mutations; molecular mechanism - transitions, transversions and frame shift mutations; Mutagens - types, mode of

action; detection of mutations.

Chromosomal aberrations : Origin types and effects of deletions, duplications, inversions and translocations.

Change in Chromosome number : Origin, types and effects of auto-polyploids and allopolyploids; aneuploidy-origin and meiosis in monosomics and trisomics.

#### Unit-IV Plant Breeding and Evolution

Plant breeding as a technology; basic procedure of plant breeding - introduction, acclimatization; selection procedures; procedures involved in hybridisation; effects of inbreeding, hybrid vigour; maintenance of hybrid; Role of polyploidy and mutation in plant breeding.

Concept of evolution; theories - Lamarkism, Darwinism, Mutation theory and modern synthetic theory; Evidences of evolution with special reference to plants.

#### Unit-V Bio-statistics

Need of statistics in biology; collection of biological data; frequency distribution : frequency, relative frequency and cumulative frequency, central tendency - mean, mode, median and their biological significance; dispersion - range, quartile deviation, mean deviation, variance, standard deviation and their biological importance; estimation and hypothesis testing; student 't' - test and chi-square test, their applications.

#### PRACTICAL-I Practical 50 Marks (6 Hours)

1. Study of morphology, anatomy and reproductive structure of genera included under Algae & Fungi.
2. Study of materials and slides available.
3. Emasculation and bagging technique.
4. Experiments related to statistics.
5. Enumeration of Microorganisms.
6. Microbiological quality of milk.
7. Study of microbial growth.
8. Gram staining technique.
9. Study of root nodule bacteria.

### SEMESTER-III

H - III Developmental Botany, Angiosperm Anatomy, Bio technology,  
Economic Botany

Term-end: 60

Internal : 15

Unit-I Developmental Botany

Structure and development of microsporangium; Microsporogenesis; structure and development of male gametophyte; structure and development of megasporangium; structure and development of female gametophyte.

Pollen stigma interaction; self-incompatibility; double fertilization; apomixis; structure, development and morphological nature of endosperms; development of dicot and monocot embryo; experimental embryology - general considerations.

#### Unit-II Angiosperm Anatomy

Tissues : Meristematic tissues, its organization in the shoot and root apices; lateral meristem, simple, complex and secretory tissue; Haberlandt's classification of plant tissue.

Mechanical tissue; types, Principles involved in the distribution; distribution of mechanical tissues in plant organs; Vascular cambium, secondary xylem (basic structure of wood); secondary phloem; periderm, anomalous secondary growth - adaptive and non-adaptive type; root-stem transition.

#### Unit-III Economic Botany

Outline classification of economical important plants; an idea of domestication of plants with special reference to primary and secondary centres of diversity and plant introduction; Economic uses of flowering plants in relation to human welfare (informing short notes) with reference to plant products like food grains (rice, wheat); sugar (sugarcane); oil seeds (groundnut); fibres (jute); and economic importance of the following spices, and condiments - ginger, turmeric, poppy, blackpepper. Botany (botanical name, family brief description) alkaloids, obtained and their role in curing diseases of the following medicinal plants - Rauvolfia, Cinchona, Ocimum, Adhatoda, Vinca.

[Questions demanding short answer (1-3 mark each) only may be set from this unit]

#### Unit-IV Bio-technology-I

Recombinant DNA technology - restriction endonucleases; ligases; linkers; prokaryotic and eukaryotic cloning vectors; formation of DNA fragments and their isolation; introduction of recombinant DNA into the host cell; transformation; selection of recombinant clones; genetic engineering of plants; vectors for gene delivery; transgenic plants. Agrobacterium, the natural genetic engineer.

#### Unit-V Bio-technology-II

Application of recombinant DNA technology : Gel electrophoresis; Southern, Northern and Western blotting techniques; technology of gene mapping; PCR; DNA finger printing; genomic and cDNA libraries, DNA sequencing;



Plant Bio-technology : Totipotency; culture condition; protoplast isolation and culture; somatic hybridisation; Plant cell culture and its applications; plant tissue culture - anther and pollen culture.

### **SEMESTER-IV**

#### **H -IV Plant physiology and techniques**

**Term-end: 60**  
**Internal : 15**

##### **Unit-I Plant Water Relations**

Osmosis and imbibition: chemical potential, water potential and its components  $s_p$  and  $m_p$ , plasmolysis, imbibition.

Water relations: Availability of soil water, absorption of water, ascent of sap; transpiration (types, mechanism of stomatal movement and significance)

##### **Unit-II Mineral nutrition and transport of organic solutes**

Mineral nutrition, essentiality of elements; macro and micro nutrients; role of essential elements; mineral deficiency symptoms.

Absorption of minerals -mechanism of mineral absorption, role of all membrane ion pumps and carriers.

Transport of organic substances: Transport of Photosynthate, source sink relationship; the mechanism of translocation in phloem, assimilate partitioning.

##### **Unit-III Photosynthesis and respiration**

Photosynthesis: Historical background and significance; structure of photosynthetic apparatus. Photosynthetic pigments; accessory pigments and the photoprotective carotenoids; evidences of two light reactions PSI & PSII, reaction centre, photochemical reaction (Photolysis of water), cyclic and non-cyclic electron transport; mechanism of photophosphorylation, formation of NADPH; tracing the path of carbon; C<sub>3</sub>, and C<sub>4</sub> cycle; CAM cycle.

Respiration: Glycolysis, anaerobic pathway; TCA cycle; electron transport system; mechanism of oxidative phosphorylation; hexose monophosphate shunt as an alternative pathway; photorespiration.

##### **Unit-IV Growth and Development**

General aspects: Definition, phases of growth, Kinetics of growth;

Physiology of seed dormancy and seed germination general account.

Photoperiodism: Mechanism

Vernalization: Mechanism

Senescence and fruit ripening: General account.

Phytohormones: Discovery, Physiological role and mechanism of action of phytohormones: auxins, cytokinins, gibberellins, abscisic acid and ethylene.

Photomorphogenesis: Discovery of phytochromes, their role and mechanism of action.

Signal transduction: basic concept

Plant movements: tropic and nastic

Biological clock: basic idea

Principles of light and electron microscopy, including phase contrast and fluorescence microscopy; TEM and SEM; centrifuge and ultracentrifuge; cell fractionation procedure; chromatography - paper chromatography, TLC, GLC and HPLC, autoradiography; paper electrophoresis and gel electrophoresis.

#### **PRACTICAL-II**

#### **Practical**

**50 Marks**

##### **I. Experiments on Physiology**

1. Determination of Osmotic Pressure of cell sap by plasmolytic method.
2. Determination of Suction Pressure of stem tuber/ root tuber/ rhizome.
3. Determination of resistance offered by cuticle to loss of water by xerophyte.
4. Determination of relation between absorption and transpiration by T/A apparatus.
5. Determination of rate of photosynthesis under different CO<sub>2</sub> concentration.
6. Effect of wavelength of light on the rate of photosynthesis by Wilmott's bubbler.
7. Determination of rate of imbibitions in starch, proteinaceous and oily seeds.

II. Preparation of temporary slides for the study of normal and abnormal secondary growth in angiosperms.

III. Identification and comments on plants/plant parts/ products with reference to their economic importance.

IV. Identification of embryological slides.

### **SEMESTER-V**

#### **H - V Bryophyta, Pteridophyta, Gymnosperms, Paleobotany**

**Term-end: 60**  
**Internal : 15**

##### **Unit-I Bryophytes**

General features of bryophytes; Smith's classification of Bryophytes; comparative account of morphology, anatomy and reproduction in Riccia, Marchantia, Pellia,

Porella, Anthoceros and Sphagnum; Affinities of Anthoceros and Sphagnum; degeneration of sporogenous tissue.

#### Unit-II Pteridophytes-I

General features of Pteridophytes; concept of stele; types of steles found in Pteridophytes; telome theory; heterospory and seed habit. Eames's classification of pteridophytes; structure, anatomy and reproduction of Psilotum, Lycopodium, Selaginella, Isoetes.

#### Unit-III Pteridophytes-II

Comparative account of structure, anatomy and reproduction of Equisetum, Ophioglossum, Osmunda, Marsilea, Azolla, Pteris.

#### Unit-IV Gymnosperms

General features of gymnosperms; Chamberlain's classification of gymnosperms; Comparative account of morphology anatomy, reproduction and life cycle of Cycas, Pinus, Ginkgo, Gnetum;

#### Unit-V Paleobotany

Process of fossilisation; vegetative and reproductive structures of Rhynia, Lepidodendron, Calamites, Lyginopteris, Cycadeoidea, Pentoxylon and their affinities.

### H - VI Cell Biology, Molecular Biology

Term-end: 60

Internal : 15

#### Unit-I Cell biology - I

Discovery of cell; cell theory; Kingdom wise cell size and structure; prokaryotic and eukaryotic cell; detailed ultramicroscopic structure of a typical plant cell.

Cell wall: Structure, chemical constituents, ultrastructure, origin, function.

Cell membrane: organisation (Daniel-Davson, Robertson and Singer:- Nicolson models); role of various membrane proteins, lipids and carbohydrates; role of ion channels and pumps in cellular transport and signaling.

Mitochondrion: Structure; variation in size, shape and number; organisation of macromolecular complexes in the membranes; genome organisation; biogenesis; origin.

Chloroplast: structure; variation in size, shape and number; organisation of macromolecular complexes in the thylakoid membranes; genome organizations; biogenesis; origin.

#### Unit-II Cell biology - II

Endoplasmic reticulum, Golgi body, lysosomes and microbodies (Peroxisomes, glyoxysomes): structure and function.

Ribosomes: Prokaryotic, eukaryotic and organellar ribosomes; structure; function. Cytoskeleton: microtubules; microfilaments; intermediary filaments; cilia; flagella; centrosome.

#### Unit-III Cell Biology III

Nucleus: structure; nuclear envelope; nuclear pore complex; nuclear matrix; nucleoplasm; nucleolus;

Chromosomes: gross morphology, DNA and histones; nucleosome; solenoid and higher level organisation.

Cell division: cell cycle and its control; stages of mitosis and meiosis with special emphasis on the roles of centromere and spindle apparatus.

#### Unit-IV Molecular Biology - I

Nucleic acids: Composition, nucleosides and nucleotides, sugar, bases and phosphate. Structure of DNA (Watson and Crick's model); A, B, Z -forms of DNA; replication of DNA; DNA as a hereditary material. Different forms of RNA, their structure and function.

#### Unit-V Molecular Biology -II

Gene structure, expression and regulation.

Concept of gene; operon concept, inducible and repressible regulations (Lac and Tryptophan operon).

#### PRACTICAL - III :

#### Practical

50 Marks (6 Hours)

1. Study and identification with the help of suitable microscopic preparations of the specimen belonging to Bryophyta, Pteridophyta and Gymnosperms included in the course.
2. Study of fossil materials/ slides.
3. Study of various stages of mitosis and meiosis using appropriate plant material.

### SEMESTER-VI

### H - VII Systematics, Environmental Biology

Term-end: 60

Internal : 15

#### Unit-I Systematics-I

Systematics in Practice : Importance of herbarium specimens and their preparation; role of herbaria, documentation keys for identification of plants.

Taxonomic Hierarchy : Taxonomic category, taxonomic groups; concepts of species; genus and family.

Botanical Nomenclature : Principles and rules; ranks and names; type method; principles of priority and its limitations.

### Unit-II Systematics-II

Systems of classification : Artificial, Natural and Phylogenetic systems, Bentham and Hooker's system; Tankhtajan system and Hutchinson's system.

Modern Taxonomy : Taxonomy in relation to anatomy, embryology, Palynology, ecology, cytology.

### Unit-III Environmental Biology-I

Interrelationship between living world and the environment; the components and dynamism; homeostasis.

Earth as a system; the biosphere, the hydrosphere, the atmosphere and the lithosphere, components within biosphere (biomes);

The environment: Soil -general account and adaptations, water-general account adaptations; the living world -biotic component of the environment, types of biotic interactions.

### Unit-IV Environmental Biology-II

Ecosystem: concepts of ecosystem; structure of ecosystem; functions of ecosystem -energy flow, biogeochemical cycles; homeostasis of ecosystem..

Diversity of ecosystem: Aquatic (fresh water); terrestrial (grassland), man-made ecosystem, Forest ecosystem.

### Unit-V Environmental Biology-III

Human ecology and ecological management: The human population; renewable and non-renewable natural sources; and their management; conservation of biodiversity; endangered species, conventional and non-conventional energy sources.

Impact of human activities: population of air, water and soil, a brief account of noise, thermal and radio active population; prevention and control of pollution; detailed account of global warming, acid rain and ozone depletion.

Bio-indicators -brief account.

Environmental impact assessment: A brief account.

**H -VIII Biochemistry and Enzymology Term-end: 60**  
**Internal : 15**

### Unit-I Basic Biochemistry

Covalent and non-covalent interaction; hydrogen bond; electrostatic interactions; Vander Waals forces and their significance; structure and properties of water and

its biological significance; pH and its significance; pH scale; Henderson -Haselbalch's equation, isoelectric point; buffer, buffer-action and its importance.

Laws of thermodynamics; Concept of free energy, energy transfer and redox potential ATP as an energy rich compound.

### Unit-II Biochemistry-I

Amino acids: types, structure, characteristics, protein and non-protein amino acids. Proteins: Peptide bond, polypeptide chain; primary secondary, tertiary and quaternary structure of proteins;

Enzymes: structure; properties; mechanism of action; activation energy; ES formation; multi substrate action; effect of substrate concentration; Michaelis -Mention equation; importance of KM; effect of enzyme concentration; pH and temperature on enzyme activity; isoenzymes; allosteric enzymes -structure, mechanism of action.

### Unit-III Biochemistry-II (Carbohydrates)

Carbohydrates: Monosaccharides - epimer enantiomers, structure, isomer, mutarotation.

Kilani -Fisher synthesis, disaccharides structure and function of lactose, maltose and sucrose; polysaccharides -structure and function of starch (amylose and amylopectin) cellulose, inulin, mucopolysaccharide; qualitative and quantitative test for carbohydrates; biosynthesis and degradation of sucrose and starch.

### Unit-IV Biochemistry-III

Lipids: fatty acids - saturated and unsaturated; glycerol; classification and functions of lipids; storage and mobilization of fatty acids and lipids; qualitative and quantitative tests for lipids.

Coenzymes: structure and function of different coenzymes.

Vitamins: Plants as sources of vitamins structure and functions of vitamins.

Unit-V Nitrogen and lipid metabolism

Nitrogen fixation - non-symbiotic and symbiotic mechanism; nif genes; regulation of nitrate reductase and nitrogenase; nitrate and ammonia assimilation.

Amino acid synthesis' : Reductive amination; transamination; GS/GOGAT cycle.

Genetic code and transcription: Genetic Code, transcription, in prokaryotes and eukaryotes.

Protein synthesis: Mechanism of protein synthesis, in prokaryotes and its regulation; post translational modification of proteins.

Protein targeting and degradation: brief account.

Fatty acid synthesis and mechanisms.

Mobilization of fatty acids and lipids - Brief account.

**PRACTICAL -IV****Practical****50 Marks**

1. Study of taxonomy of locally available plants belonging to the families included in the course and identification of their genus and species.
2. Study of anatomy of ecologically adapted plants (hydrophytes, epiphytes and xerophytes)
3. Experiments on biochemistry:
  - a. Isolation of starch from supplied material (potato/sweet potato)
  - b. Isolation of casein from milk.
  - c. Separation and identification of pigments by paper chromatography.
  - d. Isolation of chloroplast from the given leaves.
  - e. Qualitative identification of carbohydrates, proteins and fats.

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**CHEMISTRY (PASS)**

There shall be four semesters in two years with two semesters in each year. In each semester there shall be one theory paper of mark 75. There shall be internal assessment of 15 marks out of 75 (i.e. 20% of theory, so that the Term-end examination theory paper shall have 60 marks). There shall be one long or short question from each unit with alternative from the same unit. The second and fourth semester shall have practical papers with 50 marks each (6 hours duration).

**COURSE STRUCTURE****FIRST YEAR****SEMESTER-I**

P-I	Analytical Chemistry-I	75 marks	3 hours
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**SEMESTER-II**

P-II	Inorganic Chemistry-II	75 marks	3 hours
Practical-I	Inorganic Chemistry Qualitative Analysis	50 marks	6 hours
	a. Experiment I -20		
	b. Experiment II -15		
	c. Viva Voce-10		
	d. Record-05		

**SECOND YEAR****SEMESTER-III**

P-III	Organic Chemistry	75 marks	3 hours
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**SEMESTER-IV**

P-IV	Physical Chemistry	75 marks	3 hours
Practical-II	Inorganic (Quantitative)	50 marks	6 hours
	a. Experiment I -20		
	b. Experiment II -15		
	c. Viva Voce -10		
	d. Record-05		

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## DETAILED COURSE

SEMESTER-I

P - I : Analytical Chemistry

Term-end: 60

Internal : 15

**Unit - I Qualitative Analysis:**

Chemistry involved in detection and in separation of Cations of Group I, Group II, Group III, Group IV and Group V. Chemistry involved in the special tests for mixture of acid radicals such as carbonate in the presence of sulphite, nitrate in presence of nitrite, nitrate in presence of bromides and iodide, chloride in presence of bromide and/or iodide, bromide and iodide in presence of each other, iodate and iodide in the presence of each other sulphide, sulphite and thiosulphate in presence of each other, sulphide, sulphite and thiosulphate in presence of each other.

**Unit - II****a) Volumetric (Titrimetric) analysis:**

Introduction, Primary standards, secondary standards, Acid base titration and ways of locating the titration end point. Oxidation-reduction titration and ways of locating end point. Complexation titration and ways of locating end point. Problems involved in Volumetric analysis.

**b) Gravimetric analysis:**

Introduction, steps involved in gravimetric analysis, co-precipitation, post precipitation, precipitation from homogeneous solution. Errors in precipitation, Specific and selective precipitant, organic precipitants, sequestering agent. Gravimetric factor, problems involved in Gravimetry.

**Unit - III**

a) Data analysis and Stoichiometric Calculations: Data analysis - Significant figures, Errors, accuracy and precision, methods of expressing accuracy, methods of expressing precision, Problems involved.

**b) Stoichiometric Calculations:**

Principles and method of estimation of Organic compounds. Determination of iodine value, Saponification value and Reichert - Meissel value and problems involved.

**Unit - IV Separation and Purification Techniques:**

a) Separation techniques, Separation by precipitation, Solvent extraction and chromatography.

b) Purification techniques - for solid organic compounds, for liquids, chemical methods of separation and purifications.

**Unit - V Electro analytical techniques:**

- a) Electrogravimetry : Introduction in Counter or Back Potential, Over voltage, Types of electrogravimetry, electrolysis in a simple cell, Spontaneous or Internal Electrolysis, Electrolysis at the anode, application of electrogravimetry, problems involved.
- b) Coulometry: Introduction, Principle, Coulometer. Constant current coulometry, coulometric titration Equivalence point indicator, Application of Coulometric titration, Application of coulometric method. Problems involved.

SEMESTER-II

P - II:

Inorganic Chemistry

Term-end: 60

Internal : 15

**Unit - I**

- a) Atomic Structure: Bohr's model of atom and its limitations. Sommerfield's theory, de Broglie matter Waves. Heisenberg uncertainty principle. Schrodinger's Wave equation, Significance of Wave function, Normal and Orthogonal Wave functions, Quantum numbers, shape of s, p, d, orbitals, Stability of completely filled and half filled subshell.
- b) Periodic classification of Elements: Electronic basis of periodic classification of elements, s, p, d and f block elements,. Studies on periodic properties of atomic radii, ionic radii, covalent radii, ionisation potential, electron affinity and electronegativity.

**Unit - II Chemical bondings :**

- a) Ionic bond: General Characteristics, Lattice Energy, Solvation Energy, Born-Haber Cycle, Polarising Power and Polarizability. Fajan's Rule, % of ionic character from dipole moment and 'Electro negativity difference.
- b) Covalent bonds: General Characteristics, Valence-Bond approach- Concept of resonance & Resonance Energy Directional Characteristics of covalent bond Concept of hybridisation - Deduction of geometry of the following types of molecules or ions: AB<sub>2</sub>AB<sub>3</sub>, AB<sub>2</sub>E, AB<sub>4</sub>, AB<sub>3</sub>E, AB<sub>2</sub>E<sub>2</sub> AB<sub>5</sub>, AB<sub>4</sub>, E, AB<sub>3</sub>E<sub>2</sub>, AB<sub>2</sub>E<sub>3</sub>, AB<sub>2</sub>E<sub>3</sub>AB<sub>6</sub>, AB<sub>5</sub>, E, & AB<sub>4</sub>E<sub>2</sub> ('E' represents one pair of electrons).
- c) Qualitative Treatment of Molecular Orbital Theory : Bonding, Antibonding and Non-bonding molecular orbitals, MO Configuration of H<sub>2</sub>, He<sub>2</sub>, N<sub>2</sub>, O<sub>2</sub>, CO, NO and HF
- d) Hydrogen bond: Theory of hydrogen bonding, its occurrence, nature and consequence.

**Unit - III Chemistry of p-block elements:**

- a) Carbon family: Carbides, Silanes, Silicates (Structure only).
- b) Boron family: Boric acid, Diborane & Borazole (Preparation and structure).
- c) Nitrogen family: Hydrides of nitrogen (Preparation and structure).

- d) Halogen family: Oxides and Oxyacids of Chlorine, and flourine. Inter Halogen compounds.

#### Unit - IV Chemistry of d-block elements:

General trend in the. group, electronic configuration, atomic, ionic and covalent radii, electron affinity, colour and magnetic properties, variable. valency, complex formation.

- a) Redox reactions involving  $\text{KMnO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ , and  $\text{O}_3$ .

#### Unit - V Co-ordination compounds:

Werner's theory, Nomenclature of complexes, Valence bond interpretation of octahedral, and square planar complexes.

- a) Nuclear Chemistry: Fundamental particles of nucleus, size and stability of nucleus, natural and artificial radioactivity, units of radioactivity, artificial transmutation using proton, neutron and  $\alpha$ -particles, Nuclear fission and fusion, mass defects and binding energy.

### SEMESTER-II

**Practical- I :**                      **Inorganic Practical**                      **50 marks**

- a) Experiment - I  
Qualitative Analysis of mixtures of inorganic substances containing not more than four radicals.  
Acid Radicals:  $\text{CO}_3^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{SO}_3^{2-}$ ,  $\text{NO}_2^-$ ,  $\text{Cl}^-$ ,  $\text{I}^-$ ,  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$   
Basic Radicals:  $\text{Pb}^{2+}$ ,  $\text{Ag}^+$ ,  $\text{Hg}_2^{2+}$ ,  $\text{Hg}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Bi}^{3+}$ ,  $\text{As}^{3+}$ ,  $\text{Sb}^{3+}$ ,  $\text{Sn}^{2+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$ ,  $\text{Cr}^{3+}$ ,  $\text{CO}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{NH}_4^+$
- b) Experiment - II  
1. Standardisation of  $\text{KMnO}_4$  solution with standard sodium oxalate solution.  
2. Estimation of Ferrous and Ferric ion using:  
    a) Standard  $\text{KMnO}_4$  solution.  
    b) Standard  $\text{K}_2\text{Cr}_2\text{O}_7$  solution.  
3. Estimation of Calcium by  $\text{KMnO}_4$  solution.  
4. Standardisation of thiosulphate solution with  $\text{K}_2\text{Cr}_2\text{O}_7$  (solution).  
5. Estimation of Copper Iodometrically.

### SEMESTER-III

**P- III Organic Chemistry**

**Term-end: 60**

**Internal : 15**

#### Unit - I

##### (a) Distributions of electrons in Organic Molecules:

Inductive Effect, Resonance: Conditions, planarity, Unchanged atomic skeleton, presence of electron withdrawing and donating groups, dipole moment, Influence of these effects in acidity, basicity and dipole moment, steric effect. Hyperconjugation, Evidences: Heat of formation, bond distance, dipole moment.

##### (b) Reactions Intermediates:

- Carbocation: Formation, Stability and Structure.
- Carbanion: Formation, Stability and structure.

##### (c) Reactions in Organic compounds:

- Classification of reactions: Substitution, addition, elimination, electron transfer. Kinetic terms: Molecularity, order of reactions, transition state and intermediate, nucleophile and electrophile, nucleophilic and electrophilic reactions.
- Reaction Mechanisms:  $\text{SN}_1$ ,  $\text{SN}_2$ ,  $\text{E}_1$ ,  $\text{E}_2$ ,  $\text{AdN}$ ,  $\text{AdE}$  (Full forms, Explanation with examples, details not required).

##### (d) Stereochemistry :

- Stereoisomerism: Conformational Isomerism of ethane, n-butane, Cyclohexane, axial and equatorial bonds, boat and chair conformation and their energy calculation.
- Sawhorse, Newman and Fischer projection formula of molecules containing C-C bond .
- Cofigurational isomerism: Optical isomerism, concept of mirror image with simple examples, conditions for optical activity, plane polarised light and optical rotation, specific rotation, optical isomers of lactic, threonic and tartaric acids, Enantiomers and diastereoisomers, Racemic modification. Geometrical isomerism with simple examples.

#### Unit - II

- Organometallic compounds: Grignard's reagent, its preparation, structure, synthetic uses as carbanion precursdor.
- Esters containing active methylene group:
  - Acetoacetic Ester: Synthesis, synthetic uses (synthesis of alkane, ketone and acid), structure of acetoacetic ester, keto-enol tautomerism.
  - Malonic ester: Preparation and synthetic uses (synthesis of alkane, ketone, and acid).



**SEMESTER-IV**

**Practical-II Practical 50 marks**

**Experiment - I**

Systematic identification of simple organic compounds (monofunctional) of C.H.,O. and C.,H.,N.

**Experiment - II**

- (a) Preparation of buffer solution of:  
 (i) CH<sub>3</sub>COONa & CH<sub>3</sub>COOH  
 (ii) NH<sub>4</sub>Cl & NH<sub>4</sub>OH  
 (iii) NaH<sub>2</sub>PO<sub>4</sub> & Na<sub>2</sub>HPO<sub>4</sub>  
 Measurement of their pH by pH meter.
- b) Determination of the rate of reaction of acid hydrolysis of an ester.

**BOOKS RECOMMENDED:****Analytical Chemistry:**

1. Analytical Chemistry: S. Usharani, Macmillan India Ltd.
2. Electroanalytical Technique: G.R.Chatwal, Himalayan Publishing House.
3. Vogel's Qualitative Analysis: Revised by Suchla, Orient longman.
4. Vogel's Text book of Quantitative Inorganic Analysis (revised), J. Bassell, R.C. Denney, G.H. Jeffery and J.Mendham, EIBS.

**Inorganic Chemistry:**

1. Principle of Inorganic Chemistry: B.R. Puri, IoR. Sharma and K.C. Kala, S.LN. Chand & Co.
2. Textbook of Inorganic Chemistry: P.L. Soni, Sultan Publication.
3. Concise Inorganic Chemistry: J.D. Lee, ELBS.
4. Modern College Chemistry (Inorganic) : S. Guru, B.K. Mohapatra, R.C. Mishra & K.D. Sharma, Kalyani Publication.

**Organic Chemistry:**

1. Advanced Organic Chemistry: B.S. Bhal & A. Bhal, S. Chand & Co.
2. Organic Chemistry: P.L. Soni & H.M. Chawla, S: Chand & Co.
3. Fundamentals of Organic Chemistry: Solomons, John Wiley.
4. Organic Chemistry: IoG. Wade Jr., Prentice Hall

**Physical Chemistry:**

1. Principles of Physical Chemistry: B.R. Puri & L.R. Sharma, S.L.N. Chand & Co.
2. Essentials of Physical Chemistry: B.S. Bahl & G.D. Tuli, S. Chand & Co.
3. Physical Chemistry: G.M. Borrow, Mc Graw Hill.
4. Modern College Chemistry (Physical), R.C. Acharya & V.R. Sharma, Kalyani Publication.

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**CHEMISTRY (HONS.)**

There shall be six semesters in three years, with two semesters in each year. In first four semesters there shall be four theory papers with mark of 75 in each theory paper. The last two semesters shall have four theory papers in total. There shall be Internal Assessment of 15 mark out of 75 (i.e. 20% of theory, so that the term-end examination theory papers shall have 60 marks). There shall be one long or short question from each unit with alternative from the same unit. The second, fourth and fifth semesters shall have one practical paper each: Practical-I, Practical-II and Practical-III respectively, and is of 6 hours duration. However in the 6th Semester there shall be two practical papers: Practical-IV A (25 Marks, 4 hours duration), Practical-IV B(25 Marks, 4 hours duration).

**COURSE STRUCTURE****FIRST YEAR**

<b>SEMESTER-I</b>			
H-I	Analytical Chemistry-I	75 marks	3 hours
<b>SEMESTER-II</b>			
H-II	Inorganic Chemistry-II	75 marks	3 hours
Practical-I	Inorganic Chemistry Qualitative Analysis a. Experiment -35 b. Viva Voce -10 c. Record-05	50 marks	6 hours

**SECOND YEAR**

<b>SEMESTER-III</b>			
H-III	Organic Chemistry	75 marks	3 hours
<b>SEMESTER-IV</b>			
H-IV	Physical Chemistry	75 marks	3 hours
Practical-II	Inorganic (Quantitative) a. Experiment -35 b. Viva Voce-10 c. Record-05	50 marks	6 hours

**THIRD YEAR**

<b>SEMESTER-V</b>			
H-V	Analytical Chemistry-II	75 marks	3 hours
H-VI	Inorganic Chemistry-II	75 marks	3 hours
Practical-III	Organic qualitative analysis	50 marks	6 hours
<b>SEMESTER-VI</b>			
H-VII	Organic -II	75 marks	3 hours
H-VIII	Physical Chemistry -II	75 marks	3 hours
Practical-IV A	Physical Chemistry	25 marks	4 hours
Practical-IV B	Analytical Chemistry a. Experiment I -20 b. Experiment II -20 c. Viva Voce-05 d. Record-05	25 marks	4 hours



**SEMESTER-I**

**H - I: Analytical Chemistry** **Term-end: 60**  
**Internal : 15**

**Unit - I****(a) Quantitative Analysis:**

Chemistry involved in detection and in separation of Cations of Group I, Group II, Group III, Group IV and Group V. Chemistry involved in the special tests for mixture of acid radicals such as carbonate in the presence of sulphite, nitrate in presence of nitrite, nitrate in presence of bromides and iodide, chloride in presence of bromide and/or iodide, bromide and iodide in presence of each other, iodate and iodide in the presence of each other, phosphate in the presence of arsenate, sulphide, sulphite and thiosulphate in presence of each other, borate in the presence of copper and barium salts. Oxalate in presence of fluoride, silicofluoride and sulphate in presence of each other.

**Unit - II****a) Volumetric (Titrimetric) analysis :**

Introduction, Primary standards, secondary standards, Acid-base titration and ways of locating the titration end point. Oxidation-reduction titration and ways of locating end point. Complexation titration and ways of locating end point. Problems involved in Volumetric analysis.

**b) Gravimetric analysis:**

Introduction, steps involved in gravimetric analysis, coprecipitation, post precipitation, precipitation from homogeneous solution. Errors in precipitation, Specific and selective precipitant, organic precipitants, sequestering agent. Gravimetric factor, problems involved in Gravimetry.

**Unit - III Data analysis and Stoichiometric Calculations:**

**a) Data analysis** - Significant figures, Errors, accuracy and precision, methods of expressing accuracy, methods of expressing precision, Problems involved

**b) Stoichiometric Calculations:**

Principle and method of estimation of Organic compounds. Determination of iodine value, Saponification value and Reichert - Meissel value and problems involved.

**Unit - IV Separation and Purification Techniques:**

**a)** Separation techniques, Separation by precipitation, Solvent extraction and chromatography.

**b)** Purification techniques - for solid organic compounds, for liquids, chemical methods of separation and purifications.

**Unit - V Electro analytical techniques:**

- a)** Electrogravimetry : Types of electrogravimetry, electrolysis in a simple cell, Electrolysis at constant current, Electrolysis at constant voltage, electrolysis at controlled potentials, Spontaneous or Internal Electrolysis, Electrolysis at the anode, application of electrogravimetry, problems involved.
- b)** Coulometry : Introduction, Principle, Coulometer, Constant current coulometry, coulometric titration Equivalence point indicator, Application of Coulometric titration, Controlled Potential Coulometry, Application of coulometric method.

**SEMESTER -II**

**H - II Inorganic Chemistry - I** **Term-end: 60**  
**Internal : 15**

**Unit - I**

- a) Atomic Structure:** Bohr's atomic model and its limitation. Sommerfeld's model. Idea of de-Broglie matter waves, Heisenberg's uncertainty principle and its verification. Schrodinger's wave equation, Significance of wave function. Schrodinger's equation for the hydrogen atom (Solutions of the equation for hydrogen atom is not required),  $\psi$  and  $R$  equations, Quantum numbers & their significance, Radial and angular wave functions. Spherical, harmonic, Radial and angular distribution Curves, shape of s.p.d. orbitals LS coupling scheme. Derivation of ground term symbols for d1 to d2 systems.
- b) Classification of elements :** Electronic basis of periodic classification of elements, s.p.d. and f block elements, studies of the following properties: (i) Atomic radii, ionic radii, covalent radii, (octahedral tetrahedral) (ii) ionisation potential, successive ionisation potentials and the factors influencing ionisation potential, (iii) Electron affinity, (iv) Electronegativity (Pauling, Mulliken, Alfred Rochaw electronegativity scale) variation of electronegativity with bond order and partial charge.

**Unit -II Chemical bonding:**

- a)** Ionic bond: General characteristics, types of ions, size effect radius ratio and its Limitation. Packing of ions in crystals. Lattice energy. Born energy and its application. Modeling Constant. Born-Haber cycle, Polarizing power and Polarizability. Fajan's rule, percentage of ionic character from dipole moment and electronegativity difference, solvation energy.
- b)** Covalent bond: General Characteristic, valence bond approach, Heitler - London treatment of H<sub>2</sub> molecule (Mathematical treatment totally excluded), concept of resonance and resonance energy. Directional characteristics of covalent bond. Concept of hybridisation. Deduction of geometry of the following type of ions molecules from hybridisation, AB<sub>2</sub>AB<sub>3</sub>, AB<sub>2</sub>E, AB<sub>4</sub>, AB<sub>3</sub>E, AB<sub>2</sub>E<sub>2</sub>, AB<sub>5</sub>, AB<sub>4</sub>E,

AB3E2' AB2E3, AB2E3AB6, AB5, E, & AB4E2 (Where 'E' represents one pair of electron).

- c) Qualitative treatment of Molecular orbital Theory: Bonding, antibonding, non-bonding molecular orbitals, MO configuration of H<sub>2</sub>, N<sub>2</sub>, O<sub>2</sub>, F<sub>2</sub>, CO, NO, HF and their ions.
- d) Other types of chemical bonds: Hydrogen bond (Theories of hydrogen bonding, valence bond treatment), Metallic bond.

**Unit - III** Preparations, Properties and structures of following compounds of 'p' block elements.

- a) Boron family: Boric acid, Hydrides of boron & Borazole (preparation and structure)
- b) Carbon family: Carbides, Silanes, Silicates & Silicones.
- c) Nitrogen family: Hydrides of nitrogen (Preparation, Properties and Structures).

**Unit - IV** Preparation, properties and structure of following compounds of 'p' block' elements.

- a) **Oxygen family:** Oxygen flourides, peracids of sulphur.
- b) **Halogen family:** Oxides and oxy acids of chlorine, interhalogen compounds.
- c) **Noble gases:** Compounds of noble gases (Preparation & their structures).

**Unit - V** **Chemistry of d-block Elements:**

Electronic Configuration and Comparative Studies of 1st row, 2nd row and 3rd row transition series with special reference to atomic and ionic radii, ionization potential, redox potential, Oxidation State, Metallic nature and catalytic activity. Principle of Extractions and Chemistry of the following elements, Ag, V, Cr, Mn, Ni, and Co.

**Practical - I :** **Practical** **50 Marks**  
**Inorganic qualitative Analysis**

Identification of the basic and acid radicals in a mixture of inorganic substances consisting of not more than six radicals (Interfering Acid radicals like PO<sub>4</sub><sup>3-</sup>, F<sup>-</sup>, CO<sub>3</sub><sup>2-</sup>, SO<sub>3</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, NO<sub>2</sub><sup>-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, AsO<sub>4</sub><sup>3-</sup> (One insoluble substance such as BaSO<sub>4</sub>, Al<sub>2</sub>O<sub>3</sub>, SrSO<sub>4</sub> or SnO<sub>2</sub> may be given).

**SEMESTER-III**

**H - III Organic Chemistry - I** **Term-end: 60**  
**Internal : 15**

**Unit - I**

- a) Distributions of electrons in Organic Molecules:
- Inductive Effect
  - Resonance: Condition, planarity, Unchanged atomic skeleton, presence of electron withdrawing and donating groups, dipole moment, influence of these effects in acidity, basicity and dipole moment, steric effect.

- Hyperconjugation, Evidences : Heat of formation, bond distance, dipole moment etc.

**b) Reactions in Organic Compounds:**

- Classification of reactions, substitution, addition, elimination, electron transfer.
- Kinetic terms : Molecularity, Order of reaction, transition state and intermediate, nucleophiles and electrophile, nucleophilic and electrophilic reactions.

**c) Reaction intermediates:**

- Carbocation : Formation, Stability and Structure.
- Carbanion : Formation, Stability and Structure.
- Non-ionic intermediates: Free radical and Carbene (formation, stability & Structure)

- d) Reaction Mechanisms: Mechanistic Classification: SN<sub>1</sub>, SN<sub>2</sub>, SN<sub>i</sub>, SE<sub>1</sub>, SE<sub>2</sub>, E<sub>1</sub>, E<sub>2</sub>, E<sub>1</sub>CB, Ad<sub>N</sub> and, Ad<sub>E</sub>, (Full term Explanations with examples, details not required).

- e) Aliphatic substitution reactions: SN<sub>1</sub>, SN<sub>2</sub> and S<sub>N</sub>i reactions (Kinetics, Stereochemistry, structural & environmental aspects (solvent) Neighbouring group participation reactions.

**Unit - II** **Streochemistry: In addition to the topics for the pass. Course the following:**

Conformation of mono- and dimethyl cyclohexanes (1,2,1,3,1,4) D.L. Convention for designating the optical isomers with examples, R.S. notations, E.Z. Convention, Racemic modification: methods of resolution, geometrical isomerism, structural requirement (cis & trans, syn and anti), configuration of aldoximes.

**Unit - III**

- a) Organometallic compounds: Grignard reagent: preparation from alkyl bromide, synthetic uses (as carbanion precursor.)
- b) Esters containing active methylene group:
- Acetoacetic Ester: Synthesis (Claisen reaction), synthetic uses keto-enol tautomerism.
  - Malonic Ester: Preparation and synthetic uses.

**Unit - IV**

- a) Sulphur Compounds: Mercaptane Preparation and Properties).
- b) Alicyclic Compounds: Nomenclature, Preparation (from dihalides, Dieckmann) Reactions and stability, Bayer Strain theory.
- c) Electrophilic substitution (halogenation, protoation, nitration, Friedal, Craft reaction) orientation, determination of structure of benzene, aromatic substitution reaction (S<sub>Ar</sub>N<sub>1</sub>, S<sub>Ar</sub>N<sub>2</sub>) and S<sub>Ar</sub>E<sub>2</sub>.
- d) Aryl halogen Compounds: Preparation (Electrophilic substitution and Sand Mayer's reaction), intertness of halogens, as pesticides (gammexene) comparison with aliphatic halides.

**Unit - V**

- a) **Ary Nitrogen Compounds:**
- Nitrohydrocarbons: Preparation (SArEI & SArE2 of hydrocarbons), Properties, Reduction of nitrobenzene, TNT.
  - Amines : Preparation (Reduction of nitro compounds), Properties, diazo reaction, alkylation to quaternary salts, basicity, phenylhydrazine, structure and synthetic uses of benzenediazonium salt, comparison with aliphatic amines.
- b) **Aryl Oxygen compounds:**
- Phenols: Preparation (diazo reaction and fusion) properties (acidity, reactions with alkyl and aryl halides, esterification, electrophilic substitution, Kolbe synthesis, Reimer - Tieman reaction, Diazonium coupling), comparison with alcohols.
  - Aryl aldehydes & Ketones: Preparation (Etards reactions, Friedel Craft reaction) properties (Addition reactions, Cannizzaro's, Benzoin, Perkin & Iodoform reactions).
  - Aryl carboxylic acid: Preparation (oxidation, hydrolysis of nitriles, Grignard's reaction), Properties (acidity, reactions with PCl5, SOCl2, alcohol, NH3 and electrophilic substitution).
- Emphasis be given to teach the above items 4 (a) - (d) and 5 (a) - (b) through mechanistic approach.

**SEMESTER-IV**

H - IV                      **Physical Chemistry - I**                      **Term-end: 60**  
**Internal : 15**

**Unit - I**

- a) The Gaseous State: Kinetic Theory of gases (Derivation of  $PV = \frac{1}{3} mnc^2$ , its application in the derivation of the gas Laws (Boyle's Law, Charles Law, Dalton's Law of partial pressure, and Avogadro's Law.) Maxwell - Boltzmann distribution of molecular velocities (only qualitative treatment, mathematical derivation excluded). Calculation of root mean square, most probable and average velocities and the relation between them, Equipartition principle,
- b) Mean free path, Collision frequency, Deviation of real gases, Van der Waal's equation of state, Critical phenomena and critical constants, law of corresponding states, and reduced equation of state, Liquification of Gases.

**Unit -II**

- a) Law of mass action and thermodynamic derivation of equilibrium constant. Lechatelier principle and its application to gaseous reactions. Effect of temperature on equilibrium. Vant Hoff's equation and its integration. Reaction isotherm.

- b) Distribution law and its application to solvent extraction process. Phase equilibria: Phase, component and degrees of freedom. Phase diagram of one and two component systems (water, sulphur, Ag-Pb, FeCl3-water)

**Unit - III Chemical Kinetics:**

- a) Order and molecularity, Kinetics of 1st and 2nd order reactions, determination of order, simple opposing (A.B.) consecutive (A.B.C.) and chain reactions.
- b) Effect of temperature on reaction rate, collision theory of reaction rate, Qualitative treatment of transition state theory.

**Unit - IV Thermodynamics:**

- a) Thermodynamic concepts, state function and exact differentials, Zeroth Law of thermodynamics, First law of Thermodynamics, Heat content and heat capacity, isothermal and adiabatic changes, work done in the expansion of an ideal gas, Joule Thomson effect for ideal and Van der Waal's gases.
- b) Thermochemistry: Heat changes in chemical reaction, Hess's law of constant heat summation, Kirchoff's equation.

**Unit -V**

- a) Second law of Thermodynamics: Spontaneous process, Carnot's theorem and Carnot's cycle, efficiency of heat engines, entropy, entropy changes in reversible and irreversible processes.
- b) Free energy and work function, conditions of equilibrium. Clapeyron and Clausius equation, Entropy of mixing, Gibbs Helmholtz equation. Thermodynamic equilibrium and Spontaneity, Thermodynamic equation of state, partial molar quantities and their physical significance, chemical potential, Gibbs Dohem equation.

**Practical - II:**

**Practical**  
**Inorganic Quantitative Analysis**

50 marks

- Estimation of calcium by precipitation as oxalate (direct method) & standardisation of KMnO4 using sodium oxalate.
- Estimation of Ferrous ion and Ferric ion in a mixture using standard K2Cr2O7.
- Estimation of Copper Iodometrically and standardisation of thiosulphate with K2Cr2O7.
- Estimation of chloride using Volhard's method (Ferric alum, indicator)
- Gravimetric estimation of
  - Barium as BaSO4
  - Nickel as Dimethylglyoxime.

**SEMESTER-V**

**H - V Analytical Chemistry - II Term-end: 60  
Internal : 15**

**Unit - I**

Polarography, Tensametry and Chromo - Potentiometry : Introduction, Polarograph, Polarographic Cells, Polarogram, Half wave potential, Quantitative evaluation of polarographic data. Dropping mercury electrode limiting current density. Ilkovic equation. Application of polarography, Chromopotentiometry, Tensametry, and problem involved.

**Unit - II**

UV - Visible Spectroscopy: Origin of molecular spectra Absorption law, Instrumentation, theory of electronic spectroscopy, Emperical calculation of absorption maxima for Diene and Enones: Woodward - Fieser rules, Other Applications, Problem involved.

**Unit - III**

- a) Infrared Spectroscopy: Introduction, Range of infrared radiation, requirements of IAI absorptienl: Modes of Vibration of atom in polyatomic molecules\_, single beam and Double beam Spectrophotometer, application to Organic compounds and inorganic compounds, Miscellaneous examples, problem involved.
- b) Raman Spectroscopy: Introductions, Stokes and antistokes line, transitions responsible for Raman scattering. Instrumentation, Representation of spectra, Vibrational modes associated with Raman effect, Difference between Raman & IR spectra, Applications, Problems involved.

**Unit - IV**

- a) Nuclear Magnetic Resonance (NMR): Principle of NMR, Quantum description of NMR, Instrumentation, Chemical shift, Spin- Spin coupling, Application of NMR spectroscopy to simple organic compounds.
- b) Electron Spin Resonance (ESR): Introduction, Theory of ESR, Comparison between NMR and ESR, Instrumentation, Hyperfine splitting, Determination of 'g' value, Line width, application of ESR spectroscopy, Endor and Eldor.

**Unit - V**

- a) Mass Spectroscopy: Basic Principles, Instrumentation, Types of ions produced in a mass spectrometer, determination of molecular formula, Fragmentation, Identification of the mass spectra of simple organic compounds.
- b) Simple problems involving IR, NMR and Mass Spectra.

**H - VI Inorganic Chemistry - II Term-end: 60  
Internal : 15**

**Unit - I****Block Elements:**

- a) Lanthanides: General study, Electronic Configurations, Oxidation States, Magnetic, Spectral & Complex forming Properties, lanthanide Contraction, its cause and consequence. Separation of Lanthanides by ion exchange Methods, Chemistry of Cerium.
- b) Actinides: Electronic Structures, Comparison with lanthanides, Ionic radii, Oxidation states & Stereochemistry. Chemistry of Uranium and Thorium.

**Unit - II****Co-ordination ,compounds: Werner's theory:**

Nomenclature, co-ordination number, stereochemistry of different co-ordination numbers: Isomerism in coordination, Compounds: Valence bond interpretation of common octahedral, Tetrahedral and square planar complexes: Crystal field theory: Qualitative idea about d- orbitals splitting in octahedral and square planar filed, calculation of crystal field stabilisation energy. Explanation of magnetism, geometry & colour of the Co-ordination compounds on the basis of the above theories, Jahn Teller effect in octahedral complexes.

**Unit -III**

- a) Organo - Metallic Compounds: Definition, Classification, Synthesis, Properties and Structure of Organo - metallic compounds of lithium, magnesium, boron and tin. Preparation and structure of metal carbonyls of Cr, Mn, Fe, Co, Ni, Effective atomic number rule

**Unit -IV**

Nuclear Chemistry: Fundamental particles of the nucleus, the size and shape of the nucleus, Isotopes, Isobars, Isotones, Isodiapher, Qualitative idea of the stability of nucleus (n/p, radioactivity decay kinetics unit of radioactivity, disintegration series. Nuclear transmutations using proton, neutron and alphaparticles, spallation, Nuclear fission and fusion, Nuclear reactors in India, Breeder reactor, Principle of hydrogen bomb, Radioactive isotopes and their applications in industry, agriculture, medicine and study of mechanism of reactions.

**Unit - V**

- a) Inorganic Polymer: Types of Inorganic polymer, comparison with organic polymer, structure, aspects and applications of silicones, phosphonitric; halides and condensed phosphates.
- b) Non-aquous solvents: Classification of solvents, liquid ammonia solvent systems with reference to:
  - i) Acid - base reaction
  - ii) Solvolysis
  - iii) Precipitation reaction.

**Practical - III****Practical  
Organic Chemistry (6 hours duration)****50 marks****Experiment - 1**

- Detection of elements in organic compounds (C.N.S. and halogens.)
- Identification of organic compound containing C.H.N. and halogens.

**Experiment - 2**

- Estimation of glucose, estimation of anile and phenol.
- Preparation of organic substances, Ethyl benzoate, acetamide, p-tolylisothiocyanate, p-nitroaniline, picric acid.

**SEMESTER-VI****H - VII****Organic Chemistry - II****Term-end: 60  
Internal : 15****Unit - I**

- Carbohydrate: Classification, Configuration of sugars, glucose and fructose (occurrence, reactions: Osazone formation, with Fehling solution, mutarotation, elucidation of the structure of D - glucose (open chain and ring structure) interconversion of sugars.
- Naphthalene and Anthracene: Isolation, elucidation of their structures, preparations of alpha and beta-naphthols, anthraquinone, alizarin.

**Unit - 2****Heterocyclic compounds:**

- Five - membered heterocycles (Pyrrole, thiophene and furan) : their nomenclature synthesis (from sugar, dicarbonyl compound) Properties (Aromaticity, electrophilic substitution).
- Six membered heterocycles: Pyridine and Quinoline (Preparation and reactions).
- Fused heterocycles: Uracil and purines, elucidation of the structure of uric acid.
- Indigo: Structure and use.

**Unit - 3**

- Alkaloids: What are alkaloids, elucidation of the structure of nicotine and papaverine.
- Terpenes : What are terpenes, Isoprene rule, elucidation of the structure of Camphor.
- Vitamins: What are vitamins, elucidation of the structure of vitamin- C.

**Unit - 4**

- Molecular Re-arrangements: Pinacol-pinacolone, Demjanow, Dienone-phenol, Beckmann and Benzidine (Mechanism and applications).

- Name reactions: Diels -Alder, fries,. Michale, Mannich, Reformasky, Claisen (Principle, Mechanism and application).
- Reagents:  $\text{LiAlH}_4$ ,  $\text{NaBH}_4$ ,  $\text{HIO}_4$ ,  $\text{MnO}_4$ ,  $\text{Pb(OAc)}_4$ .

**Unit - 5**

- Dyes: Colour and constitution, Classification, Chemistry & Synthesis of Methyl orange, Bismark Brown, Congo red, Crystal violet. Malachite green, Phenolphthalein, Auorescein & Alizarin.
- Aminoacids and Proteins: Classifications, Structure & Stereochemistry of aminoacids, Acid-base properties, Isoelectric point and electrophoresis, Preparations and reactions of-amino acids. Structure and nomenclature of peptides and proteins classification of proteins, Peptide structure determination. Classical peptide synthesis, solid-phase peptide synthesis. Structure of peptides and proteins, Protein functions. Protein Denaturation / Re-naturation.

**H - VIII Physical Chemistry - II****Term-end: 60  
Internal : 15****Unit - I Electrochemistry:**

- Conductance and its measurements, Molar conductivity, Equivalent conductivity, Law of Independent migration of ions, Ionic velocities and mobilities, Weak and Strong Electrolytes, Arrhenius theory, Debye- Huckel theory (qualitative).
- Application of conductance measurements for determination of solubility and solubility product, Degree of Ionisation, ionic product of water; and hydrolysis constant.
- Transference number and its determination by Hittorf's method and moving boundary method, conductometric titrations.

**Unit -II**

- Electromotive force: Galvanic Cells, Cell reactions, Reversible Electrodes, Thermodynamic parameters of reversible cells, Nernst equation and expression for single electrode potentials, reference electrode (Calomel, hydrogen, Silver Chloride), redox potential.
- Concentration cells with and without transference, liquid junction potential, determinations of solubility product, ionic product of water and mean ionic activity coefficient of electrolyte.

**Unit - III**

- Equilibrium in Electrolytes: Theories of Acids and Bases, Solubility, Salt hydrolysis, determination of pH by emf method using hydrogen, quinhydrone and glass electrodes.
- Hammett Acidity Function: Buffer solutions: Henderson equation, Acid Base indicators and indicator constants, neutralisation curves.

**Unit - IV**

- a) Colloid and Surface Chemistry: Physisorption and Chemisorption: Adsorption isotherms, Derivation of Freundlich and Langmuir adsorption isotherms, Gibbs adsorption isotherms. Soaps & detergents, Micelle formation, Critical micellar concentration (CMC).
- b) Photochemistry: Beer-Lambert's Law, Grotthus Draper law, Stark-Einstein Law of photochemical equivalence, quantum yield, Comparison between thermal and photochemical reactions, Decomposition of HI and HBr, Elementary ideas about photosensitized reaction and photosynthesis, Jablonsky diagram, Fluorescence, Chemiluminescence.

**Unit- V**

- a) Wave mechanics: Postulates of quantum mechanics, Schrodinger equation and its application to a particle in box rigid rotator and harmonic oscillator.
- b) The solid state: Classification, Isotropy and anisotropy in solids, crystallography, symmetry, crystal system and defects in crystals.

**Paper - IV(A) Practical 25 marks**  
**Physical Chemistry (4 hours duration)**

**Experiment- 1**

- a) Study of the distribution equilibrium of iodine in water/benzene or water/ carbon tetra chloride or water/chloroform medium at room temperature.
- b) Determination of the pseudo first order hydrolysis rate constant of methyl acetate at room temperature in 0.5 M. H<sub>2</sub>SO<sub>4</sub> and 0.5 M HCl media.
- c) Determination of molecular mass of volatile liquids by Victor Meyers methods.
- d) Study of adsorption using animal charcoal.

**Paper-IV(B) Practical 25 marks**  
**Analytical Chemistry (4 hours duration)**

**Experiment- 2**

- a) Estimation of Calcium and Magnesium in a mixture by EDTA titration.
- b) Estimation of total manganese in pyrolusite by Volhard's titration.
- c) Estimation of Mn in mild steel.
- d) Estimation of copper and zinc in a mixture by EDTA titration.
- e) Determination of iodine number in a given fat or oil
- f) Determination of saponification value of given fat or oil.

**BOOKS RECOMMENDED:****Analytical Chemistry:**

1. Analytical Chemistry: S. Usharani, Macmillan India Ltd.
2. Electroanalytical Technique: G.R.Chatwal, Himalayan Publishing House.

3. Vogel's Qualitative Analysis: Revised by Suchla, Orient longman.
4. Vogel's Text book of Quantitative Inorganic Analysis (revised), J. Bassell, R.C. Denney, G.H. Jeffery and J.Mendham, EIBS.
5. Elementary Organic Spectroscopy: Y.R. Sharma, S.Chand &Co. Ltd.
6. A textbook of Spectroscopy: O.D. Tyagi & M. Yadav, Anmol Publication.

**Inorganic Chemistry:**

1. Principle of Inorganic Chemistry: B.R. Puri, I.R. Sharma & K.C. Kala, S.Chand & Co.
2. Textbook of Inorganic Chemistry: P.L. Soni, Sultan Publication.
3. Concise Inorganic Chemistry: J.D. Lee, ELBS.
4. Modern College Chemistry (Inorganic) : S. Guru, B.K. Mohapatra, R.C. Mishra & K.D. Sharma, Kalyani Publication.
5. Basic inorganic Chemistry : F.A. Cotton. G.Wilinson & P.L.Gaus, Wiley.
6. Inorganic Chemistry : D.E. Shiver, P.W. Atkins & C.H. Longfold, Oxford.
7. Inorganic Chemistry: A.G. Sharpe, ELBS.

**Organic Chemistry:**

1. Advanced Organic Chemistry: B.S. Bhal & A. Bhal, S. Chand & Co.
2. Organic Chemistry: P.I. Soni & H.M. Chawla, S: Chand & Co.
3. Fundamentals of Organic Chemistry: Solomons, John Wiley.
4. Organic Chemistry: I.G. Wade Jr., Prentice Hall
5. Organic Chemistry : Morrison & Boyd, Prentice Hall.
6. Textbook of Organic Chemistry, Vol - I & II : I.L.Finar, Longman
7. Advanced Organic Chemistry: Jerry March, John Wiley.
8. Chemistry of Organic Natural Products, Vol -I & II, Agrawal, Goel Publishing House.
9. Organic Chemistry of Natural Products, Vol-I&II , G Chatwal, Himalayan Publications.
10. Organic Name Reactions and Molecular Rearrangements:G.Raj, K.Prakash Media (P) Ltd.
11. Modern Organic Reaction : H.O. House, Benjamin.
12. Stereochemistry of Organic Compounds : D. Nasipuri, New Age international

**Physical Chemistry:**

1. Principles of Physical Chemistry: B.R. Puri & L.R. Sharma, S.L.N. Chand & Co.
2. Essentials of Physical Chemistry: B.S. Baht & G.D. Tuli, S. Chand & Co.
3. Physical Chemistry: G.M. Borrow, Mac Graw Hill.
4. Modern College Chemistry (Physical), R.C. Acharya & V.R. Sharma, Kalyani Publication.
5. Physical Chemistry : G.M.Barrow, International Students' Edition, Mc - Graw Hill.
6. University General Chemistry : C.N.R. Rao, Macmillan.
7. Physical Chemistry : R.A. Alberty, Wiley Eastern Ltd.

8. The Elements of Physical Chemistry: P.W. Atkins, Oxford.
9. Physical Chemistry through Problems : S.K. Dogra & S.Dogra, Wiley Eastern Ltd.

**Practical Courses:**

1. Vogel's Qualitative Analysis: Revised by Suchla, Orient Longman.
2. Vogel's Textbook of Quantitative inorganic Analysis (revised,) J.J. Bassell, R.C. Denney, G.H. Jeffery & J.J. Menndham, Elbs.
3. Experimental inorganic Chemistry : W.G. Palmer, Cambridge.
4. Vogel's Textbook of Practical Organic Chemistry : B.S. Funiss, A.J. Hannaford, V. Rogers, P.W.G. Smith & A.R. Tatchell, ELBS.
5. Laboratory Manual in Organic Chemistry : R.K. Bhansal.
6. Experiments in Physical Chemistry : R.C. Das & B. Behera, Tata McGraw Hill.
7. Advanced Practical Physical Chemistry : J.B. Yadav, Goel Publishing House.
8. Experiments in Physical Chemistry : J.C. Ghosh.

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**COMPUTER SCIENCE (HONOURS) 2010-13**

There shall be six semesters in three years, with two semesters in each year. In first four semesters there shall be four theory papers with mark of 75 in each theory paper. The last two semesters shall have four theory papers in total. There shall be Internal Assessment of 15 marks out of 75 (i.e. 20% of theory), so that the final examination theory papers shall have 60 marks. There shall be one long or short question from each unit with alternative from the same unit. The second, fourth and fifth semesters shall have one practical each: Practical-I, Practical-II and Practical-III, carrying 50 marks each and of 6 hours duration. In the sixth semester there shall be a project work (Practical-IV) carrying 50 marks.

**FIRST YEAR****SEMESTER-I**

H-I	Computer Basics And Operating Systems	75 marks	3 hours
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**SEMESTER-II**

H-II	Computer Organization and Architecture	75 marks	3 hours
Practical-I	Experiment - 30	50 marks	6 hours
	Viva - 10		
	Record - 10		

**SECOND YEAR****SEMESTER-III**

H-III	Programming With C	75 marks	3 hours
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**SEMESTER-IV**

H-IV	File Organization and Data Base Management	75 marks	3 hours
Practical-II	Experiment - 30	50 marks	6 hours
	Viva - 10		
	Record - 10		

**THIRD YEAR****SEMESTER-V**

H-V	ORACLE	75 marks	3 hours
H-VI	Object Oriented Programming With C++	75 marks	3 hours
Practical-III	Experiment - 30		
	Viva - 10		
	Record - 10		

**SEMESTER-VI**

H-VII	Elements Of Java And Computer Graphics	75 marks	3 hours
H-VIII	Data Communication And Computer Network	75 marks	3 hours
Practical-IV	PROJECT WORK.	50 marks	

**SEMESTER-I**

H-I (THEORY)

**COMPUTER BASICS AND OPERATING SYSTEMS****Term-end: 60****Internal : 15****Unit-I: Basics of Computer**

Computer System Overview, Classification of Computers, Components of Computer System-Control Unit, Memory Unit(Primary/secondary), Arithmetic Logical Unit Input and Output Devices- Keyboard, pointing devices, Printers,VDU, LCD  
Types of Software -System, Application and Utility Software.  
Computer security and Maintenance.

**Unit-II: Operating System Overview**

Function of operating system as a resource manager, evolution of OS, types of OS (Concepts of multi-programming, multiuser, multi tasking, Batch Processing, Time Sharing, Real time). Process description and control. Processor management; Types of scheduling, Scheduling algorithms, Concurrency System Deadlock and starvation.

**Unit -III: Memory and I/O Management**

Memory management: Requirements, partitioning, simple paging, simple segmentation, virtual memory, page table structure, page size, combined paging and segmentation, page replacement algorithms, cache memory.

I/O management and Disk scheduling, Direct memory Access, Buffering, Disk scheduling algorithms, File management, File allocation methods.

**Unit IV : DOS & Windows**

MS-DOS: Directory structure and concept of path, Naming conventions.

System commands- tree, date, time, CLS.

Directory Commands- dir, cd, (chdir), mkdir (md), rd (or rmdir)

File Management Commands - del, erase, copy, move, type, more, rename, print.

Creating/editing files by edit. Changing attribute. Wild card notation. Batch files. windows: windows components, control panel, Diagnostic tools, Network neighborhood Important features of Word pad and Ms-Word.

**Unit-V : LINUX**

UNIX and LINUX, Login, logout, shutdown procedures, changing password. Linux users. Shell and Kernel, Linux Shell fundamentals,

Architecture of LINUX, Basic features of LINUX, File and Directory.

LINUX System Commands- tty, writ, mesg, passwd, clear, echo, cal, date, man, who.

Directory commands- pwd, mkdir, ls, cd, rmdir,

File Management Commands- cat, more, pg, grep, sort, comm., cmp, diff, rm, mv, cp, ln.

File Ownership and Permission (FAP),

Vi Editor, vi commands.

**References-**

- Computer Fundamentals - P.K.Sinha, BPB Publications  
Fundamentals of Computer - Raja Raman  
Operating System - William Stalling, Prentice Hall  
Modern Operating System - A.S. Tanenbaum, Prentice Hall

**SEMESTER-II**

H -II (THEORY)

**Computer Organization and Architecture****Term-end: 60****Internal : 15****Unit I**

Boolean Algebra, binary, octal and hexadecimal number system, BCD numbers and conversion from one base to another base, Binary Coded Octal (BCO), Binary Coded Hexadecimal (BCH) and Binary coded Decimal (BCD) representation.

Binary Arithmetic, ASCII code, r-l's and r's complements, Fixed point representation, Floating point representation, Subtraction of signed and unsigned binary numbers.

**Unit II**

Logic gates, Map simplification, sum of product equation, product of sum equation using Karnaugh map, Don't care condition, Half Adder and Full Adder, Flip flops (SR, D, JK, Master-slave and T flip-flops).

**Unit III**

Decoder (using AND and NAND gates), Decoder expansion, Multiplexer & its implementation, Registers with parallel load, Shift register, Binary counter, Register Transfer Language

**Unit IV**

Computer registers, Computer Instructions, Timing and Control, Design of Basic Computer

CPU: General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation

**Unit V**

Machine Language, Assembly Language, Rules of the Language, Assembler-first & second pass, Program Loops, Programming Arithmetic and logic, Subroutines.

**Text Book**

1. Computer System Architecture: M. Morris Mano
2. Microprocessor: R L Gaonkar

**Reference Books**

1. Digital Logic and Computer Design: M Mano
2. Computer Hardware, System Software and Architecture: T Luce (Mc Graw Hill)



**PRACTICAL-I (PRACTICAL)****Time -6 hours****50 Marks**

**Learning MS Office:** Creating and formatting documents using MS Word, MailMerge, Creating and Formatting spread sheets using MS-Excel (salary bill preparation, admission merit list preparation using formula), Linking and Embedding objects, Making presentations using Ms-Power Point.

**Learning DOS Commands:** creating a directory tree (state with districts as subdirectories, each district having subdivisions as subdirectories and each subdivision having subdivisions as subdirectories and each subdivision having important towns as subdirectories). Creating a Bio-data file and a text file using edit (inside one of the towns subdirectory of the above directory tree). Copying & moving the above two files to different subdirectories/directories of the above tree.

**Learning LINUX Commands:** Repeating the above assignments using UNIX (and the vi text editor). Learning the use of basic LINUX commands.

**SEMESTER-III****H - III (THEORY) PROGRAMMING WITH C****Term-end: 60****Internal : 15****UNIT - I: Introduction to C**

Introduction to C as a middle level language, advantages, limitation and use; Structure of a C program; Basic idea about Compiler assembler and Linker.Preprocessor.

C Character set, identifiers and Key words, Data types, constants, variables, arrays, declaration statements, expressions, symbolic constants and operators. I/O Library functions - getchar, putchar, scanf, printf, gets and puts functions. Steps involving Preparing and running a complete C program.

**Unit-II: Control structure**

if - else,. Conditional operator, Comma operator, switch statements. while loop, do-while, for loop, nested looping, break and continue statements, goto statements.

**Unit III: Functions and Pointers**

Defining and accessing a function. Advantage of functions, Function declaration and prototyping, return statement, Storage class specifications-. Automatic, Register, External (Global) and Static, Pointer notations, Pointer arithmetic, Passing arguments to a function, calling by value, calling by reference, recursion.

**Unit IV: Arrays and Strings:**

Defining and processing an array, Array elements in memory, Passing arrays to functions, Sorting of one dimensional array.

Multidimensional arrays (Matrices), Pointer over multidimensional array, multiplication between two matrices.

Arrays and strings, Creating string functions, sorting of strings.

**Unit V: Structure , Union and File handling**

Defining and processing a structure, Array of structure, Structures and pointers, Passing structures to functions.

Unions, Self referential structures.

Dynamic memory Allocation, Typedef, enum and bitfield (basic concept only)

Creating, opening, closing and writing data to file.

**TEXT BOOK**

1. Programming in C - Gottfreid (Schaum Serie)

**REFERENCE BOOKS**

1. Let us C - Yashwant Kanetkar
2. Programming in C - E. Balguruswami.
3. Programming With C - Venugopal and Prasad

**SEMESTER-IV****H-IV (THEORY)****File Organization and Data Base Management System****Term-end: 60****Internal : 15****Unit I: (Introduction of Database)**

Introduction of Database, Need of Database, Characteristics of data in database, concept of database, Advantages and disadvantages of DBMS.

Database Architecture and Modeling (Conceptual, Physical and Logical database models), Database design, application areas of DBMS.

Entity Relationship Model: Component of ER model, ER Modeling, Schema, sub-schema

**Unit II: (Relational DBMS and Normalization)**

Introduction to Relational DBMS and terminology

Database Normalization: Keys, Relationships, Different types of Normal Forms, functional dependencies.

Relational algebraic operations, Relational Calculus

**Unit III: (SQL)**

History of SQL, Characteristics of SQL, SQL data types and literals, Types of SQL commands, Operator and their precedence, Table, views and indexes, Queries and sub queries, Update and deletion, Join, union and intersection, Embedded SQL

**Unit IV: (Data Warehousing and Data Mining)**

Data Warehouse and its characteristics, Metadata - types and component

Data mining, Application, tools and Benefits of Data mining.

**Unit V: (Data backup, Recovery and Database Security and Integrity)**

Database backup, its need and Importance, Database recovery -concept and terminology  
Database integrity, its type and constraints, Database security and its requirements.

**Text Book**

1. An Introduction to Database System (Vol. I & Vol. II) : C. J. Date

**Reference Books**

1. Database System Concepts: Silberschatz & Korth
2. Principles of Database Systems: Jeffery D Ullman (Galgotia Publication)
1. Introduction of Database: Bipin C Desai (Galgotia Publication)

**PRACTICAL-II (PRACTICAL) TIME= 6 Hours 50 marks**

Programming with C: - Exercise to study various features of the C language. Writing well structured modular programs using control structure, functions, array and pointers and their applications in sorting, searching; string manipulation.

**DBMS**

1. Familiarity with MS - ACCESS.
2. Use of forms, queries and reports.

**SEMESTER-V****H-V (THEORY) ORACLE**

**Term-end: 60**  
**Internal : 15**

**UNIT I**

Introduction to Oracle: A brief history about Oracle, Oracle's role in client/server computing, Features of oracle, Process architecture, Data concurrency and locking

**UNIT II**

Getting started with Oracle: Logging on to SQL \*PLUS, Data types, Classification of SQL commands, Difference between SQL and SQL \*PLUS, SQL operators, functions & commands

**UNIT III**

PL/SQL: What is PL/SQL, Features of PL/SQL, Its advantages, PL/SQL blocks, Control structures, Procedures and Functions

**UNIT IV**

Object and Object Oriented Programming: Understand the concepts of OOP, Know how to implement objects, Define an object type, Instantiating and using an object, Storing objects in an object table, Understand nesting and sharing objects, Self parameter, Overloading, Compare objects, Limitation of Oracle's implementation.

**UNIT V**

Advanced Oracle Options: Parallel server option, Parallel query option, Parallel index creation, Parallel loading, Web publishing assistant, Network computing architecture, Replication

**Reference books:**

1. ORACLE 7 - Ivan Byrass
2. Understanding Oracle - Perry J. and Later J.
3. SQL, PL/SQL Programming Language Ivan Byrass of oracle

**SEMESTER -V****H-VI (THEORY) OBJECT ORIENTED PROGRAMMING WITH C++**

**Term-end: 60**  
**Internal : 15**

**UNIT - I**

Principles of object oriented programming, object oriented Programming paradigm, basic concept of OOP, benefits of OOP, applications of OOP. Structure of C++ programme ; source file creation, compiling and linking.

Tokens, expressions and control structures - Key words, identifiers, data types, user defined data types, derived data types, symbolic constant, variables, operators in C++.

**UNIT - II**

Functions in C++ - functions prototyping, call by reference return by reference, inline function, default argument, virtual function, function overloading.

Classes and objects - Defining class and member function, Structure of a C++ programme with class, nesting of member function, memory allocation for objects, static data member, static member function, friend function, pointers to data members.

**Unit-III**

Constructors and destructors - default constructor and parameterized constructor, copy constructor, dynamic constructor, Constructor with default arguments, dynamic initialization of objects, constructor overloading destructors and its functions.

**UNIT - IV**

Defining operator overloading, overloading unary and binary operators, overloading binary operator using friend function, manipulation of strings using operators, rules for overloading operators, type Conversions.

Inheritance: - Extending classes - defining derived classes. Single inheritance, making a private member inheritable multiple inheritance, hierarchical inheritance, hybrid inheritance.

**Unit - V**

Virtual base class, abstract classes, constructors in derived class, nesting of classes. Pointers, virtual functions and polymorphism - pointers to objects, this pointer, pointer to derived classes, virtual functions, pure virtual function.

**TEXT BOOK**

Object Oriented programming with C++ - E. Balaguruswamy (Chapters 1 to 9)

**REFERENCE BOOKS**

1. Object Oriented Programming in Turbo C++ - Robert Lafore
2. Mastering C++ - Venugopal
3. Let Us C++ - Y Kanetkar

**PRACTICAL-III (PRACTICAL)**

**TIME= 6 Hours**  
**50 Marks**

**C++ and D B M S Practical**

- a) Simple practical application of Oracle (Paper-V)
- b) Simple Programming Examples with C++

**SEMESTER-VI****H-VII(THEORY)****Data Communication And Computer Network**

**Term-end: 60**  
**Internal : 15**

**Unit - I**

Introduction to data Communication and Computer networks, Concepts and terminologies, Network goals, motivation, Application of Computer networks, analog and digital data transmission, concept of noise, attenuation, delay Elementary idea about packet radio networks, broad cast network, satellite networks.

**Unit - II**

LAN, WAN and MAN, Transmission terminology - Simplex, half duplex, full duplex Elementary idea about optical fibers, coaxial cable & twisted pair, wireless transmission.

**Unit - III**

Data encoding, modulation and demodulation techniques - AM, FM, Pulse Amplitude modulation and pulse code modulation. Modes of transmission (Asynchronous and synchronous). Line Configuration and interfacing, frequency division multiplexing, synchronous time division multiplexing and statistical time division multiplexing.

**Unit - IV**

Error detection and control (parity check, CRC) Flow control High level data link control, Circuit switching, message switching packet switching. Routing and congestion control

in packet switched networks, X.25, RS. 232. Introduction to frame relay, ATM- ATM protocol architecture, ATM Cells.

**Unit - V**

Network security and management, privacy, message authentication, public key encryption, digital signature, IPV4 and IPV6 security. Concept of e-mail, URL, HTTP, concept of ISDN.

**BOOKS RECOMNDED:****TEXT BOOK**

1. Data and Computer Communication - William Stalling (PHI)
2. Computer Networks - A.S. Tannenbaum (PHI)

**REFERENCE BOOK**

1. Computer Networks - Protocol, standards and Interfaces U. Black (PHI)

**SEMESTER - VI**

**H-VIII (THEORY)Elements Of Java And Computer Graphics** **Term-end: 60**  
**Internal : 15**

**UNIT - I****Element of JAVA:**

Basic JAVA features, difference between Java and C++, writing simple JAVA application programs, Applet creation.

**Unit - II**

Working with HTML for web page designing, Elements of HTML, Heading elements, Paragraph, Marquee, Table, Frames, Forms. Internal and External linking, Incorporating of images etc. in HTML.

**UNIT - III****Computer Graphics:**

Display devices - Language and point plotting system, Raster, Vector, pixel and point plotters, continual refresh and storage displays, digital frame buffer, plasma panel displays, very high resolution devices, colour display techniques (shadow mask and penetration CRT, Colour lookup tables, analog false colours, hard copy colour printers).

**Unit -- IV**

Display description - Scan Conversion, Screen Co-ordinates, user coordinate Graphical data structures (Compressed incremental list, vector list, use of homogeneous coordinates), Display code generation, Graphical functions. The view algorithm.

Transformation and Clippings: 2D translation, scaling and Rotation, Point and line clipping, Midpoint subdivision.

### Unit - V

Interactive Graphics - Pointing and positioning devices (Cursor, light pen, digitizing tablet, the mouse, trackballs), Interactive graphical techniques, positioning elastic lines, linking, zooming, panning.

### BOOKS RECOMMENDED:

#### TEXT BOOKS:-

1. Computer graphics - D.Hern & M.Pauline Baker
2. Elements Java - E. Balguruswamy (TMH)

#### REFERENCE BOOKS:

1. JAVA & Complete Reference (PHI)
2. Principles of interactive Computer Graphics - William M.Newman & Robert F.Sporull

### PRACTICAL- IV (PROJECT WORK)

50 Marks

Each student has to submit a project work carrying 50 marks. This has to be examined by an external examiner.

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## ENVIRONMENTAL POLLUTION & TOXICOLOGY (HONS)

### COURSE STRUCTURE

There shall be six semesters in three years, (two semesters in each year). In first four semesters there shall be four theory papers (one theory paper in each semester) of 75 marks each. The last two semesters shall have four theory papers (two theory paper in each semester) of 75 mark each. There shall be an Internal Assessment in each theory paper of 15 mark out of 75 (i.e. 20% of theory), so that the term-end examination theory papers shall have 60 marks out of 75. There shall be one long question from each unit with alternative. The second, fourth, fifth and sixth semesters shall have one practical each: Practical-I, Practical-II, Practical-III and Practical-IV respectively, carrying 50 marks each. All practical papers shall be of 6 hours duration.

#### FIRST YEAR

##### SEMESTER-I

H-I	Introduction to Environment and Ecology	75 marks	3 hours
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##### SEMESTER-II

H-II	Resource Conservation and Management	75 marks	3 hours
Practical-I	Practical based on H-I and H-II	50 marks	6 hours
	Experiment-35		
	Viva -10		
	Record -05		

#### SECOND YEAR

##### SEMESTER-III

H-III	Instrumental Techniques and Data Analysis	75 marks	3 hours
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##### SEMESTER-IV

H-IV	Indian Environmental Law	75 marks	3 hours
Practical-II	Practical based on H-III and H-IV	50 marks	6 hours
	Experiment-35		
	Viva -10		
	Record -05		

#### THIRD YEAR

##### SEMESTER-V

H-V	Fundamentals of Environmental Pollution	75 marks	3 hours
H-VI	Pollution Control and Management	75 marks	3 hours
Practical-III	Practical based on H-V and H-VI	50 marks	6 hours
	Experiment-35		
	Viva -10		
	Record -05		

#### SEMESTER-VI

H-VII	Fundamentals of Toxicology	75 marks	3 hours
H-VIII	Toxicology of Xenobiotics	75 marks	3 hours
Practical-IV	Practical based on H-VII and H-VIII	50 marks	6 hours
	Experiment-35		
	Viva -10		
	Record -05		

**COURSE CONTENT**  
**SEMESTER-I**

**H-I Introduction to Environment and Ecology** **Term-end: 60**  
**Internal : 15**

**Unit-I**

**Hydrosphere:** Distribution of water and water cycle; **Atmosphere:** Major regions and chemical elements present in atmosphere; **Lithosphere:** Soil formation and soil development, Physico Chemical characteristics of soil, organism present in soil; **Ecology and Ecosystems:** Scope of Ecology, Subdivisions in Ecology, system concept in Ecology, Component parts of an ecosystem, Classification of ecosystems.

**Unit-II**

**Functional attributes of an Ecosystem: I:** Ecological factors: temperature, light, water, food chain; Trophic levels and Ecological pyramid concept: types of food chain and significance of food chains, method for studying food chains, pyramid of number, biomass and energy; Bio-geo-chemical cycles: Carbon cycle, Nitrogen cycle, Sulphur cycle, Phosphorous cycle.

**Unit-III**

**Functional attributes of an Ecosystem: II:** Primary production: concept of Primary Production, Factors affecting primary production, method for measuring primary production; Secondary Production: Concept of Secondary Production and Secondary Productivity; Energy flow in Ecosystems: Concept of Energy, Energy source in Ecosystem, Laws governing energy transformation, Energy flow in producers and consumers, Lindeman's Trophic-Dynamic concept, Ecological efficiencies.

**Unit-IV**

**Concept of population and population attributes:** biotic potentiality, natality, mortality, survivorship curves, life table, age structure, population growth forms, concept of carrying capacity and environmental resistance; Population fluctuation and population interaction: Extrinsic and intrinsic factors associated with population fluctuation, abiotic, biotic, density dependent and independent factors, parasitism, predation, competition, social behaviour in animals.

**Unit-V**

**Community:** concept of habitat and niche, types of niches, community organisation, types of communities, qualitative features of community (Composition, stratification, physiognomy, dispersion, sociability, vitality etc), quantitative characteristics of community (frequency, density, cover dominance and diversity, important value index), Ecotone and edge effect; Community dynamics and succession: ecological succession and kind of succession, succession process, concept of climax, monocl意思, and polyclimax theories, examples of succession (hydrosere, lithosere and xerosere)

**SEMESTER-II**

**H-II Resource Conservation and Management** **Term-end: 60**  
**Internal : 15**

**Unit-I**

Concept of resources: Renewable, non-renewables and perpetual resources and their conservation in general. Forest resources: Major types and composition of forests with reference to India, Primary production in different Forest ecosystems and methods of measurement. Importance of Forest with reference to major and minor produce, climate, soil, erosion, pollution control and water management.

**Unit-II**

Concept of Biosphere Reserve, Biodiversity and forest, impact of deforestation and shifting cultivation on forest ecosystems, objective, principle and techniques of forest management. Management of forests involving different silvicultural principles and practices. Social forestry and Agroforestry.

**Unit-III**

Wild life protection and management: Wild life and its importance. Human activities and Wild Life, Concept of Endangered Species and Red data Book, How species become endangered and extinct, Protecting wild species from extinctions, Ecological basis of Wild Life conservation and management.

**Unit-IV**

Non-renewable Resources: Environmental impact of mining and processing mineral resources, conservation of mineral resources, Fossil fuels: Classification; Coal, its type and its analysis, Carbonisation; oil fractionation, cracking, octane and octane number, addition of TEL; natural gas and other gaseous fuels derived from fossil fuels, Environmental Impact of Fossil Fuel use.

**Unit-V**

Perpetual energy source: Geothermal energy: Nuclear Energy: Advantages and disadvantages; solar energy: its advantages and drawbacks; Wind Energy: Wind mills applications; Water Energy: Hydroelectricity, wave and tidal energy; Energy from Biomass: Biomass as fuel, Biogas plants and generation, uses of biogas.

**Practical-I Practical based on H-I and H-II****50 Marks**

- i) Primary productivity.
- ii) Analysis of grassland community: size species curve
- iii) Analysis of grassland community: species area curve
- iv) Analysis of grassland community by gradient method: Abundance, density, frequency, dominance.
- v) Study of the structure of a pond ecosystem (to name the biotic and abiotic components)

- vi) Study of the structure of a grassland ecosystem (to name the biotic and abiotic components)
- vii) Determination of pH of water and soil.
- viii) Determination of moisture of soil sample.
- ix) Analysis of forest community: Abundance, Density, Frequency, RA, RD, RF and IVI.
- x) Determination of CO<sub>2</sub> evolution from grassland and forest soils.

### SEMESTER-III

**H-III Instrumental Techniques and Data Analysis**      **Term-end: 60**  
**Internal : 15**

#### Unit-I

pH metry and Centrifugation: Idea of pH and buffer, buffer capacity and Ionic strength, pH measurement by method of pH indicators and potentiometric methods. Centrifugation Techniques.

#### Unit-II

Spectroscopic methods: The principle, and application of visible spectrometry, Atomic Absorption, Spectroscopy: The principle and application of Flame emission spectroscopy and Absorption spectroscopy. Bomb Calorimetry: Principle and its application.

#### Unit-III

Chromatography Techniques: The Principle and application of Ion exchange chromatography, paper chromatography and thin layer chromatography.

#### Unit-IV

Methods of sampling: size of sample, sampling and non-sampling errors, measure of central values: objectives, Types of averages: Arithmetic mean (simple and weighted) median, mode, measure of dispersion range, Interquartile range and quartile deviation, mean deviation, the standard deviation, confidence interval of mean.

#### Unit-V

Student 't' test, contingency tables and non-parametric tests (Chi-Square test), Simple correlation and Linear regression, analysis of variance (one-way)

### SEMESTER-IV

**H-IV Indian Environmental Law**      **Term-end: 60**  
**Internal : 15**

#### Unit-I

Water Act 1974 and Air Act 1981: Constitution of Central and State Pollution Control Boards, power, function and responsibility of Central and State Boards (Objectives, Area of jurisdiction, responsibility of an industry, power and function of state and central Government, cognizance of offence, penalties and punishment).

#### Unit-II

The Environment Protection Act 1986: Necessity and Scope of the Act. Powers of the Central Government, Parallel provisions with the water and the Air Act. Water Cess Act 1977 and its salient provisions, provisions of Public Liability Insurance Act 1991.

#### Unit-III

Important rules under the Environment Protection Act 1986: Biomedical waste (Handling and Disposal) rules 1998. Recycled plastic manufacture and usage rules 1999, Municipal Solid Waste (Management and Handling) Rules 2000, The Noise Pollution (Regulation and Control) Rules 2000, Ozone depleting substances (Regulation) Rules 2000.

#### Unit-IV

Important notification under the environment protection Act 1986: Emission Standards, Ambient Noise Standard, Effluent standard, National Ambient Air quality, Coastal Regulation Zone, Environmental Impact Assessment. Public Hearing notification.

#### Unit-V

Forest conservation Act 1980: Objective and Jurisdiction, Responsibility of industry, Wildlife Protection Act 1972, Authorities under the Act. Wildlife Advisory Boards and their functions, Detection and prevention of offences. Cognizance of offences, The Wildlife (protection) Amendment Act 1991.

#### Practical-II Practical based on H-III and H-IV

**50 Marks**

- i) Analysis of pigment content of leaf sample.
- ii) Analysis of AA content of biological sample.
- iii) Analysis of carbohydrate content of biological sample.
- iv) Analysis of protein content of biological sample.
- v) pH of water and soil.
- vi) Electrical conductivity of water and soil.
- vii) Turbidity of water and soil. (pH meter, Conductivity meter, Nephthometer)
- viii) Statistical process relating to mean, median, mode and standard deviation.
- ix) Statistical problem relating to variance of test and adova.
- x) Statistical problem relating to correlation and regression.

### SEMESTER-V

**H-V Fundamentals of Environmental Pollution**      **Term-end: 60**  
**Internal : 15**

#### Unit-I

Concept and definition of environmental pollution, types and classification of Air pollution, pollutants and source of pollution, history of major air pollution episodes. Air pollution: Air pollution meteorology, major and minor pollutants in atmosphere (SO<sub>2</sub>, NO<sub>2</sub>, CO<sub>2</sub>, Fluoride) Acid rain, Photochemical smog, Greenhouse effect and ozone layer depletion.

**Unit-II**

Water pollution: History of major water pollution episodes, classification and types of water pollution: Industrial wastes, Municipal waste, Agriculture chemicals, oil pollution, Eutrophication, Heavy metals (Mercury, Lead, Arsenic) ecological magnification, ground water pollution.

**Unit-III**

Soil Pollution: Pollution effect of pesticides in soil: Source, accumulation and effect, types of solid wastes and their effect in soil and ground water, pollution due to fertilizers.

**Unit-IV**

Pollution by radiation: Sources of radioactive pollution, effects of radiation, protection and control from radiation, disposal of radio active waste.

**Unit-V**

Pollution due to noise: Sources of noise, loudness on decibel scale, noise levels in decibel scale, effect of noise on human health, prevention and control of noise pollution.

**H-VI Population Control and Management**

**Term-end: 60**  
**Internal : 15**

**Unit-I**

Water quality standard: Drinking water quality standard, irrigation water standard, stream standard and effluent standard, characterisation of Municipal waste water, characterisation of some major water polluting industries and air polluting industries, prevention and control of Air Pollution.

**Unit-II**

Methods of treatment of waste water: Preliminary treatment, primary treatment, (Sedimentation, Equalisation and Neutralisation etc), Secondary treatment (Activated Sludge Technique & Trickling Filter) Tertiary treatment methods for waste water treatment (Evaporation, Ion exchange, adsorption, Electrodialysis, Electrolytic recovery, Reverse osmosis) low-cost methods of water pollution control.

**Unit-III**

Permissible limit and ambient air quality, methods for control of gaseous air pollutants (Combustion scrubber, Dry scrubber, Electrostatic precipitator)

**Unit-IV**

Municipal solid waste disposal and management, industrial solid waste disposal and management, types of solid wastes and their effect, management of solid wastes.

**Unit-V**

Pollution due to pesticides and fertilisers, alternate methods of pest control: biological control, hormonal control, integrated pest management.

**Practical-III Practical based on H-V and H-VI****50 Marks**

- i) Estimation of DO content of water sample.
- ii) Estimation of hardness of water sample
- iii) Estimation of alkalinity of water sample
- iv) Estimation of chloride content of water sample
- v) Estimation of free CO<sub>2</sub> content of water sample
- vi) Estimation of COD content of water sample
- vii) Measurement of SO<sub>2</sub> content of air
- viii) Measurement of NO<sub>2</sub> of air
- ix) Measurement of suspended particulate matter in air.
- x) Measurement of noise intensity by sonometer.

**SEMESTER-VI****H-VII Fundamentals of Toxicology**

**Term-end: 60**  
**Internal : 15**

**Unit-I**

Introducing Toxicology: History, types of toxicology, toxicity, hazards, risks, benefit-to-risk-ratio, tolerance limits, acceptable daily intake, threshold value. Natural laws concerning toxicology: factors affecting toxicity: Host factor, age, species and strain, sex, food and feeding, idiosyncratic toxicity, interaction between chemicals (synerism, antagonism) environmental factors, Physico chemical properties of toxic substances, route and rate of administration, dose, effect and response, dose-response curves and dose effect relationships (graded and quantal response) statistical concept of toxicity (acute toxicity, margin of safety)

**Unit-II**

Translocation of toxicity: Absorption, distribution and excretion of toxic substances, absorption: membrane permeability, mechanism of chemical transfer, absorption (Gastrointestinal, skin, lungs), Distribution: tissue affecting distributions and tissues retention. Excretion: Renal excretion, Biliary excretion and gastrointestinal. Receptor concept, nature of receptors, theory of toxicant receptor interaction, mechanism of action of pesticides and heavy metals

**Unit-III**

Biotransformation of bioaccumulation of toxicants: site, Biotransformation reactions, Phase I and Phase II reactions and associated enzymes (Oxidation, Reduction, Hydrolysis), factors affecting biotransformation of xenobiotics, process of accumulation and elimination of toxicants.

**Unit-IV**

Toxicity tests: types of test based on number of species (single species, multispecies and ecosystem tests), based on exposure (single dose and multiple dose), based on duration of exposure (acute and chronic toxicity test)

**Unit-V**

Occupational health: occupational health hazards, particulate emissions gaseous emissions, corrosive toxic chemicals, noise and vibration, epidemiology, risk assessment, irreversible health disorders.

**H-VIII Toxicology of Xenobiotics****Term-end: 60****Internal : 15****Unit-I**

Pesticides: Mechanism, metabolism and biotransformation of selected Organo-chlorine (DDT) Organo-phosphate (malathion) and carbamate (carbaryl) pesticides. Effects of pesticides on biota. Human poisoning by pesticides.

**Unit-II**

Heavy metals: Historical perspective, source, emissions, environmental metabolism, mammalian metabolism, biochemical mechanism of toxicity of Arsenic, Lead, Mercury and Chromium.

**Unit-III**

Food Additives: Definition and types, sources, factors, encouraging the development and use of food additives, chemicals used as food additives, nature of health risk of food additives, safety evaluation of food additives, hazards/risks of food additives.

**Unit-IV**

Animal and Plant Toxins: General characteristics of animal and plant toxins, toxicology of snake venoms, mycotoxins, toxic principle in plants.

**Unit-V**

Immunotoxicity: Concept of immunity and immune system. Antigens and Antibodies, defence mechanism of body, cells involved in immune response. Hypersensitivity.

**Practical-IV Practical based on H-VII and H-VIII 50 Marks**

- i) Determination of LC<sub>10</sub>, LC<sub>50</sub> and LC<sub>90</sub> of fish or earthworm exposed to different concentration of heavy metal and pesticide.
- ii) Determine the effect of heavy metal on oxygen uptake of fish and earthworm.
- iii) Determine the effect of pesticide or oxygen uptake of fish and earthworm.
- iv) Determine the effect of heavy metal on ammonia excretion of earthworm.
- v) Determine the effect of heavy metals on urea excretion of earthworm.
- vi) Determine the effect of pesticide on ammonia excretion of earthworm.
- vii) Determine the effect of pesticide on urea excretion of earthworm.

**Books Recommended**

1. Fundamentals of Ecology : M.C.Dash, Mc Graw Hills.
2. Concept of Ecology : E.J.Kormundy, Oxford
3. Fundamental of Air and Water Pollution : P.C.Mishra, Ashis

4. Environmental Chemistry : A.K.Dey, Wiley Eastern
5. Environmental Pollution : Katyal & Satake, Anmol.
6. Ecology : E.P.Odum
7. Biochemical Techniques : Robyt & White Books/Cole, California
8. Applied Environmental Biology : Saxena
9. Ecological methods for field laboratory investigation : Michael, Tata Mc Graw Hill.
10. Ecology Work Book : R.Mishra, Oxford & IBHS
11. Practical methods in Ecology and Environmental Science : Trivedy & Goel, Environmental Publication.
12. Statistics : Gupta, Sultan Chand
13. Fundamental of Statistics : Elhance
14. Biostatics : Mishra & Mishra
15. Air Pollution : Kudesia, Pragati
16. Water Pollution : Kudesia, Pragati
17. Toxicology : Vol I, II and III, Gupta Metropolitan Book Co.
18. Forest and Wildlife of India : Krishna Murthy, Costed Publ.
19. The Wild Life of India : S.H.Prater, BNHS
20. Fundamentals of Ecology : S.K.Agrawal, IUCN Ashis
21. Toxicology : Omkar
22. Toxicology : Sood, Sarup and Sons
23. Environmental Science : Santra, Central
24. Air Pollution : Goel, Technoscience
25. Water Pollution, Causes, Effect and Control : Goel, New Age International
26. Environmental Pollution and Toxicology : Ray Choudhury and Gupta, Today and Tomorrow Publ.
27. Ecotoxicology : Moriarty, Elsevier
28. Man and Environment : Dash and Mishra, Macmillan.
29. Practical methods in Ecology and Environmental Science. : Trivedi, Goel and Trisal, Environmental Publication, Kard, India
30. Ecological methods for field and Lab. investigation : P.Michael, Tata Mc Graw Hill Publication, New Delhi
31. Chemicals Methods for Environmental Analysis (Water and rudiments) : R.Ramesh, Ph.D., M.Anbu, Ph.D., Mc Millan India Ltd.
32. Standard Methods for examination of water and waste matter : Marry AMH Franson, APHA-AWAA-WPCF.
33. Ecology Work Book : R.Mishra, Oxford and IBA
34. Soil Chemical Analysis : Jackson.

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## MATHEMATICS (PASS) FOR ARTS & SCIENCE

The Pass course in Mathematics shall comprise four compulsory papers. There shall be one paper in each Semester (Semester-I, Semester-II, Semester-III and Semester-IV). Each paper shall carry 100 marks (80 marks of Term-end Examination and 20 marks Internal Assessment Examination) and is of 03 hours duration. There shall be 05 units in each paper. Each paper shall have questions (comprising long and short types) with alternatives from the same unit; carrying equal marks.

### SEMESTER-I

P-I	- 80+20 Marks
A. Calculus	- 32 + 8 (Internal Assessment)
B. Ordinary Differential Equations	- 32 + 8 (Internal Assessment)
C. Analytical Solid Geometry	- 16 + 4 (Internal Assessment)

### SEMESTER-II

P-II	- 80+20 Marks
A. Linear Algebra	- 48 + 12 (Internal Assessment)
B. Modern Algebra	- 32 + 8 (Internal Assessment)

### SEMESTER-III

P-III	- 80+20 Marks
A. Analysis-I	- 48 + 12 (Internal Assessment)
B. Advanced Calculus	- 32 + 8 (Internal Assessment)

### SEMESTER-IV

P-IV	- 80+20 Marks
A. Numerical Analysis	- 48 + 12 (Internal Assessment)
B. Linear Programming	- 32 + 8 (Internal Assessment)

### SEMESTER-I

P-I	<b>Term End-80</b>
	<b>Internal -20</b>
<b>A. Calculus</b>	<b>32 Marks</b>
<b>Unit-I</b>	
Curvature, Asymptotes, Tracing of Curves (Cartenary, Cycloid, Folium of Descartes', Astroid, Limacon, Cissoid and Loops)	
<b>Unit-II</b>	
Rectification, Quadrature, Volume and Surface area of Solids of revolutions.	
<b>Books Recommended:</b>	
1.	Text book of Calculus (Part-II)- by Shantinakaran, - S Chand & Co. Chapter 8 (Art 24, 25, 26)
2.	Text book of Calculus (Part-III)- by Shantinakaran - S Chand & Co. Chapters: 1 (1, 2), 3, 4 (10-12 omitting Simpson's Rule), 5 (13), 6 (15)

### Reference Books

- Text Book of Differential Calculus: Gorakh Prasad, Pothisala Pvt. Ltd., Allahabad
- Text Book of Integral Calculus: Gorakh Prasad, Pothisala Pvt. Ltd., Allahabad
- A Treatise of Differential Calculus: by J. Edward.
- Differential Calculus: by Das & Mukherjee, U.N. Dhar & Sons. Pvt. Ltd., Calcutta
- Integral Calculus: by Das & Mukherjee, U.N. Dhar & Sons Pvt. Ltd., Calcutta
- Advanced Calculus: by David Widder, PHI.

### B. Ordinary differential equations

**32 Marks**

#### Unit-III

Ordinary differential equations of 1st order and 1st degree (Variable Separable, Linear, homogenous, exact), Equations of 1st order and higher degree.

#### Unit-IV

Second order linear equation with constant coefficients; homogeneous forms Second order equation with Variable coefficients, Variation of Parameters, Laplace Transformation and its application to solutions of differential equations.

#### Books Recommended:

- A Course of Ordinary and Partial differential equations by Dr. J. Sinha Roy and Dr. S. Padhy - Kalyani Publishers. Chapters: 2 (2.1 to 2.7), 3, 4 (4.1 to 4.7), 5, 9 (9.1, 9.2, 9.4, 9.5, 9.10, 9.11, 9.13)

#### Reference Books:

- Introductory Course in Differential Equation: by D.A. Murry (Longman)
- Differential Equation and their Application: by Martin Braun, Springer International.

### C. Analytical Solid Geometry

**16 Marks**

#### Unit-V

**Sphere:** Plane section of a sphere, Intersection of two Spheres, sphere with a given diameter, Equation of circle, Sphere through a given circle. Intersection of a sphere with a line. Equation of Tangent plane. Angle of intersection of two spheres and condition of orthogonality of two spheres.

#### Cones and Cylinders:

Definition, Equation of a cone with a conic as guiding Curve. Enveloping Cone of a sphere. Condition that the general equation of second degree should represent a cone. Intersection of a line with a cone. The tangent line and tangent planes at a point. Condition of tangency. The Right circular cone, its definition and equation. Definition and Equation of Cylinder Enveloping by cylinders, Definition and Equation of right circular cylinder.

#### Conicoid:

General equation of Conicoid, shapes of some surfaces, central conicoids. Intersection of a line with a conicoid. Tangent line and tangent plane at a point, condition of tangency. The Director sphere.

**Books Recommended**

1. **Analytical Solid Geometry**:- by Shanti Narayan and P.K. Mittal. (S. Chand & Co.)  
 Chapters: 6(6.3, 6.3.1, 6.3.2, 6.3.3, 6.4, 6.4.1, 6.5, 6.6, 6.6.1, 6.7, 6.7.1) 7(7.1, 7.1.1, 7.1.2, 7.2, 7.4, 7.4.1, 7.4.2, 7.6, 7.6.1, 7.7, 7.7.1, 7.8, 7.8.1, 7.8.2) 8(8.1, 8.2, 8.3.1, 8.3.2, 8.3.3)

**Reference Books:**

- An introduction to the theory of quadratic surface by R.N.Das, Kalyani Publishers, New Delhi.
- Textbook of Analytical Geometry of 3 dimensions by P.K.Jain and Khalil Ahmed, Willy Eastern Ltd., New Delhi.

**D. Internal Assessment 20 Marks**

Problems relating to all the five units above.

**SEMESTER-II****P-II Term End-80**

**Internal -20**

**A. Linear Algebra 48 Marks****Unit-I**

Vector space, subspace, span, Linear dependence and independence, dimensions and basis.

**Unit-II**

Linear transformations, range, kernel, rank, nullity, inverse of a linear map, Rank - nullity theorem, matrices and linear maps, rank and nullity of a matrix, transpose of a matrix, types of matrices.

**Unit-III**

Elementary row operations, system of linear equations, matrix inversion using row operations, minor and rank of matrices, Eigen values, Eigenvectors, Quadratic forms.

**Book Recommended:**

- An introduction to linear Algebra by V. Krishnamurthy, V.P. Mainra, J.L. Arora (EWP).  
 Chapter: 3, 4 (4.1 to 4.7), 5 (except 5.3), 6 (6.1, 6.2, 6.5, 6.6, 6.8), 7 (7.4 only)

**Reference Books:**

- Basic structure in Algebra, by J.N. Pattnaik, Kalyani Publisher, Delhi
- Higher Algebra, by A. Kurush, Mir Publication
- Linear Algebra, by S.K. Huffman and R. Kunze, East-West Publisher
- Finite Dimensional Vector Spaces, by Halmos

**B. Modern Algebra 32 Marks****Unit-IV**

The integer, Groups and subgroups, normal subgroups, quotient groups, group homomorphism.

**Unit-V**

- Rings, Special types of rings, ideals and quotient rings, right homomorphism.
- Preliminaries, property of equations, Descartes' Rules of Science, Relation between roots and co-efficients, symmetric function of roots, Algebraic solution of cubics, nature of roots of a cubic, solution of cubic by Cardan's method, solution of biquadratic.

**Books Recommended:**

- Topics in Algebra: by I.N. Herstein, (Vikas Publishing)  
 Chapters: 1 (1, 3); 2 (2.1 - 2.3); 3 (3.1 - 3.5)
- Theory of Algebra: by Chandrika Prasad (Pothisala Publishing)  
 Chapters: 11 (11.1 - 11.4); 12 (12.1 - 12.3, 12.6)

**Reference Books:**

- Higher Algebra: by A. Kurosh, Mir Publishers
- A first course in Abstract Algebra: by J.B. Fraleigh, Addition Wesley Publ. Comp.

**C. Internal Assessment 20 Marks**

Problems relating to all the five units above

**SEMESTER-III****P-III Term End-80**

**Internal -20**

**A. Analysis-I 48 Marks****Unit-I**

Algebra of real numbers, Order completeness (Continuum); Density, decimal representation of real numbers, Cardinality, Countability and uncountability (restricted), Convergence of sequences, Limit theorems, Weierstrass Completeness principle, Cantor's Completeness principle, subsequences and Bolzano-Weierstrass Theorem.

**Unit-II**

Cauchy's Completeness Principle, Convergence of Series and series of Positive terms, Analytic Properties of  $\mathbb{R}$  and  $\mathbb{C}$ .

**Unit-III**

Limits and Continuity of functions, Discontinuity, properties of continuous functions, Infinite limits and limit at infinity, Uniform Continuity, Differentiability of functions, Mean-Value theorems, Indeterminate forms, Higher order derivatives and Taylor's theorem.

**Books Recommended:**

1. Fundamentals of Mathematical Analysis - by G. Das and S. Pattnaik (TMH)  
Chapter: 2(2.2. to 2.4; 2.5 to 2.7), 3 (3.2, 3.3 (except proofs of Thm.2 and Thm.3), 3.4), 4 (4.1 to 4.7, 4.10, 4.11); 5 (5.1 to 5.5); 6 (6.1 to 6.7, 6.9); 7 (7.1 to 7.6).

**Reference Books:**

- i. Mathematical Analysis: by S.C. Mallik, Willy Eastern, Pvt. Ltd.
- ii. A course of Mathematical Analysis: by Shanti Narayan, P.K. Mittal, S. Chand and Com.

**B. Advanced Calculus:****32 Marks****Unit-IV**

Limits and continuity of a function of several variables, Partial derivatives, Homogenous functions, change of variables, Mean-Value Theorem, Maclaurin's Theorem.

**Unit-V**

Maxima and Minima of a function of two and three variables, (NASC without proof), Lagranges Multiplier, Multiple integral.

Vector differentiation, Grad, div, curl, line integral, surface and volume integrals; Statements of Gauss, Stoke's and Green's theorems (without proof).

**Books Recommended:**

1. Mathematical Analysis - by S.C. Mallick, S. Arora and others. (New-Age International)  
Chapter: 15 (1 to 10), 17, 18.
2. Topics in Calculus - R.K. Panda and P.K. Satapathy.

**Reference Books:**

- i. Advanced Engineering Mathematics: by Erwin Kreyszig, Wiley Eastern Ltd.

**C. Internal Assessment****20 Marks**

Problems from topics Covered under Units I to V above.

**SEMESTER-IV****P-IV****Term End-80****Internal -20****A. Numerical Analysis****48 Marks****Unit-I**

Number system and Errors, Binary numbers, Octal numbers, hexa-decimal numbers, Floating point Arithmetic, K-digit Arithmetic, Errors, Sources of Errors. Numerical Solution of non-linear equations, method of bisection, Regula-Falsi method, Secant method, Newton - Raphson method, Fixed point iteration method, Aitken's 2-process.

**Unit-II**

Polynomial Interpolation, Existence and uniqueness of interpolating polynomials, Lagranges Interpolating polynomial, Error in Interpolation, Newtons Divided Difference Interpolating Polynomial, Forward and Backward Difference operators, Newton's Forward Difference Interpolation Formula, Newton's Backward Difference Interpolation Formula. Approximation of Functions, Discrete least square approximation.

**Unit-III**

Numerical Differentiation, Simple Numerical methods, Interpolatory Formulas, Numerical Integration, Simple Quadrature Rules, Newton's-Cotes' Rule, Gauss Quadrature Rule, Gauss - Legendre Rule, Numerical Solution of Differential Equation, Picard's method, Euler's method, modified Euler's method, Runge-Kutta methods.

**Remark:** Scientific calculator may be allowed for the numerical analysis.

**Books Recommended:**

1. A Course on Numerical Analysis by B.P. Acharya and R.N. Das (Kalyani)  
Chapter: 1;2(2.1 to 2.4, 2.6, 2.8, 2.9); 3(3.1 to 3.4, 3.6 to 3.8, 3.10); 4(4.1, 4.2); 5(5.1, 5.2, 5.3); 6(6.1, 6.2, 6.3, 6.10, 6.11); 7(7.1, 7.2, 7.3, 7.4, 7.7).

**Reference Books:**

- i. Introductory methods of numerical analysis: by G.S.S. Sastry, PHI, ND
- ii. Finite Differences and Numerical Analysis: by H.L. Saxena, S. Chand and Comp.
- iii. Introduction to Numerical Analysis: by F.B. Hildebrend Magraw Hill, NY
- iv. Numerical methods for Scientists and Engineering: by R.G. Stanton, PHI

**B. Linear Programming****32 Marks****Unit-IV**

Linear programming problem: formulation of LP problems, graphical solutions of two variables problems, general formulation of LPP, slack and surplus variables, standard form of LPP, matrix form of LPP, some important definitions, applications of LP.

**Unit-V**

Simplex Method: some more definitions and notations, computational procedure, artificial variable techniques.

**Book Recommended:**

1. Operations research by S.D. Sharma, Kedar Nath Ram Nath and Co., Meerut, Thirteenth Edition (improved and enlarged edition)  
Chapter: 3 (3.1-3.8, 3.11), 5 (5.1-5.5)

**Reference Books:**

- i. Operations Research: by P.K. Gupta, Kanti Swarup, Man Mohan, Sultan Chand and Sons, Dargaganj, New Delhi-110002.
- ii. Operations Research by B.S. Goel and S.K. Mittal, Pragati Prakashani, Meerut.
- iii. Linear programming problem, by S.I. Gauss.
- iv. Linear programming by T.N. Mallik, U.N. Dhar and sons Pvt. Ltd, Calcutta.
- v. Operations Research by Prem Kumar Gupta, S. Mica, S. Chand and Com.

**MATHEMATICS (HONS)**

The Honours course in Mathematics shall comprise 08 (eight) papers. There shall be one paper each in Semester-I, Semester-II, Semester-III and Semester-IV and two papers each in Semester-V and Semester-VI. Each paper shall carry 100 marks (80 marks of Term-end Examination and 20 marks of Internal Assessment Examination) and is of 03 hours duration. There shall be 05 units in each paper. Each paper shall have questions (comprising long and short types) with alternatives from the same unit; carrying equal marks. Paper-VIII has an alternative practical component and Paper-VII has three elective groups, out of which one has to be chosen. The rest papers are compulsory.

**SEMESTER-I**

H-I	-	80+20 Marks
A. Calculus	-	32 + 8 (Internal Assessment)
B. Ordinary Differential Equations	-	32 + 8 (Internal Assessment)
C. Analytical Solid Geometry	-	16 + 4 (Internal Assessment)

**SEMESTER-II**

H-II	-	80+20 Marks
A. Linear Algebra	-	48 + 12 (Internal Assessment)
B. Modern Algebra	-	32 + 8 (Internal Assessment)

**SEMESTER-III**

H-III	-	80+20 Marks
A. Analysis-I	-	48 + 12 (Internal Assessment)
B. Advanced Calculus	-	32 + 8 (Internal Assessment)

**SEMESTER-IV**

H-IV	-	80+20 Marks
A. Numerical Analysis	-	48 + 12 (Internal Assessment)
B. Linear Programming	-	32 + 8 (Internal Assessment)

**SEMESTER-V**

H-V	-	80+20 Marks
A. Partial Differential Equations	-	48 + 12 (Internal Assessment)
B. Probability	-	32 + 8 (Internal Assessment)

H-VI	-	80+20 Marks
A. Analysis-II	-	48 + 12 (Internal Assessment)
B. Complex Analysis	-	32 + 8 (Internal Assessment)

**SEMESTER-VI**

H-VII	-	80+20 Marks
A. Anyone of the Elective Groups	-	
H-VIII	-	80+20 Marks
A. (i) Discrete Mathematics	-	48 + 12 (Internal Assessment)
(ii) Programming in C (without practical)	-	32 + 8 (Internal Assessment)

**OR**

B. Programming in C (with practical)	-	80 + 20 (Internal Assessment)
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**ELECTIVE GROUPS****GROUP-I**

A. Financial Mathematics	-	48 + 12 (Internal Assessment)
B. Number Theory	-	32 + 8 (Internal Assessment)

**GROUP-II**

A. Mathematical Modelling	-	48 + 12 (Internal Assessment)
B. Mechanics	-	32 + 8 (Internal Assessment)

**GROUP-III**

A. Differential Geometry	-	48 + 12 (Internal Assessment)
B. Operations Research	-	32 + 8 (Internal Assessment)

**SEMESTER-I**

H-I		<b>Term End-80 Internal -20 32 Marks</b>
<b>A. Calculus</b>		

**Unit-I**

Curvature, Asymptotes, Tracing of Curves (Cartenary, Cycloid, Folium of Descartes, Astroid, Limacon, Cissoid and Loops)

**Unit-II**

Rectification, Quadrature, Volume and Surface area of Solids of revolutions.

**Books Recommended:**

1. Text book of Calculus (Part-II)- by Shantinirayan, - S Chand & Co. Chapter 8 (Art 24, 25, 26)
2. Text book of Calculus (Part-III)- by Shantinirayan - S Chand & Co. Chapters: 1 (1, 2), 3, 4 (10-12 omitting Simpson's Rule), 5 (13), 6 (15)

**Reference Books**

- i. Text Book of Differential Calculus: Gorakh Prasad, Pothisala Pvt. Ltd., Allahabad
- ii. Text Book of Integral Calculus: Gorakh Prasad, Pothisala Pvt. Ltd., Allahabad
- iii. A Treatise of Differential Calculus: by J. Edward.
- iv. Differential Calculus: by Das & Mukherjee, U.N. Dhar & Sons. Pvt. Ltd., Calcutta
- v. Integral Calculus: by Das & Mukherjee, U.N. Dhar & Sons Pvt. Ltd., Calcutta
- vi. Advanced Calculus: by David Widder, PHI.

**B. Ordinary differential equations 32 Marks****Unit-III**

Ordinary differential equations of 1st order and 1st degree (Variable Separable, Linear, homogenous, exact), Equations of 1st order and higher degree.

**Unit-IV**

Second order linear equation with constant coefficients; homogeneous forms Second order equation with Variable coefficients, Variation of Parameters, Laplace Transformation and its application to solutions of differential equations.

**Books Recommended:**

1. A Course of Ordinary and Partial differential equations by Dr. J. Sinha Roy and Dr. S. Padhy - Kalyani Publishers. Chapters: 2 (2.1 to 2.7), 3, 4 (4.1 to 4.7), 5, 9 (9.1, 9.2, 9.4, 9.5, 9.10, 9.11, 9.13)

**Reference Books:**

- i. Introductory Course in Differential Equation: by D.A. Murry (Longman)
- ii. Differential Equation and their Application: by Martin Braun, Springer International.

**C. Analytical Solid Geometry 16 Marks****Unit-V****Sphere:**

Plane section of a sphere, Intersection of two Spheres, sphere with a given diameter, Equation of circle, Sphere through a given circle. Intersection of a sphere with a line. Equation of Tangent plane. Angle of intersection of two spheres and condition of orthogonality of two spheres.

**Cones and Cylinders:**

Definition, Equation of a cone with a conic as guiding Curve. Enveloping Cone of a sphere, Condition that the general equation of second degree should represent a cone. Intersection of a line with a cone. The tangent line and tangent planes at a point. Condition of tangency. The Right circular cone, its definition and equation. Definition and Equation of Cylinder Enveloping by cylinders, Definition and Equation of right circular cylinder.

**Conicoid:**

General equation of Conicoid, shapes of some surfaces, central conicoids. Intersection of a line with a conicoid. Tangent line and tangent plane at a point, condition of tangency. The Director sphere.

**Books Recommended**

1. Analytical Solid Geometry:- by Shanti Narayan and P.K. Mittal. (S. Chand & Co.) Chapters: 6(6.3, 6.3.1, 6.3.2, 6.3.3, 6.4, 6.4.1, 6.5, 6.6, 6.6.1, 6.7, 6.7.1) 7(7.1, 7.1.1, 7.1.2, 7.2, 7.4, 7.4.1, 7.4.2, 7.6, 7.6.1, 7.7, 7.7.1, 7.8, 7.8.1, 7.8.2) 8(8.1, 8.2, 8.3.1, 8.3.2, 8.3.3)

**Reference Books:**

- i. An introduction to the theory of quadratic surface by R.N.Das, Kalyani Publishers, New Delhi.
- ii. Textbook of Analytical Geometry of 3 dimensions by P.K.Jain and Khalil Ahmed, Willy Eastern Ltd., New Delhi.

**D. Internal Assessment 20 Marks**

Problems relating to all the five units above.

**SEMESTER-II****H-II**

**Term End-80**  
**Internal -20**  
**48 Marks**

**A. Linear Algebra****Unit-I**

Vector space, subspace, span, Linear dependence and independence, dimensions and basis.

**Unit-II**

Linear transformations, range, kernel, rank, nullity, inverse of a linear map, Rank - nullity theorem, matrices and linear maps, rank and nullity of a matrix, transpose of a matrix, types of matrices.

**Unit-III**

Elementary row operations, system of linear equations, matrix inversion using row operations, minor and rank of matrices, Eigen values, Eigenvectors, Quadratic forms.

**Book Recommended:**

1. An introduction to linear Algebra by V. Krishnamurthy, V.P. Mainra, J.L. Arora (EWP), New Delhi.  
Chapter: 3, 4 (4.1 to 4.7), 5 (except 5.3), 6 (6.1, 6.2, 6.5, 6.6, 6.8), 7 (7.4 only)

**Reference Books:**

- i. Basic structure in Algebra, by J.N. Pattnaik, Kalyani Publisher, Delhi
- ii. Higher Algebra, by A. Kurush, Mir Publication
- iii. Linear Algebra, by S.K. Huffman and R. Kunze, East-West Publisher
- iv. Finite Dimensional Vector Spaces, by Halmos

**B. Modern Algebra 32 Marks****Unit-IV**

The integer, Groups and subgroups, normal subgroups, quotient groups, group homomorphism.

**Unit-V**

- i. Rings, Special types of rings, ideals and quotient rings, right homomorphism.
- ii. Preliminaries, property of equations, Descartes's Rules of Science, Relation between roots and co-efficients, symmetric function of roots, Algebraic solution of cubics, nature of roots of a cubic, solution of cubic by Cardan's method, solution of biquadratic.

**Books Recommended:**

1. Topics in Algebra: by I.N. Herstein, (Vikas Publishing)  
Chapters: 1 (1, 3); 2 (2.1 - 2.3); 3 (3.1 - 3.5)
2. Theory of Algebra: by Chandrika Prasad (Pothisala Publishing)  
Chapters: 11 (11.1 - 11.4); 12 (12.1 - 12.3, 12.6)

**Reference Books:**

- i. Higher Algebra: by A. Kurosh, Mir Publishers
- ii. A first course in Abstract Algebra: by J.B. Fraleigh, Addition Wesley Publ. Comp.

**C. Internal Assessment 20 Marks**

Problems relating to all the five units above

**SEMESTER-III**

H-III Term End-80  
Internal -20

**A. Analysis-I 48 Marks****Unit-I**

Algebra of real numbers, Order completeness (Continuum); Density, decimal representation of real numbers, Cardinality, Countability and uncountability (restricted), Convergence of sequences, Limit theorems, Weierstrass Completeness principle, Cantor's Completeness principle, subsequences and Bolzano-Weierstrass Theorem.

**Unit-II**

Cauchy's Completeness Principle, Convergence of Series and series of Positive terms, Analytic Properties of R and C.

**Unit-III**

Limits and Continuity of functions, Discontinuity, properties of continuous functions, Infinite limits and limit at infinity, Uniform Continuity, Differentiability of functions, Mean-Value theorems, Indeterminate forms, Higher order derivatives and Taylor's theorem.

**Books Recommended:**

1. Fundamentals of Mathematical Analysis - by G. Das and S. Pattnaik (TMH)  
Chapter: 2(2.2. to 2.4; 2.5 to 2.7), 3(3.2, 3.3 (except proofs of Thm.2 and Thm.3), 3.4), 4(4.1 to 4.7, 4.10, 4.11); 5(5.1 to 5.5); 6(6.1 to 6.7, 6.9); 7(7.1 to 7.6).

**Reference Books:**

- i. Mathematical Analysis: by S.C. Mallik, Wiley Eastern, Pvt. Ltd.
- ii. A course of Mathematical Analysis: by Shanti Narayan, P.K. Mittal, S. Chand and Com.

**B. Advanced Calculus: 32 Marks****Unit-IV**

Limits and continuity of a function of several variables, Partial derivatives, Homogenous functions, change of variables, Mean-Value Theorem, Maclaurin's Theorem.

**Unit-V**

Maxima and Minima of a function of two and three variables, (NASC without proof), Lagranges Multiplier, Multiple integral.

Vector differentiation, Grad, div, curl, line integral, surface and volume integrals; Statements of Gauss, Stoke's and Green's theorems (without proof).

**Books Recommended:**

1. Mathematical Analysis - by S.C. Mallick, S. Arora and others. (New-Age International)  
Chapter: 15 (1 to 10), 17, 18.
2. Topics in Calculus - R.K. Panda and P.K. Satapathy.

**Reference Books:**

- i. Advanced Engineering Mathematics: by Erwin Kreyszig, Wiley Eastern Ltd.

**C. Internal Assessment 20 Marks**

Problems from topics Covered under Units I to V above.

**SEMESTER-IV**

H-IV Term End-80  
Internal -20

**A. Numerical Analysis 48 Marks****Unit-I**

Number system and Errors, Binary numbers, Octal numbers, hexa-decimal numbers, Floating point Arithmetic, K-digit Arithmetic, Errors, Sources of Errors. Numerical Solution of non-linear equations, method of bisection, Regula Falsi method, Secant method, Newton - Raphson method, Fixed point iteration method, Aitken's 2-process.

**Unit-II**

Polynomial Interpolation, Existence and uniqueness of interpolating polynomials, Lagrange's Interpolating polynomial, Error in Interpolation, Newton's Divided Difference Interpolating Polynomial, Forward and Backward Difference operators, Newton's Forward Difference Interpolation Formula, Newton's Backward Difference Interpolation Formula. Approximation of Functions, Discrete least square approximation.

**Unit-III**

Numerical Differentiation, Simple Numerical methods, Interpolatory Formulas, Numerical Integration, Simple Quadrature Rules, Newton's-Cotes' Rule, Gauss Quadrature Rule, Gauss - Legendre Rule, Numerical Solution of Differential Equation, Picard's method, Euler's method, modified Euler's method, Runge-Kutta methods.

Remark: Scientific calculator may be allowed for the numerical analysis.

**Books Recommended:**

1. A Course on Numerical Analysis by B.P. Acharya and R.N. Das (Kalyani)  
Chapter: 1;2(2.1 to 2.4, 2.6, 2.8, 2.9); 3(3.1 to 3.4, 3.6 to 3.8, 3.10); 4(4.1, 4.2); 5(5.1, 5.2, 5.3); 6(6.1, 6.2, 6.3, 6.10, 6.11); 7(7.1, 7.2, 7.3, 7.4, 7.7).

**Reference Books:**

- i. Introductory methods of numerical analysis: by G.S.S. Sastry, PHI, ND
- ii. Finite Differences and Numerical Analysis: by H.L. Saxena, S. Chand and Comp.
- iii. Introduction to Numerical Analysis: by F.B. Hildebrend Magraw Hill, NY
- iv. Numerical methods for Scientists and Engineering: by R.G. Stanton, PHI

**B. Linear Programming****32 Marks****Unit-IV**

Linear programming problem: formulation of LP problems, graphical solutions of two variables problems, general formulation of LPP, slack and surplus variables, standard form of LPP, matrix form of LPP, some important definitions, applications of LP.

**Unit-V**

Simplex Method: some more definitions and notations, computational procedure, artificial variable techniques.

**Book Recommended:**

1. Operations research by S.D. Sharma, Kedar Nath Ram Nath and Co., Meerut, Thirteenth Edition (improved and enlarged edition)  
Chapter: 3 (3.1-3.8, 3.11), 5 (5.1-5.5)

**Reference Books:**

- i. Operations Research: by P.K. Gupta, Kanti Swarup, Man Mohan, Sultan Chand and Sons, Dargaganj, New Delhi-110002.
- ii. Operations Research by B.S. Goel and S.K. Mittal, Pragati Prakashani, Meerut.
- iii. Linear programming problem, by S.I. Gauss.
- iv. Linear programming by T.N. Mallik, U.N. Dhar and sons Pvt. Ltd, Calcutta.
- v. Operations Research by Prem Kumar Gupta, S. Mica, S. Chand and Com.

**SEMESTER-V****H-V****Term End-80  
Internal -20****A. Partial Differential Equations****48 Marks****Unit-I**

Ordinary Differential Equations in more than two Variables, Linear Partial Differential Equations.

**Unit-II**

Non-Linear Partial Differential Equations of the First Order, Linear Partial Differential Equations with Constant Co-efficients Equations Reducible to Linear forms.

**Unit-III**

Partial Differential Equations with constant co-efficients, Partial Differential Equations with variable co-efficients, some standard forms of variable co-efficients, Non-Linear Equations of the Second Order.

**Books Recommended:**

1. A course on Ordinary and Partial Differential Equations (with applications) by J. Sinharoy, S. Padhy, Kalyani Publishers.  
Articles: 11.1 to 11.4, 12.1 to 12.6, 13.1 to 13.5, 13.7.

**Reference Books:**

- i. Ordinary and partial diff. Equations: by M.D. Raisinghnia, S. Chand and Com. Ltd., New Delhi

**B. Probability****32 Marks**

**Unit-IV** Axioms of Probability, Conditional Probability and Independence, Random Variables.

**Unit-V** Continuous Random Variables, Jointly Distributed Random Variables, Properties of Expectation.

**Book Recommended:**

1. A First Course in Probability, by Sheldon Ross, Pearson Education  
Chapter-Arts: 2.1 to 2.5, 3.1 to 3.4, 4.1 to 4.7, 4.9, 5.1 to 5.4, 5.7, 6.1 to 6.3, 7.1 to 7.3, 7.6.

**Reference Books:**

1. Probability, Random Variables and Random Process: by P. Kandasamy, K. Thilagavathi, K. Gunavathi, S. Chand and Suar, New Delhi.
2. Elementary Probability Theory with Stochastic Processes: by K.L. Chury, Spriyer Int. Std. Edition.

**C. Internal Assessment****20 Marks**

Problems related to Units-I to IV above.

**H-VI****Term End-80  
Internal -20  
48 Marks****A. Analysis-II**

**Unit-I** Limit Superior, Limit inferior, Absolute Convergence and Conditional Convergence of Series; Power series, Multiplication of Series; Compactness.

**Unit-II** Riemann Integration, Properties of Riemann Integrals, Fundamental Theorem of integral Calculus, Improper integral.

**Unit-III** Pointwise convergence and Uniform Convergence of Series, Uniform convergence and continuity; Term-by-Term integration and differentiation of Series; Power series and Taylor series.

**Book Recommended:**

1. Fundamentals of Mathematical Analysis by G. Das and S. Pattnaik (TMH)  
Chapters: 4 (4.8, 4.12 to 4.15); 5 (5.6); 8 (8.1 to 8.6); 9 (9.1 to 9.7).

**B. Complex Analysis 32 Marks**

**Unit-IV** Complex number, complex plane, complex function, limits and derivatives, cauchy reimann equation, laplace equation, harmonic function, harmonic conjugate, relational function, exponential function, logarithmic function, analytic function, examples of analytic function.

**Unit-V** Complex integration: Cauchy theorem, cauchy integral formula (without proof) independence of path, cauchy inequality, Liou-Ville's theorem, fundamental theorem of algebra, power series, radius of convergence of power series.

**Book recommended:**

- Advanced Engineering Mathematics : by Erwin Kreyszig, Wiley Eastern Pvt. Ltd. Chapter: 12 (12.1-12.8), 13 (13.1-13.4), 14 (14.1-14.3)

**Reference Books:**

- Complex Analysis by S.Arumugam, A.T.Isac and A.Somasundaram (SCITECH)

**C. Internal Assessment 20 Marks**

Problems related to Units-I to IV above.

**SEMESTER-VI****H-VII Term End-80  
Internal -20****Any one group**

(Group-I or Group-II or Group-III from Electives in the Appendix)

**H-VIII (Without practical) Term End-80  
Internal -20****A. DISCRETE MATHEMATICS 48 Marks**

**Unit-I** Logic, Proportional equivalence, predicates and quantifiers, Nested quantifiers, Methods of Proof, Relations and their properties, n-ary relations and their applications, Boolean functions and their representation.

**Unit-II** The basic counting, The Pigeon-hole principle, Generalised permutations and Combinations. Recurrence relations and their solutions, Inclusion- Exclusion and applications.

**Unit-III** Graphs: Introduction, Graph terminology, Representing Graphs and graph isomorphism, Connectivity, Euler and Hamiltonian Path.

**Books Recommended:**

- Discrete Mathematics and its Applications by Kenneth H. Rosen (fifth edition, TMH)  
Chapter: 1 (1.1 to 1.5); 4(4.1, 4.2, 4.5), 6(6.1, 6.2, 6.5, 6.6), 7(7.1, 7.2), 8, 10 (10.1, 10.2).

**B. Programming in C (without practical) 32 Marks**

**Unit-IV** Programming in C, Overview of C, Constant, Variable and Data types, Operators and Expressions, Managing input and output operations, Decision making and Branching, Decision making and looping.

**Unit-V** Arrays, Character Arrays and Strings, User-Defined Functions, Structures and Unions, Pointers.

**Books Recommended:**

Programming in ANSI C by E. Balagurusami, TMH

**C. Internal Assessment 20 Marks**

Problems from each of Unit-I to V above.

**OR****H-VIII (With practical) Term End-80  
Internal -20**

- Writing programmes in C (Two questions from the contents covered in Unit-IV and V above) 20 Marks
- Writing a programme in C and implementing in Computer [One question among the following programmes] 30 Marks
  - Numerical solution of a Non-linear Equation by Newton - Raphson Method
  - Numerical Integration by composite Simpson's Rule.
  - Numerical solution of an initial value problem using second order Runge-Kutta method.
  - Solution of Systems of Linear Equation by Gaussion Elimination Method.
  - Finding product of matrices, searching of primes
  - Fitting of curves using least square method
  - Fitting curves using Lay range and Newton Interpolation method
  - Arranging a given set of number and in ascending or descending order
- Record 10 Marks
- Viva 20 Marks

**Book Recommended:**

Programming in ANSI C: by E. Balagurusami, TMH.

**C. Internal Assessment 20 Marks**

Problems from each of Unit-IV and Unit-V above.



## APPENDIX

## ELECTIVES

## GROUP-I

Term End-80  
Internal -20  
48 Marks

## A. FINANCIAL MATHEMATICS

**Unit-I** Introduction: A simple market mode, Risk free Assets (time value of money, money market)

Risky Assets (Dynamics of stock price, Binomial tree model).

**Unit-II** Discrete Time market models; Portfolio management (Risk, Two and more securities, capital Asset pricing model).

**Unit-III** Forward and Future Contracts, Options (General Properties), Option Pricing, Financial Engineering (Headging option Position).

**Books Recommended:**

Mathematics for Finance, An introduction to Financial Engineering - by Marek Capiski & Tomasz Zastawnian. (Springer 2004 edition)

Chapters: 1, 2, 3 (excluding 3.3), 4 (excluding 4.2), 5, 6, 7, 8, 9 (only 9.1)

## B. NUMBER THEORY

32 Marks

**Unit-IV** Divisibility theorem in integers, Primes and their distributions, Theory of Congruences.

**Unit-V** Fermat's Theorem, Number theoretic Functions, Euler's generalisation of Fermat's theorem, Primitive Roots and Indices; Quadratic Reciprocity Law.

**Books Recommended:**

Elementary Number Theory by - David M Bunton International Edition.

Chapters: 2.1 to 2.4, 3.1 to 3.3, 4.1 to 4.4, 5.1 to 5.4, 6.1 to 6.3, 7.1 to 7.3, 8.1 to 8.2, 9.1 to 9.3.

## C. Internal Assessment

20 Marks

Problems on topics covered in Unit-I to Unit-V above.

OR

## GROUP-II

Term End-80  
Internal -20  
48 Marks

## A. MATHEMATICAL MODELLING

**Unit-I** Simple Situations Requiring Mathematical Modeling, The Technique of Mathematical Modelling, Mathematical Modelling Through Differential Equations, Linear Growth and Decay Models, Non-Linear Growth and Decay Models, Compartment Models, Mathematical Modelling of Geometrical Problems Through Ordinary Differential Equations of First Order.

**Unit-II** Mathematical Modelling in Population Dynamics, Mathematical Modelling of

Epidemics Through System of Ordinary Differential Equations of First Order, Compartment Models Through Systems of Ordinary Differential Equations, Mathematical Modelling in Economics Through Systems of Ordinary Differential Equations of First Order, Mathematical Models in Medicine, Arms Race, Battles and Internal Trade in Terms of Systems of Ordinary Differential Equations, Mathematical Modelling of Planetary Motions, Mathematical Modelling of Circular Motion and Motion of Satellites, Mathematical Modelling Through Linear Differential Equations of Second Order.

**Unit-III** Situations Giving Rise to Partial Differential Equations Models, Mass-Balance Equations: First Method of Getting PDE Models, Momentum-Balance Equations: The Second Method of Obtaining Partial Differential Equations Models, Variational Principles: Third method of Obtaining Partial Differential Equation Models, Probability Generating Function, Fourth Method of Obtaining Partial Differential Equation Models, Model for Traffic Flow on a Highway. Situations that can be Modelled Through Graphs, Mathematical Models in Terms of Directed Graphs, Optimisation Principles and Techniques, Mathematical Modelling Through Calculus of Variations.

**Book Recommended:**

Mathematical Modelling by J.N. Kapur

Chapters: 1 (1.1 and 1.2), 2(2.1 to 2.4, 2.6), 3(3.1 to 3.5), 4(4.1 to 4.3), 6(6.1 to 6.6.), 7(7.1 to 7.2), 9 (9.1 and 9.2).

## B. MECHANICS

32 Marks

**Unit-IV** Method of plane statics, application in plane statics.

**Unit-V** Plane Kinematics, methods of plane dynamics, application in plane dynamics. Motion of a particle and motion of rigid body

**Book Recommended:**

Mechanics - by J.L. Synge and Griffith (Mc. Graw Hill)

Chapters: 2; 3 (excluding 3.3, Cables with smooth and rough curves & 3.5); 4;5 (excluding 5.3); 6(6.1 and 6.2); 7(7.1, 7.2, 7.3, 7.5).

## C. Internal Assessment

20 Marks

Problems on topics covered in Units I to V above.

OR

## GROUP-III

Term End-80  
Internal -20  
48 Marks

## A. DIFFERENTIAL GEOMETRY

**Unit-I** Theory of space curve : Equations, to a curve, arc length of a curve, tangential vector, osculating plane, normal plane and rectifying plane, curvature and frenet formulae, formulae for curvature and torsion and frenet formulae for curvature and torsion, some theorems on curvature and torsion, helices.

**Unit-II** Osculating circle, osculating sphere, spherical indicatrices, involute and evolute, Bertrand curves, coordinates in terms of arc-length, intrinsic equation.

**Unit-III** Theory of surfaces : Introduction, normal line and tangent plane, surface of revolution, characteristics, envelope and edge of regression. Developable surfaces, fundamental differential form, angle between two directions. Family of curves, normal sections, principal direction, asymptotic direction, conjugate directions and geodesic.

**Books Recommended:**

Fundamentals of differential geometry by B.P. Acharya and R.N. Das, Kalyani Publisher, New Delhi  
Chapter-I (1.0-1.17)  
Chapter-2 (2.0-2.12)

**B. OPERATIONS RESEARCH**

**32 Marks**

**Unit-IV** What is Operations Research? The nature and meaning of 'OR', management applications, modelling, main characteristics, main phases of OR study, scope, role of OR, brief outlines of OR-models, role of computers in OR. Assignment problems: mathematical formulation, fundamental theorems, Hungarian method, More illustrative examples.

**Unit-V** Transportation problem: mathematical formulation, matrix form, special structure, loops, initial basic feasible solution, u, v method, Algorithm, computational process, Degeneracy, unbalanced transportation problem.

**Book Recommended:**

Operations Research by S.D. Sharma, Kedar Nath Ram Nath and Co., Meerut, Thirteenth Edition (improved and enlarged edition)  
Chapter: 1 (1.1-1.13 and 1.15)  
Chapter: 11 (11.1-11.5)  
Chapter: 12 (12.1-12.12)

**Reference Books:**

1. Operations Research by P.K. Gupta, Kantiswarup, Man Mohan, Sultan Chand and Sons, Daryaganj, New Delhi-110002.
2. Linear programming problem by S.I. Gauss.
3. Operations Research by B.S. Goel and S.K. Mittal, Pragati Prakashani, Meerut.
4. Linear programming by T.N. Mallik, U.N. Dhar and Sons Pvt. Ltd., Calcutta.

**C. Internal Assessment**

**20 Marks**

Problems on topics covered in Units I to V above.

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**COURSES OF STUDIES  
OPTOELECTRONICS (HONS)**

There shall be six semesters in three years, with two semesters in each year. In first four semesters there shall be four theory papers with mark of 75 in each theory paper. The last two semesters shall have four theory papers in total. There shall be Internal Assessment of 15 and Term-end Examination shall have 60 marks. The second, fourth, fifth and sixth semesters shall have one practical paper each covering the theory of 1st and 2nd paper (Practical-I), 3rd and 4th paper (Practical-II), 5th and 6th paper (Practical-III) and 7th and 8th paper (Practical-IV). All practical paper shall be of 6 hours duration carrying 50 marks each out of which 35 marks allotted to Experiment, 10 marks for Viva-Voce and 05 marks for Record.

Questions are to be set from each UNIT carrying 12 marks each with alternative from the same unit. The question pattern should be such that both derivational and analytical type should be asked in the form of long or short question.

**COURSE STRUCTURE  
FIRST YEAR**

**SEMESTER-I**

H-I GEOMETRICAL & PHYSICAL OPTICS 75 Marks 3 hours

**SEMESTER-II**

H-II BASIC ELECTRONICS 75 Marks 3 hours

Practical-I Practical based on H- I & H-II 50 marks 6 hours

Experiment-30

Viva -10

Record -10

**SECOND YEAR**

**SEMESTER-III**

H-III ATOMIC PHENOMENON OF LIGHT & APPLIED OPTICS 75 Marks 3 hours

**SEMESTER-IV**

H-IV ELECTRONIC INSTRUMENTATION 75 Marks 3 hours

Practical-II Practical based on H-III & H-IV 50 marks 6 hours

Experiment-30

Viva -10

Record -10

**THIRD YEAR**

**SEMESTER-V**

H-V MATERIAL SCIENCE 75 Marks 3 hours

H-VI OPTOELECTRONICS 75 Marks 3 hours

Practical-III Practical based on H-V & H-VI 50 marks 6 hours

Experiment-30

Viva -10

Record -10

**SEMESTER-VI**

H-VII FIBER OPTICS 75 Marks 3 hours

H-VIII LASER PHYSICS 75 Marks 3 hours

Practical-IV Practical based on H-VII & H-VIII 50 marks 6 hours

Experiment-30

Viva -10

Record -10

**SEMESTER-I****H - I (GEOMETRICAL & PHYSICAL OPTICS)**

**Term-end: 60**  
**Internal : 15**

**UNIT-I** Nature of light: light as waves, rays and photons, refractive index velocity of light: Photometry: radiometric and photometric units, inverse square law, Lambert's law, Lummer, Flicker and Photovoltaic photometers, efficiency of a source of light, illumination photometers

**UNIT-II** Fermat's principle, laws of reflection and refraction from Fermat's principle, total internal reflection, prism, minimum deviation, achromatism in prisms, dispersion without deviation, normal and anomalous dispersion, Wood's experiment

**UNIT-III** Wave particle duality, Huygen's principle, superposition of two sinusoidal waves, analytical and graphical methods, coherence Interference by division of wave front: Young's double slit experiment, Fresnel biprism, Newton's rings in reflection and transmission mode, spatial and temporal coherence, optical beats

**UNIT-IV** Polarization: experimental observation, polarization by reflection and refraction, Brewster angle, Malus laws, double refraction, uniaxial and biaxial crystals, optical activity, half shade polarimeter, quarter and half wave plates, production and detection of plane, elliptical and circular polarization of light, John's vectors and matrices Electro-optic magneto-optic and acousto optic effects (qualitative ideas)

**UNIT-V** Matrix methods in optics: paraxial rays, matrix representation of translation, refraction, reflection of light rays, ABCD law, lens wave guide, imaging by thin and thick lens

**Advanced Reading Section** - Optics and photonics in nature

**Reference:**

1. Fundamentals of Physics - Resnik, Halliday , Walker
2. Textbook of Optics - Ajay Ghatak
3. A text book of Optics - N Subrahmanian and Brijlal ( Text)
4. Feynman Lectures
5. Handbook of Optics ( 2Vol) - Michael Bags
6. Principles of Adaptive Optics - R K Tyson
7. Adaptive Optics Engineering Handbook - R K Tyson
8. Meso Optics - L M Soroko

**SEMESTER-II****H -II (BASIC ELECTRONICS)**

**Term-end: 60**  
**Internal : 15**

**UNIT -I** Diodes and their applications: conductors, insulators and semiconductors, elements of semiconductor physics, P-type and N-type semiconductors, P-N junction

diode, diode equation, operation and characteristics of diode, junction capacitance, Zener diode, photo diode, solar cell, varactor diode, LED, rectification, ripple factor, bridge rectifier, filters, voltage multipliers, clippers, clampers

**UNIT-II** Transistors: bipolar junction transistor, PNP and NPN transistors, CE, CB, CC configurations, current gain, leakage current in a transistor, transistor characteristics, Unipolar transistors: FET , FET parameters, JFET, MOSFET operations and their characteristics

**UNIT-III** Transistor biasing: need for biasing, faithful amplification, operation point, bias stabilization, stability factor (definition only), transistor parameters, biasing techniques Voltage regulation using Zener diode and transistor

**UNIT-IV** Transistor amplifier: amplifier classification based on operating point, voltage gain, input and output impedances, frequency responses of RC coupled CE amplifier, Multistage amplifiers, DC, RC and transformer coupled amplifiers, power amplifiers, class A, class B and class C operations, Push Pull amplifiers, feedback amplifiers, gain stabilization by negative feed back, Voltage series feedback, emitter follower, current series feed back.

**UNIT-V** Oscillators: feedback requirements, phase shift oscillator, Hartely crystal oscillator modulation and demodulation: AM and FM modulator demodulators, slope detector, super heterodyne principle (block diagram only), principles of television systems

**References:**

1. Electronic devices and circuit theory - Robert Boylestad and Nashelski
2. Electronics devices and circuits - Allen Motershed (Text)
3. Integrated Electronics - Millman and Halkias
4. Fundamentals of Electronics - Ryder (Text)
5. Microelectronics - Millman and Garbel

**PRACTICAL-I****50 Marks****6 Hours**

1. Angle of minimum deviation of a prism and hence determination of
2. Determination of  $\mu$  by I-D curve method.
3. Newton's ring (determination of  $\mu$ )
4. Grating element
5. V-I characteristics of a P-N junction.
6. Characteristic of triode.
7. Characteristics of transistor.
8. Determination of diameter of narrow wire.
9. Sacharimeter.
10. Brewster's law.

**SEMESTER-III****H-III (ATOMIC PHENOMENON OF LIGHT & APPLIED OPTICS) Term-end: 60****Internal : 15**

**UNIT-I** Fluorescence and phosphorescence, thermoluminescence, Thermo optic spectroscopy, thermal lens, photoacoustic and photothermal deflection techniques (introductory ideas only), multi photon spectroscopy (introductory ideas).

**UNIT-II** Maxwell's equations in vacuum and in dielectric media, vector and scalar potentials, gauges transformations, Lorentz and Coulomb gauges, solution of Maxwell's equations in vacuum and dielectric media, Poynting theorem, conservation of energy and momentum, Poynting vector

**UNIT-III** Reflection and refraction of EMW at dielectric boundaries, Snell's law, Brewster law, absorption and dispersion of EMW, skin effect, anomalous dispersion, wave packets, group velocity, metallic waveguides, Q-factor, radiating fields and antennas

**UNIT-IV** Photometry and radiometry: photometric and radiometric quantities, colour temperature, standardization of sources, theory of vision, visual basis of colorimetry Light sources: filament lamps, halogen and fluorescent lamps, low pressure sodium and high pressure discharge lamps, all-solid-state lamps, high brightness LED, light extraction from LED, White solid-state lamps, applications of solid-state lamps

**UNIT-V** Stress induced optical anisotropy: EO effect: Pockel's and Kerr effect, Photoelastic effect and applications, Magneto optic and acousto optic effects, Raman-Nath and Bragg scattering, Faraday effects, application to modulation, e-o and m-o materials

**References:**

1. Atomic Spectra - White (Text)
2. Thermo optic effect - Sell
3. Handbook of Applied Photometry - C de Cusatis (Text)
4. Introduction to Solid-state Lighting - Zukauskas, Shur, Caska (Text)
5. Contemporary Optics - Ghatak and Thyagarajan

**SEMESTER-IV****H-IV (ELECTRONIC INSTRUMENTATION)****Term-end: 60****Internal : 15****UNIT-I**

DC and AC deflection instruments, current meters, ohmmeters, multimeters, hotwire ammeters, rectifier instruments, comparison measurements, potentiometers, automated comparison circuits digital instruments, binary and decimal counters, display devices, frequency and period counters electronic multimeters, electronic ohmmeters and digital voltmeters.

**UNIT-II** Oscilloscopes: deflection systems, X-Y and Y-t oscilloscopes, triggered sweep,

sensitivity, bandwidth rise time, dual beam models, storage oscilloscope, digital storage oscilloscopes, sampling oscilloscopes recording systems: X-t and X-Y recorders

**UNIT-III** Tuned amplifiers: chopper stabilized amplifiers, measurements on untuned and tuned amplifier circuits, lock-in-amplifier, voltage gain and output power measurements, testing tuned circuits, spectrum analyzers, BOX CAR averager

**UNIT-IV** Transducers: transducers and transduction, strain gauges, temperature transducers, inductive transducers, LVDT, position-displacement, velocity, acceleration, force, pressure and capacitive transducers data converters: DAC and servo ADC circuits, parallel converters, voltage to frequency converters

**UNIT-V** Probes and connectors: test leads, shielded cables, connectors, low capacitance probes, high voltage probes, special probes for IC circuits Micro computers: advantages of microcomputers, microcomputer interfacing, microcomputers in instrument and system design, introduction to GPIB

**References:**

1. Elements of Electronic Instrumentation and Measurement - J J Car (Text)
2. Industrial Solid State Electronics: Devices and Systems - T J Maloney

**PRACTICAL-II****50 Marks****(6 Hours duration)**

- 1) Diffraction from single slit (use of basic LASER kit)
- 2) Diffraction from a wire and measurement of its diameter (use of basic LASER kit)
- 3) Study of Gaussian nature of LASER beam.
- 4) Beam spot measurement.
- 5) Divergence measurement.
- 6) Polarisation of light and verification of Malus law (use of standard LASER Kit)
- 7) Determination of refractive index of transparent (material by finding Brewster angle (use of standard LASER kit)

**SEMESTER-V****H-V (MATERIAL SCIENCE)****Term-end: 60****Internal : 15****UNIT-I**

Crystal symmetry and crystal systems: translational vectors and lattices, unit cell, Miller indices, symmetry operations, reciprocal lattices, hexagonal close packed structure, NaCl, CsCl, diamond and ZnS structures X-ray diffraction and Bragg's law, Powder diffraction, different types of bonding in crystals, Vandervaal's, ionic, covalent and hydrogen bonds.

**UNIT-II**

Band theory of solids: density of states, Fermi level, origin of bands, classification of materials based on band gap, electrical conduction in metals and semiconductors, effect of doping on Fermi level in semiconductors.

**UNIT-III**

Lattice vibrations: phonons, phonon spectra of monatomic and diatomic linear lattices, scattering of phonons by neutrons, experimental techniques to get phonon spectra, lattice heat capacity, Einstein's Model, Debye's Model

**UNIT-IV**

Superconductivity: types of superconductors, Meissner effect, isotope effect, BCS theory, Josephson effect, SQUID, high temperature superconductors, applications Dielectric properties of solids: polarisability, ferroelectric crystals, magnetic properties of solids, dia, para and ferro magnetism, ferromagnetic domains, hysteresis, BH curve, adiabatic demagnetization

**UNIT-V**

Optical properties of solids: luminescence in solids, photo and electro luminescence, colour centers, fluorescence and phosphorescence, thermo luminescence, effect of doping, luminescence of rare earth doped phosphors, applications

**References:**

1. Solid State Physics - Kittel (Text)
2. Introduction to Solids - Azaroff
3. Text Book of Solid State Physics - S O Pillai
4. Problems in Solid State Physics - S O Pillai

**H-VI (OPTOELECTRONICS)**

**Term-end: 60**  
**Internal : 15**

**UNIT-I**

Electronic properties of semi conductors: effect of pressure and temperature on band gap, density of carriers in intrinsic and extrinsic semiconductors, consequence of heavy doping, conduction processes in semiconductors, electron-hole pair formation and recombination, PN junction, carrier recombination and diffusion, injection efficiency, heterojunction, internal quantum efficiency, double heterojunction, quantum well, quantum dot and superlattices

**UNIT-II**

Optical properties in semiconductors: exciton absorption, donor-acceptor and impurity band absorption, long wavelength absorption, Franz-Keldysh and Stark effect, absorption in quantum wells and quantum-confined Stark effect, Kramer-Kronig relations, Stokes shift in optical transitions, luminescence from quantum wells

**UNIT-III**

Optoelectronic devices: LED, LED materials, device configuration and efficiency, light output from LED, LED structure, device performance characteristics, manufacturing process of LED and applications, laser diode, threshold current and power output, heterojunction lasers, distributed feedback lasers, cleaved-coupled-cavity laser, quantum

well lasers, surface emitting and rare earth doped lasers, laser mounting and fibre coupling, mode locking of SC

**UNIT-IV**

Photodetectors: thermal detectors, photoconductors, junction photodiodes, avalanche photo diode, optical heterodyning and electro-optic measurements, fibre coupling, phototransistor, modulated barrier photo diode, Schottky barrier photo diode, MSM photo diode, detectors for long wavelength operation, micro cavity photo diode. Solar cells: I-V characteristics and spectral response, materials and design considerations of solar cells

**UNIT-V**

Display devices: photoluminescence, electroluminescence and cathodoluminescence displays, displays based on LED, plasma panel and LCD Optoelectronic modulation and switching devices: analog and digital modulation, Franz-Keldysh and Stark effect modulator, quantum well electro-absorption modulators, electro-optic, acousto-optic and magneto-optic modulators, SEED

**References:**

1. Semiconductor Optoelectronic Devices - Pallab Bhattacharya (Text)
2. Optoelectronics- An Introduction - J Wilson and J F B Hawkes
3. Optical Fibre Communication - J M Senior
4. Semiconductor Optoelectronics - Jasprit Singh

**PRACTICAL -III 50 Marks****6 Hours****(6 Hours duration)**

Candidate has to perform one experiment chosen through lottery

**List of experiments**

- 1) Diffraction of LASER light by meter scale ruling and wave length measurement (use of optoelectronic kit)
- 2) Beam spot measurement (use of Optoelectronic kit)
- 3) Divergence measurement (use of Optoelectronic kit)
- 4) Numerical aperture of optical fibre.
- 5) Characteristics of photo transistor.
- 6) Determination of bandgap.
- 7) Determination of conductivity of semiconductor by 4 probe method.

**SEMESTER-VI****H-VII (FIBER OPTICS)**

**Term-end: 60**  
**Internal : 15**

**UNIT-I**

Optical waveguides: numerical aperture, modes in planar waveguides, Goos-Hanschen effect, evanescent field, cylindrical fibres, step index and graded index fibres, single

mode and multimode fibres, cut of wavelengths, channel waveguides, electro optic waveguides, i/p and o/p couplers, e-o and m-o modulators applications of integrated optics: lenses, grating, spectrum analyzers

**UNIT-II**

Transmission characteristics of optical fiber: attenuation, absorption and scattering losses, nonlinear losses, wavelengths for communication, bend losses, dispersion effects in optical fibres, material and waveguide dispersions, modal birefringence and polarization maintaining fibres

**UNIT-III**

Optical fibre measurements: attenuation, loss-dispersion band width, refractive index profile, OTDR, testing of optical fibre systems, eye pattern techniques Fabrication and characterization of polymer fibres and holey fibres, erbium doped fibres

**UNIT-IV**

Fibre optic sensors: intensity modulation and interference type sensors, intrinsic and extrinsic fibres, polarization modulation type sensors, Sagniac and fibre gyro, temperature, pressure, force and chemical sensors.

**UNIT-V**

Fibre components: couplers, connectors, packaging Fibre optic communication: basic principle, WDM Telemetric, industrial, medical and technological applications of optical fibre

**References:**

1. Optical Fibre Communication - J M Senior (Text)
2. Optical Fibre Communication systems - J Gowar
3. Fibre optic Communication - J Palais
4. Fundamentals of Fibre Optic Telecommunication - B P Pal
5. Integrated Optics - R G Husperge
6. Fundamentals of Fibre Optics - B P Pal

**H-VIII (LASER PHYSICS)**

**Term-end: 60**  
**Internal : 15**

**UNIT-I**

Radiative transitions and emission linewidths, radiative decay of excited states, homogeneous and inhomogeneous broadenings, absorption, spontaneous and stimulated emissions, Einstein's A and B coefficients, absorption and gain of homogeneously broadened radiative transitions, gain coefficient and stimulated emission cross section for homogeneous and inhomogeneous broadening

**UNIT-II**

Necessary and sufficient conditions for laser action (population inversion and saturation intensity), threshold requirements for laser with and without cavity, laser amplifiers, rate

equations for three and four level systems, pumping mechanisms

**UNIT-III**

Laser cavity modes: longitudinal and transverse modes in rectangular cavity, FP cavity modes, spectral and spatial hole burning, stability of laser resonator and stability diagram, unstable and ring resonators

**UNIT-IV**

Q-switching and mode locking, active and passive techniques, generation of giant pulses and pico second optical pulses, properties of laser beam and techniques to characterize laser beam

**UNIT-V**

Generation of ultra fast optical pulses: pulse compression, femto-second optical pulses, characterization of femto second pulses, Semi classical theory of lasers: polarization in the medium, first order theory

**References:**

1. Laser Fundamentals - W T Selfvast (Text)
2. Laser Electronics - J T Vardeyan
3. Lasers: Theory and Applications - Ghatak and Thyagarajan (Text)
4. Principles of lasers - Svelto
5. Solidstate laser engineering - Koechner
6. Laser Physics - Tarasov

**PRACTICAL -IV****50 Marks****6 Hours****List of experiments**

- 1) Characteristics of photo diode.
- 2) Characteristics of light dependent resistor (LDR)
- 3) Characteristics of solar cell.
- 4) Characteristics of light emitting diode (LED).
- 5) Characteristics of optocoupler
- 6) To set up Michelson interferometer out of individual components, observation of fringes and determination of wave length.

\* \* \* \* \*

**PHYSICS (PASS)**

There shall be four semesters in two years with two semesters in each year. In each semester there shall be one theory paper of 75 marks. There shall be internal assessment of 15 marks and Term-end Examination shall have 60 marks. There shall be one question (long/short/numerical problems) from each unit with alternative from the same unit. The second and fourth semester shall have practical papers with 50 marks each. All practical paper shall be of 6 hours duration.

**FIRST YEAR****SEMESTER-I**

P-I Mechanics, properties of Matter, Heat and Thermodynamics 75 marks 3 hours

**SEMESTER-II**

P-II Oscillation, Optics and Relativity 75 marks 3 hours  
 Practical-I Practical 50 marks 4 hours

**SECOND YEAR****SEMESTER-III**

P-III Electricity, Electronics and Electromagnetic theory 3 hours

**SEMESTER-IV**

P-IV Atomic and Nuclear Physics, Quantum Mechanics and Solid State Physics 75 marks 3 hours  
 Practical-II Practical 50 marks 4 hours

**SEMESTER-I**

**P-I Mechanics, Properties of Matter, Heat and Thermodynamics**

**Term-end: 60**

**Internal : 15**

**Unit-I Vectors**

Triple Scalar product. Triple vector product, Gradient, Divergence, Curl operations, Differentiation of vectors, line, surface and volume integration of vectors, Gauss divergence theorem.

**Unit-II** Rotational motion, parallel and perpendicular axis theorem of moment of inertia, Moment of inertia of solid cylinder and spheres, compound pendulum, Kepler's laws of planetary motion, Gravitational field and potential.

**Unit-III** Elastic constants and their relations, torsion of a right circular cylinder, Bending of beams, surface tension, surface energy, pressure difference across a curved surface, viscous flow, Poiseuille's equation.

**Unit-IV** Zeroth law of thermodynamics and concept of temperature, 1st law of thermodynamics, internal energy, and applications, Second law of thermodynamics.

Kelvin, planck and clausius formulations and their equivalence, Camot cycle and efficiency of carnot engine, Kelvin's scale of temperature, concepts of entropy and T.S. diagram.

**Unit-V** Maxwell's thermodynamic relation, phase change, clausius - clapeyron's equation, Joule - Thomson effect, porous plug experiment, production of low temperature.

**SEMESTER-II**

**P-II Oscillation, Optics and Relativity**

**Term-end: 60**

**Internal : 15**

**Unit-I** Simple harmonic motion, Damped harmonic motion, power loss, Q-factor, overdamped, under damped and critically damped motion, forced vibration, Resonance, wave equation for progressive wave, velocity of longitudinal and transverse waves in elastic medium, Laws of transverse vibration of stretched strings.

Composition of SHM, Lissajous figures.

**Unit-II** Co-axial system of two thin lens, Cardinal points of combination of two thin lens and thick lens, chromatic and spherical aberration, Huygen's and Ramsden's eyepieces.

**Unit-III** Huygen's principle, Interference due to a biprism, bimirror, Newtons rings, Michelson's Interferometer, Fraunhoffer and Fresnel diffraction, Zone plate, Diffraction at a single slit, double slit and grating, Resolving power of a grating.

**Unit-IV** Polarization by reflection, Brewster's law, Double Refraction, Construction and use of Nicol Prism.

**Unit-V** Michelsons Morley's experiment, postulates of special theory of relativity, Lorentz transformation, length contraction and time dialation, variation of mass with velocity, Equivalence of mass and Energy.

**Practical-I (Practical)**

**50 Marks**

**4 Hours**

(One experiment either from the group to be performed by lottery)

Experiment	-	30
Viva	-	10
Record	-	10

**Group 'A'**

**Experiments relating to:**

- 1) Accurate weighing with a balance applying Buoyancy Correction.
- 2) Young's modulus of a wire by Searle's method.
- 3) Surface tension of liquids (Capillary method)
- 4) Bar Pendulum with movable knife edge.
- 5) Rigidity modulus : Static method.
- 6) Poission's ratio of rubber.

- 7) Specific Heat of liquids (Method of cooling).
- 8) Velocity of sound by resonance method avoiding end correction.
- 9) Sonometer - Verification of Laws of transverse, Vibration of strings.

**Group 'B'****Experiments relating to:**

- 1) Refractive index of liquid and solid (Traveling Microscope method).
- 2) Refractive index of liquids (Plane mirror convex lens methods).
- 3) Kachlrausch's method.
- 4) E.C.E. of Copper.
- 5) Comparison of capacities by Desauty's method.
- 6) Figure of merit of a galvanometer. (Galvanometer with lamp & Scale)
- 7) End correction of meter bridge. Galvanometer with lamp and scale should be used.

**SEMESTER-III**

**P-III Electricity, Electronics and Electromagnetic Theory Term-end: 60**  
**Internal : 15**

**Unit-I**

Electrostatic field and potential, Gauss law in electrostatic and application to compute electrostatic field due to linear, spherical and plane charge distribution, Differential form of Gauss law, electrostatic energy of discrete and continuous charge distribution, energy density, Gauss law in dielectric, electric displacement vector D in dielectric, Dielectric constant.

**Unit-II**

Transient phenomena, Growth and decay of current in L-R, L-C and L-C-R Circuit, Ballistic Galvanometer, AC in LR and LCR Circuit, phase diagram, impedance, power factor, watt less current and resonance.

**Unit-III**

Magnetic Induction B, Lorentz force on a charged particle, Biot-savart's Law, Ampere's Circutal law in differential form, magnetic field due to a current carrying conductor, Faraday's law of electro magnetic induction in differential form, self and mutual induction.

**Unit-IV**

Crystal diodes, PNP and NPN transistors, half wave and full wave rectifier, Efficiency, Ripple factor, Amplifier in CE, CB and CC modes, Feedback amplifier - positive and negative, Criteria for sustained oscillation - Harley and Colpitt Oscillation VTVM, CRO and their application, modulation and demodulation.

**Unit-V**

Electromagnetic waves, production and properties, Maxwell's Electromagnetic equations and their physical significance, wave equation, pointing vector.

**SEMESTER-IV**

**P-IV Atomic & Nuclear Physics, Quantum Mechanics & Solid-state Physics**

**Term-end: 60**  
**Internal : 15**

**Unit-I** Measurement of charge mass of electron. Millikan's and Thomson's experiment, Rutherford's scattering formula. Bohr's model of the atom, stationary states, energy levels and spectra of hydrogen like atoms. Bohr's correspondence principles.

**Unit-II** Quantisation of angular momentum, Zeeman effect, Raman effect, characteristics of continuous X-ray spectra, Mosley's law, photo electric effect, Compton scattering.

**Unit-III** Properties atomic nucleus, mass defect, Binding energy, stability of nucleus, Law of radioactive decay, linear accelerator, cyclotron.

**Unit-IV** Inadequacy of classical physics, Black body radiation, de-Broglie hypothesis, Davison-Germer experiment, Uncertainty principle, Group velocity, wave velocity, schrodinger wave equation for one dimensional barrier, particle in a box.

Quantum mechanical operation.

**Unit-V** Elementary theory of crystal structure, types of lattices, crystal bonding, unit cell, Miller indices, Reciprocal lattices, Brag's law and X-ray diffraction.

**Practical-II (Practical) 50 Marks 4 Hours**

(One experiment either from the group to be performed by lottery)

Experiment	-	30
Viva	-	10
Record	-	10

**Group 'A'**

- 1) Rigidity modulus of a wire (Dynamic method).
- 2) Surface tension of liquids (Weighing drop method).
- 3) Viscosity by capillary flow method.
- 4) Young's modulus of a beam loaded at the middle.
- 5) Moment of inertia of rotating / rolling solid cylinder.
- 6) Joule's Calorimeter (Radiation correction).
- 7) Weight Thermometer.
- 8) Surface tension of mercury by Quinik's method.
- 9) Latent heat of wax cooling method.

**Group 'B'**

- 1) Angle of prism and minimum deviation of the prism (Spectrometer).
- 2) I.D. curve using a spectrometer.



- 3) Newton's Ring
- 4) Diffraction Crating.
- 5) Galvanometer resistance by Kelvin's method.
- 6) Comparison of two resistances.
- 7) Comparison of E.M.F. by stretched wire, Potentic meter.
- 8) V.I. characteristics of a PN Junction. (Galvanometer with lamp and scale should be used)

**Books Recommended :**

- |                                |                           |
|--------------------------------|---------------------------|
| 1) Classical Mechanics         | : Gupta Kumar Sharma      |
| 2) Properties of Matter        | : D.S.Mathur              |
| 3) Heat & Thermodynamics       | : Zeemansky               |
| 4) Modern Physics              | : Sohgal Chepter a Seghal |
| 5) Math. Physics               | : Satya Prakash           |
| 6) Math. Physics               | : Rajput and Gupta        |
| 7) Optics & Atomic (Physics)   | : Satya Prakash           |
| 8) Optics                      | : B.K.Mathur              |
| 9) Modern Physics              | : S.H.Patil               |
| 10) A.T.B. of Sound            | : Saishal                 |
| 11) Quantum Mech.              | : Ghatak                  |
| 12) Quantum Mech.              | : Schawal                 |
| 13) Electronics I & II         | : B.B.Swain               |
| 14) Electricity & Mag.         | : Brijlal & Subramanyam   |
| 15) Advanced Practical Physics | : Ghosh                   |
| 16) B.Sc. Physics              | : K.N.Sharma              |
| 17) Properties of Matter       | : Brijlal & Subramanyam   |
| 18) Modern College Physics     | : Das, Barik, Sharma      |
| 19) Atomic Physics             | : J.B.Rajan               |

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**PHYSICS (HONOURS)**

There shall be six semesters in three years, with two semesters in each year. In first four semesters there shall be four theory papers with mark of 75 in each theory paper. The last two semesters shall have four theory papers in total. There shall be internal assessment of 15 marks and Term-end Examination shall have 60 marks. There shall be one question(long/short/numerical problems) from each unit with alternative from the same unit. The second, fourth, fifth and sixth semester shall have one practical each: Practical-I, Practical-II, Practical-III and Practical-IV respectively, carrying 50 marks each. All practical paper shall be of 6 hours duration.

**FIRST YEAR****SEMESTER-I**

H-I	Mechanics, Properties of Matter and Sound	75 Marks	3 hours
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**SEMESTER-II**

H-II	Heat and Thermodynamics, Statistical Physics	75 Marks	3 hours
Practical-I	Practical	50 Marks	6 hours

**SECOND YEAR****SEMESTER-III**

H-III	Geometrical & Physical Optics	75 Marks	3 hours
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**SEMESTER-IV**

H-IV	Mathematical Physics and Special Theory of Relativity	75 Marks	3 hours
Practical-II	Practical	50 marks	6 hours

**THIRD YEAR****SEMESTER-V**

H-V	Electricity and Magnetism, Electromagnetic Theory	75 Marks	3 hours
H-VI	Electronics and Laser Physics	75 Marks	3 hours
Practical-III	Practical	50 Marks	6 hours

**SEMESTER-VI**

H-VII	Atomic Physics and Quantum Mechanics	75 Marks	3 hours
H-VIII	Nuclear and Particle Physics, Solid State Physics	75 Marks	3 hours
Practical-IV	Practical	50 Marks	6 hours

## DETAILED COURSE

**SEMESTER-I**H-I **Mechanics, Properties of Matter and Sound**Term-end: 60  
Internal : 15**A) Mechanics**

**Unit-I** Mechanics of a particle and system of particles, Generalised coordinate. D'Alembert's principle and Lagrange's equation, simple application. Hamilton's principle and Lagrange equation. Conservation theorems and symmetry properties.

**Unit-II** Two body central force problem, Equivalent one body problem. Equation of motion and first integral. The equivalent one-dimensional problem and classification of orbit. The differential equation for the orbit and integrable power law/potentials. Deduction of Kepler's law. Rutherford scattering cross section. Rotation of rigid bodies about an axis, simple and compound pendulum. Moment of Inertia of simple objects. Sphere and rectangular lamina.

**B) Properties of Matter**

**Unit-III** Gravitational field and potential due to a spherical shell and sphere.

Elasticity : Relation among elastic constants, Bending of beams. Torsion of rigid circular cylinder, vibration of loaded spring and beam.

**Unit-IV** Surface tension and surface energy, effect of temperature. Pressure difference across a curved surface. Shape of a large drop, Quincke's method to determine surface tension. Velocity of gravity waves, capillary waves and ripples.

Fluid motion, viscosity of liquids and gases. Poiseuille's equation. Stoke's theorem, Searle's viscometer.

**C) Sound**

**Unit-V** Velocity of longitudinal waves in elastic medium. Superposition of SHM, coupled oscillation, Lissajous figure. Vibration of string, theory of struck, plucked and bowed string.

Ultrasonics - production by Glazstone whistle and piezoelectric crystal method and application. Damped and forced vibration, Resonance.

**PAPER-I**

- |                                  |   |                     |
|----------------------------------|---|---------------------|
| 1. Classical Mechanics           | - | H. Goldstein        |
| 2. Mechanics                     | - | K.R. Simon          |
| 3. Properties of matter          | - | D.S. Mathur         |
| 4. Properties of matter          | - | Newman and Searle   |
| 5. Sound                         | - | M. Ghose            |
| 6. Physics for Degree students-I | - | Das Jena and Others |
| 7. Classical mechanics           | - | Kiran Chand Gupta   |

**SEMESTER-II**H-II **Heat and Thermodynamics, Statistical Physics**Term-end: 60  
Internal : 15**Unit-I Heat and Thermodynamics**

Differential form of 1st law, Reversible and irreversible process. Concept of entropy of an ideal gas, T-S diagram, change of entropy in various processes in an ideal gas. Cyclic processes, Carnot cycle, calculation of efficiency. Kelvin formulation and Clausius formulation of 2nd law of thermodynamics. Equivalence of these two formulations. Carnot theorem. Kelvin's temperature scale. Equivalence of ideal gas temperature and Kelvin's temperature. Entropy and reversibility, Entropy and irreversibility principle of increase of entropy, Entropy and unavailable energy.

**Unit-II Heat and thermodynamics**

Thermodynamic functions : Helmholtz and Gibbs functions, enthalpy, Maxwell's thermodynamic relations : 1st Tds and 2nd Tds equations. 1st energy and 2nd energy equations. Heat capacity equation. Clausius Clapeyron's equation. Joule's Thomson effect. Porous plug experiment. Inversion temperature. 3rd law of thermodynamics.

**Unit-III** Vanderwaal's equation of state. Critical phenomena. Reduced equations of state. Mean free path, Clausius formula. Brownian motion (Einstein Theory). Thermoelectricity - Seebeck and Peltier effect, Thomson effect.

**Unit-IV Conduction in solids:** Differential equation of heat flow, Thermal conductivity, Lees method of determination of thermal conductivity.

Radiation : Radiation pressure, Kirchoff's and Stefan's law of radiation Black body radiation, spectral distribution Wein's law, Raleigh Jean's law. Planck's law and Planck's quantum theory. Einstein and Debye's theory of specific heat of solids.

**Unit-V Statistical Physics**

Equilibrium distribution, Entropy and thermodynamic probability, Micro Canonical and Canonical ensembles, Partition function, Maxwell Boltzmann statistics, Partition function of ideal monoatomic gas, Entropy of a classical ideal gas and Gibbs paradox. Equipartition of energy. Maxwell Boltzmann molecular speed distribution. Entropy and disorder. Limitation of classical statistics.

**BOOKS RECOMMENDED**

- |                            |   |                         |
|----------------------------|---|-------------------------|
| 1. Treatise on Heat        | - | Saha and Srivasthav     |
| 2. Heat and Thermodynamics | - | A.B. Gupta and H.P. Roy |
| 3. Heat and Thermodynamics | - | Raxhit                  |

**Practical-I (Practical)****50 Marks****Experiments relating to :**

1. Kater's Pendulum
2. 'Y' by bending of beam loaded at the middle.
3. 'n' by dynamic method.

4. Moment of inertia of a rolling / rotating cylinder.
5. Surface tension of soap solution (soap bubble).
6. Viscosity by capillary flow method.
7. Co-efficient of cubical expansion of water by sinker.
8. Thermal conductivity by Lee's method.
9. Absolute determination of frequency of a tuning fork by sonometer.
10. Specific heat of solids by radiation correction.
11. Weight thermometer.
12. Latent heat of wax by cooling.
13. Verification of law of length of transverse vibration of a stretched string and have to determine the unknown frequency of a tuning fork.

### SEMESTER-III

H-III Geometrical & Physical Optics

Term-end: 60  
Internal : 15

#### A) Geometrical Optics

**Unit-I** Fermat's principal. Derivation of law of reflection and refraction. Cardinal points of optical system. Cardinal points in case of thin lenses separated by a distance in air. Cardinal points of thick lens.

**Unit-II** Defects of images : Spherical and chromatic aberration and their remedies. Achromatism. Elementary idea about coma, astigmatism and distortion. Huygen's and Ramsden's eyepiece. Theory of primary and secondary rainbow.

#### B) Physical Optics

**Unit-III** Interference - Superposition of waves of (i) equal phase and frequency and (ii) Constant phase difference. Intensity distribution in the interference pattern. Condition of interference. Fresnel's Biprism.

Interference by a plane parallel film illuminated by a plane wave. Interference by a plane parallel film illuminated by a point source. Interference with two nonparallel reflecting surfaces. Colour of thin films. Newton's ring. The Michelson interferometer. Determination of wavelength with Newton's ring. Determination of wavelength of Na light by using Michelson interferometer. Fabry-Perot interferometer and its resolving power. Determination of wavelength of mono-chromatic light using it.

#### Unit-IV Diffraction :-

Fresnel diffraction. Fresnel half period zone, zone plate as convex lens. Diffraction at a straight edge. Fraunhofer diffraction. Diffraction at a single slit, double slit, plane diffraction grating. Limit of resolution. Resolving power of microscope, telescope and grating.

#### Unit-V Polarisation

Polarized and unpolarised light. Polarization by reflection, double refraction and scattering.

Malu's law, Brewster's law. Huygen's construction of wave fronts in uniaxial crystal. Nicol prism. Halfwave and quarterwave plates. Mathematical analysis of plane polarized light, circular polarized light and elliptically polarized light. Circular and elliptically polarized light by a quarter wave plate. Babinet compensator. Optical rotation, principle of saccharimetry. Fresnel's explanation, Laurent polarimeter.

### BOOKS RECOMMENDED

- |                                    |                                  |
|------------------------------------|----------------------------------|
| 1. Optics                          | - Brijlal and Subramanjan        |
| 2. Optics                          | - B.K. Mathur                    |
| 3. Optics                          | - A Ghatak                       |
| 4. Geometrical and Physical Optics | - P.K. Chakrabarty               |
| 5. Geometrical and Physical Optics | - K.G. Majumdar                  |
| 6. Physics for Degree Students-III | - Bhuyan, Mishra, Das and Others |

### SEMESTER-IV

H-IV Mathematical Physics and Special Theory of Relativity

Term-end: 60  
Internal : 15

#### A) Mathematical Physics

**Unit-I** Scalars and vectors, transformation properties, scalar and vector product. Triple scalar product, triple vector product. Differentiation of vectors - Grad, Div, Curl and Laplacian. Line, surface and volume integrals. Gauss Divergence theorem, Stoke's and Green's Theorem. Cartesian, spherical and cylindrical coordinate system. Relation between their basis vectors. Expression for Grad, Div, Curl and Laplacian in different coordinate systems.

**Unit-II** Complex Algebra : Analytic functions, Cauchy Reimann conditions, Cauchy's theorem, Cauchy's integral formula, Taylor and Laurent series, singularities, simple poles, Residues and its calculation, residue theorem, calculation of simple integrations (excluding branch cuts).

**Unit-III** Power series solutions of differential equation (Frobenius method) of Legendre, Bessel and Hermite equations. Hermite functions. Generating functions of Hermite Polynomials, Recurrence relation and properties, orthogonality. Legendre polynomials generating function, recurrence relations, orthogonality, Rodrigue's formula, Associated Legendre polynomials, spherical harmonics.

**Unit-IV** Beta function, Gamma function, Fourier series, Fourier Cosine and sine series. Fourier integral, complex form of Fourier series. Fourier transform cosine and sine transform. Transformation of derivatives, convolution theorem, Parseval relation, Laplace transform.

#### B) Special Theory of Relativity

**Unit-V** Michelson Morley experiment and its implications. Postulates of special theory

of relativity. Lorentz transformation and concept of four vectors. Simultaneity and order of events. Lorentz contraction and time dilation. Relativistic addition of velocities, variation of mass with velocity. Mass energy relation. Relativistic Doppler effect. Relativistic kinematics, transformation of energy and momentum.

#### BOOKS RECOMMENDED

1. Mathematical Method for Physics - G. Arfken
2. Mathematical Physics - Gupta and Rajput
3. Mathematical Physics - Satya Prakash
4. Mathematical Physics - Dr. Nayak
5. Mathematical Physics and Special Relativity - M. Das, P.K. Jena and B.K. Das

#### PRACTICAL-II (Practical)

50 Marks

##### Experiments relating to :

- 1) Diameter of a narrow wire.
- 2) Diffraction grating.
- 3) Molecular rotation of sugar solution.
- 4) Resolving power of a telescope.
- 5) Resolving power of a grating.
- 6) Diffraction pattern due to a single slit.
- 7) Cauchy's constant of a prism.
- 8) Newton's ring.
- 9) Comparison of e.m.f. using stretched wire potentiometer.
- 10) Comparison of two nearly equal resistances.
- 11) Constant of a ballistic galvanometer.
- 12) Measurement of high resistance by leakage.
- 13) Static characteristic of a triode.
- 14) Characteristic curves for a transistor.
- 15) I.D. curve of prism by spectrometer.

### SEMESTER-V

**H-V Electricity and Magnetism, Electromagnetic Theory** Term-end: 60  
Internal : 15

#### A) Electricity and Magnetism

**Unit-I** Coulomb's law, Electric field and potential, Gauss law and application - field due to linear, spherical and plane charge distribution. Poisson's and Laplace's equation for potential, solution of Laplace's equation in spherical coordinate. Conducting sphere in uniform field. Potential due to an arbitrary charge distribution.

**Unit-II** Dielectrics, Electric fields in matter, Atomic and molecular dipoles, induced dipoles. Polarizability tensor, electronic and molecular contribution, electric field caused by

polarized matter, E and D fields, permittivity dielectric constant field of a polarized sphere, Dielectric sphere in a uniform field. Energy density of an electrostatic field.

**Unit-III** Magnetic induction, Biot Savart's law, calculation of magnetic induction of infinite straight, circular and solenoidal currents, Ampere's circuital law. Magnetic vector potential, Torque on a current loop in uniform magnetic field. Ballistic galvanometer. Search coil. Electromagnetic induction, self inductance, mutual inductance, energy stored in a magnetic field.

Magnetic permeability, susceptibility, Hysteresis. Langevin's theory of dia, para, ferromagnetism.

**Unit-IV** Growth and decay of currents in R-C, L-R and L-CR circuit. Alternating currents in LR, LC, RC and LCR circuit. Wattles current series and parallel resonant circuits, sharpness of resonance, Q-factor.

#### B) Electromagnetic Theory

**Unit-V** Maxwell's equation, Displacement current, vector and scalar potential, Boundary conditions, wave equations. Plane waves in dielectric and conducting media. Poynting vector. Reflection and refraction of electromagnetic wave (normal and oblique incidence)

#### BOOKS RECOMMENDED

1. Electricity and Magnetism - D.C. Tayal
2. Electricity and Magnetism - Khare and Srivasthav
3. Physics for Degree Students-II - Bhuyan, Mishra, Das, Jena and Others
4. Electricity and Magnetism - Brijlal and Subramayan
5. Foundation of Electromagnetic theory - Ritic and Milford

#### H-VI Electronics and Laser Physics

Term-end: 60  
Internal : 15

#### A) Electronics

**Unit-I** Crystal diode, PN junction and its characteristics, transistor and its characteristics. Half wave and full wave rectifier, Filter circuit, Amplifier performance. Feedback amplifier - Negative feedback and Positive feedback. Advantages of negative feedback.

**Unit-II** Criteria for oscillation. Hartley and colpitt oscillator, principle of AM, FM and PM. Principle of demodulation. VTVM and CRO and their application.

**Unit-III** An overview of computer system, components of computer system. Binary, octal, hexadecimal number, conversion from one from to another. 9's and 10's complements of decimal number. 1's and 2's complement of binary number. Binary addition and subtraction. Logic gates - AND, OR, NOT, NAND, NOR and XOR (only symbolic representation). Demorgan's theorem, elements of Boolean Algebra.

**Unit-IV** Combinational circuit - Half adder, full adder, SR, D, JK and T flip-flops. 2 bit and 4 bit binary counters.

**B) Laser Physics**

**Unit-V** Spontaneous and stimulated emission of radiation. Population inversion, condition for laser action. Einstein's A, B coefficients. Properties of laser beam and its application in different fields.

Ruby Laser, Helium - Neon Laser, Semiconductor diode laser.

**BOOKS RECOMMENDED**

- |   |                                 |
|---|---------------------------------|
| 1. Electronics Fundamentals and Application | - J.D. Ryder                    |
| 2. Handbook of Electronics                  | - Gupta Kumar                   |
| 3. Foundation of Electronics                | - Chhatopadhyaya and Rakhit     |
| 4. Fundamental of Electronics               | - V.K. Mehta                    |
| 5. B.Sc. Physics                            | - K.N. Sharma                   |
| 6. Physics for Degree Students-II           | - Bhyan, Mishra, Das and Others |

**PRACTICAL-III (Practical)****50 Marks****Experiments relating to :**

- 1) Callibration of a set of weights.
- 2) Surface tension (Quincke's method)
- 3) Young's modulus (Vibration method)
- 4) Viscosity by Stoke's method
- 5) Viscosity by Soarle's method
- 6) Viscosity by Oscillating disc method.
- 7) Viscosity of air.
- 8) Temperature co-efficient of surface tension.
- 9) Thermal conductivity of glass/rubber (Calorimetric method)
- 10) 'J' by Callendor's method.
- 11) 'J' by Joule's calorimeter.
- 12) Measurement of absolute value of earth's field.

**SEMESTER-VI****H-VII Atomic Physics and Quantum Mechanics****Term-end: 60  
Internal : 15****A) Atomic Physics**

**Unit-I** Bohr's model of atom, correction in Bohr's theory for finite nuclear mass, Bohr's correspondence principle- Sommerfeld's extension of Bohr's theory, vector model of atom. Electron spin, orbital and spin angular momenta and corresponding magnetic momenta (stern - Gerlach experiment). The total angular momentum J. A general account of quantum numbers (n, l, s, j, m), L-S and J-J coupling scheme for 2 electron atoms. Normal and anomalous zeeman effect.

**Unit-II** The continuous x-ray spectrum, characteristic of x-rays, Mosley's law, Doublet fine structure. X-ray absorption spectra. x-ray diffraction, Laue's theory for x-ray diffraction.

**Unit-III** Quantisation of vibration and rotational energy, Pure rotational and vibration spectra, Roman effect, Stoke's and antistoke's line. Experimental arrangement for Raman spectra.

**B) Quantum Mechanics**

**Unit-IV** Inadequacy of classical physics : Photoelectric effect. The wave nature of particles, de-Broglie hypothesis, wave particle duality, Davisson Germer experiment. Principle of complimentary, wave packets, group velocity and phase velocity, Heisenberg's uncertainty principle.

**Unit-V** The time dependent schrodinger equation in one and three dimensions. The wave function  $(r, t)$  and its normalization. Probability current density. Momentum space wave function. Position, momentum and energy operators in the coordinate space as well as momentum space. Expectation value of dynamical variables. Ehrenfest's theorem. Hermitian operator. Eigen value and Eigen function of hermitian operators. Orthonormality of eigen function.

Application of time independent schrodinger equation for potential step, square well potential, particle in a 3D box.

**BOOKS RECOMMENDED**

- |                                   |                        |
|-----------------------------------|------------------------|
| 1. Atomic Physics                 | - J.B. Rajam           |
| 2. Modern Physics                 | - Shegal and Chopra    |
| 3. Physics for Degree Students-IV | - Bhuyan and Others    |
| 4. Quantum Mechanics              | - Singh Bagde          |
| 5. Quantum Mechanics              | - L.I. Schiff          |
| 6. Atomic and Nuclear Physics     | - A.B. Gupta and Ghosh |

**H-VIII Nuclear and Particle Physics, Solid State Physics****Term-end: 60  
Internal : 15****A) Nuclear and Particle Physics**

**Unit-I** Properties of nucleus (mass, charge, spin, magnetic moment) stability of nucleus. Nuclear force and properties. Mass defect and binding energy. Packing fraction. Liquid drop model (qualitative idea). Nuclear reaction, Q value and binding energy. Disintegration of nucleus by proton, neutron and deuteron bombardment. Fission and fusion of nuclei (elementary ideas).

**Unit-II** Laws of radioactive decay, Alpha decay, Beta decay, energy distribution, neutrino hypothesis, principle of G.M counter. Bubble chamber and cloud chamber. Linear accelerator and cyclotron.

**Unit-III** Basic forces of nature, their relative strength and range. Classification of elementary particles. Hadrons and Leptons, Mesons and Baryons. Lepton number, baryon number, hyper charge, isospin, Quark model.

### B) Solid State Physics

**Unit-IV** Crystal structure, types of lattices, unit cell, wigner seitz cell, Simple Cubic (sc), Body Centred Cubic (BCC), Face Centred Cubic (FCC), Hexagonal Close Packed (HCP) and diamond structure. Miller indices, crystal diffraction, Bragg's law, Reciprocal lattice, Law's derivation, Form factor and structure factor.

**Unit-V** Electrom in periodic potential, Kroning - Penny model. Free electron theory of metals and expression for thermal conductivity and electrical conductivity. Idea of zener diode Tunnel diode and light emitting diode.

### BOOKS RECOMMENDED

1. Physics for Degree Students-IV - Bhuyan, Mishra and Others
2. Solid State Physics - Gupta Kumar
3. Solid State Physics - C. Kittel
4. Concept of Modern Physics - A. Beiser
5. Atomic and Nuclear Physics - Gopal Krishnan
6. Nuclear Physics - Kaplan

### Practical-IV (Practical) 50 Marks

#### Experiments relating to :

- 1) Biprism
- 2) Diffraction from single slit using Laser kit
- 3) Diffraction by a single wire and determination of its diameter by using Laser kit.
- 4) Brewster's law
- 5) Calibration curve of a prism spectrometer.
- 6) Study of Gaussian nature of Laser beam.
- 7) Beam spot measurement.
- 8) Polarisation of light and verification of Malus Law by using Laser kit.
- 9) Calibration of meter bridge.
- 10) Calibration of a millimeter.
- 11) Growth and decay of potential of a capacitance.
- 12) Growth and decay of current in a circuit containing resistance and capacitance.

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## ZOOLOGY (PASS)

There shall be four semesters in two years (two semesters in each year). In each semester there shall be one theory paper of mark 75. There shall be an internal assessment of 15 marks out of 75 in each theory paper (i.e. 20% of theory, so that the term-end examination theory paper shall have 60 marks). There shall be one long question from each unit with alternative. The second and fourth semesters shall have practical papers with 50 marks each (6 hours duration).

### COURSE STRUCTURE

#### FIRST YEAR

#### SEMESTER-I

P-I Non-chordata and cell biology: 75 Marks 3 hours

#### SEMESTER-II

P-II Ecology, Evolution and Resource Biology 75 Marks 3 hours  
 Practical-I Practical based on P- I & P-II 50 marks 6 hours

#### SECOND YEAR

#### SEMESTER-III

P-III Chordata and Genetics 75 Marks 3 hours

#### SEMESTER-IV

P-IV Human Physiology 75 Marks 3 hours  
 Practical-II Practical based on P-III & P-IV 50 marks 6 hours

### DETAILED SYLLABUS

#### SEMESTER - I

**P - I Non-chordata and cell biology** Term-end: 60  
 Internal : 15

Candidates are required to answer one question from each unit.

#### Unit -I:

Broad outline classification of the following non-chordate phyla and the types mentioned in each phylum with habit, habitat, morphology, anatomy and life history.

1. Protozoa... Euglena and Paramecium.
2. Porifera - Sycon.
3. Coelenterata - Aurelia.

#### Unit - II :

1. Phylum - Platyhelminthes - Fasciola.
2. Nematelminthes - Ascaris.
3. Annelida - Hirudo.

#### Unit - III :

1. Arthropoda : Prawn.
2. Mollusca: Pila
3. Echinodermata : Asterias

**Unit - IV :**

1. Cell concept, Prokaryote and eukaryote cell types.
2. Ultrastructure of typical animal cell and elementary, knowledge about the functions of subcellular components such as endoplasmic reticulum and mitochondria.

**Unit-V:**

1. Structure and principle of working of a light microscope.
2. Electron microscope
3. Centrifugation: Elementary idea of centrifuge, types of centrifugation and mechanism of centrifugation (Cell fractionation)

**SEMESTER-II****P - II Ecology, Evolution and Resource Biology****Term-end: 60****Internal : 15****(Candidates are required to answer one question from each unit)****Unit - I:**

1. Definition, Scope, and Sub-divisions of Ecology.
2. Ecosystem: Concept of ecosystem, Structural component of an ecosystem, the Pond as an aquatic ecosystem.
3. Food - Chain, food-web, Trophic level and elementary concept on energy flow in ecosystem.

**Unit - II :**

1. Temperature and light as ecological factors.
2. Biogeochemical cycle: Carbon and nitrogen cycle.
3. Environment: Atmosphere - various zones of atmosphere: Lithosphere - Process of Soil formation, soil profile, major soil group of India.

**Unit - III :**

1. Definition and evidences in support of organic evolution with reference to palaeontological and embryological evidences.
2. Lamarckism, Darwinism and Neo-Darwinism.
3. Distribution of animals in geological timetable.

**Unit - IV :**

1. Definition of resource, renewable and non-renewable resources.
2. Renewable resource: Forestry with reference to social forestry, Aquaculture and its scope in Orissa.

**Unit - V :**

1. Habit, breeding and distribution (in Orissa) of Tiger, and Elephant.
2. Life - history and culture methods of Silk moth (Tassar Silk moth) and Honey bee.

**Practical - I Practical****6 hrs.****- 50 marks****(Practical related to theory papers I & II)**

1. Dissections: Anatomical features of the following types: Earthworm, Leech, Prawn, Cockroach & Pila. **8 marks**
2. Microscopic preparations of the following: Euglena, Paramecium and other protozoan species, gemmules of sponges, Hydrozoan colonies, Green gland and statocyst of Prawn, Crustacean Larva, Tube feet of starfish and study of museum specimens related to theories **4 marks**
3. Simulation of an ecosystem in the Laboratory. Determination of Oxygen content of water sample by Winkler's method. **8 marks**
4. Identification of animal association like symbiosis, commensalism and parasitism, Renewable and non-renewable resources, silk moth, Honeybees, fossils. **10 marks**
5. Squash preparation of onion root tip and grasshopper testis for demonstration of chromosomes and identification of different stages of mitosis and meiosis. **5 marks**
6. Viva-voice **5 marks**
7. Class record, field report/collection **6 + 4 = 10 marks**

**SEMESTER-III****P-III Chordate and Genetics****Term-end: 60****Internal : 15****(Candidates are required to answer one question from each unit)****Unit - I :**

1. Broad outline classification of the Phylum Chordata up to orders but up to sub-classes in case of Protochordates, Agnatha, Pisces, Aves and mammals.
2. Habit, Habitat and morphological organization and anatomy of the Hemichordata : Balanoglossus.
3. Urochordata : Herdmania.

**Unit - II :**

1. Cephalochordata : Amphioxus.
2. Pisces: Scoliodon.
3. Amphibia: Rana or Bufo (Except cranial and peripheral nerves).

**Unit - III :**

1. Reptilia: Calotes (Except cranial and peripheral nerves.)
2. Aves: Columba - Anatomical organs (only circulatory and respiratory system).
3. Mammalia: Rabbit/Rat (Except cranial and peripheral nerves).

**Unit - IV :**

1. Structure of chromosomes and their behaviour during cell division (Mitosis and Meiosis).
2. Mendel's Laws of Inheritance.

3. Linkage and crossing over.

**Unit - V :**

1. Chemical nature of gene and its replication.
2. Sex Linked-inheritance: Sex Linkage in Drosophila, Sex linkage in human beings (Haemophilia and colour blindness).
3. Determination of sex: Sex chromosome mechanism and Genic balance mechanism.

**SEMESTER-IV****P - IV Human Physiology****Term-end: 60****Internal : 15****(Candidates are required to answer one question from each unit)****Unit - I :**

1. Physiology of digestion of carbohydrate, proteins and fats in man.
2. Composition and function of mammalian blood, process of clotting, physiological types of heart, cardiac cycle.

**Unit - II :**

1. Mechanism of Urine formation and function of loop of Henle in mammals.
2. Structure and function of a vertebrate neuron.
3. Structure of skeletal muscles and mechanism of muscle contraction.

**Unit - III :**

1. A general idea about mammalian hormone secreting glands.
2. Hormones of pituitary and thyroid glands, their functions.
3. Physical and Chemical properties of protoplasm.

**Unit - IV :**

1. Chemical nature of enzymes and mechanism of enzyme Catalysis.
2. Ionic products of water, Hydrogen ion concentration (pH) and its determination, buffers and buffering action.

**Unit - V :**

1. Structure of male and female gametes.
2. Mechanism of fertilisation.
3. Development of Frog with reference to gastrulation and origin of three germ layers.

**Practical - II Practical****50 marks**

1. Dissections: Anatomical features of
  - a. Herdmania.
  - b. Scoliodon.
  - c. Frog / Toad (Cranial nerves & hyoid apparatus).
  - d. Calotes (Except peripheral nervous system).
  - e. Pigeon (Except peripheral nervous system).
  - f. Rat or any mammal (Blood vascular and reproductive system).

**9 marks**

2. Temporary Preparations
  - a. Amphioxus.
  - b. Scales of fishes.
  - c. Blood film of Frog and mammals.
  - d. Filoplumes of birds.
  - e. Pecten of birds
3. Museum specimens and bones of different chordate groups, Models of DNA, RNA, Purine and Pyrimidine bases **9 marks**
4.
  - a. Estimation of total count of RBC, WBC, and haemoglobin in mammalian blood.
  - b. Effect of different concentrations of NaCl and HCl solution on RBC.
  - c. Estimation of human salivary digestion.
  - d. Measurement of pH of Saliva, urine, or any other solution **8 marks**
5.
  - a. Identification and comment on embryological slides of various stages of frog's development.
  - b. Study of amphibian spawn and living amphibian sperms **6 marks**
6. Viva-voce **4 marks**
7. Class record / field report and field collection **6+4 = 10 marks**

**BOOKS RECOMMENDED****Theory:**

1. Text Book Of Zoology, Vol-I, Macmillan (Parker & Haswell)
2. Life Of Invertebrate, Vikas (Prasad)
3. Invertebrate Zoology, S.Chand & Co. (E. L. Jordan)
4. Invertebrate Zoology, Nagin & Co. (Nigam)
5. Invertebrate (Vol .I To VII) Mac-Graw Hill (Hyman)
6. Proto Zoology, Today Tomorrow Book Series (Kurdo)
7. Book Of Zoology (Sedgwick)
8. A General Zoology Of Invertebrates (Carter)
9. An Introduction To Protozoa (Coelenterata, Annelida, Echinodermata) (G.S. Sandhu)
10. Cell Biology, Himalayan Publ. (C.B. Power)
11. Cell Structure And Function (Lowely And Cickerites)
12. Cell Structure And Function, Vikash (Varnet And Bhatia)
13. Cytology And Genetics (Sawnsen)
14. Cell Biology (J. Lewys)
15. Elements Of Cytology (N.S. Kohn)
16. Fundamentals Of Ecology, Tata Mcgraw Hill (Dash)
17. Fundamentals Of Ecology, Sanders (Odum)
18. Concepts Of Ecology, Prentice Hall (Kormondy)
19. A Wild Life Sanctuary, (S.K. Tiwary)



20. A Text Book Of Zoology Vol III (Parker And Haswell)
21. A Text Book Of Vertebrate Zoology (Kitab Mahal)
22. Chordate Zoology (Jordan)
23. An Introduction to Comparative Anatomy Of Vertebrate. (Srivastav)
24. An Introduction to Comparative Anatomy Of Vertebrate. (Kingsley)
25. Fundamental Of Genetics (ISLAM)
26. General Genetics (Owen And Edger)
27. Elementary Genetics (Grigleton)
28. Principle Of Genetics (Sinot, Dunn And Dobzhansky)
29. Essential Of Animal Physiology (Rastogi)
30. Cell Physiology (Geese)
31. The Vertebrate Body (Bert And Tayler)
32. Comparative Animal Physiology (Prosser And Brown)
33. Elementary Human Physiology (Resers)
34. Biochemistry (Lehinger)
35. Molecular Genetics (Woodward And Woodward)
36. Molecular Biology Of Genes (Watson)
37. Molecular Biology (Frei Felder)
38. Comparative Embryology Of Verts (Nelson)
39. An Introduction To Embryology (Balinsky)
40. Chordate Embryology (Verma And Agarwal)
41. Modern Embryology (Bodemere)
42. Principle Of Animal Taxonomy (Simpson)
43. Principles Of Systematic Zoology (Mayer)
44. Bio Resource Ecology (Anathkrishnan)
45. Introductory Practical Biostatitics (Mishra & Mishra)
46. A Text Book Of Animal Behaviour (Harjinder Singh)
47. Quantitative Zoology (Simpson)

**Practical :**

1. Practical Invert. (Lull)
2. Practical Invert Zoology (Srivastav)
3. Vertebrate Practical Zoology (Banarjee)
4. Experimental Physiology (Siddiqi)
5. Ecological Methods For Field And Laboratory Investigation (Michel)
6. General Zoological Micro Techniques (Welsner)

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**ZOOLOGY (HONS.)**

There shall be six semesters in three years, (two semesters in each year). In first four semesters there shall be four theory papers (one theory paper in each semester) of 75 marks each. The last two semesters shall have four theory papers (two theory paper in each semester) of 75 mark each. There shall be internal assessment of 15 marks and Term-end Examination shall have 60 marks. There shall be one long question from each unit with alternative from the same unit. The second, fourth, fifth and sixth semesters shall have one practical each: Practical-I, Practical-II, Practical-III and Practical-IV respectively, carrying 50 marks each. All practical papers shall be of 6 hours duration.

**COURSE STRUCTURE****FIRST YEAR****SEMESTER-I**

H-I	Non-chordates	75 Marks	3 hours
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**SEMESTER-II**

H-II	Cell Biology and Resource Biology	75 Marks	3 hours
Practical-I	Practical based on H- I & H-II	50 marks	6 hours

**SECOND YEAR****SEMESTER-III**

H-III	Chordate	75 Marks	3 hours
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**SEMESTER-IV**

H-IV	Ecology and Evolution	75 Marks	3 hours
Practical-II	Practical based on H-III & H-IV	50 marks	6 hours

**THIRD YEAR****SEMESTER-V**

H-V	Animal development and Genetics	75 Marks	3 hours
H-VI	Taxonomy, Biostatistics, Ethology and Basic Biotechnology	75 Marks	3 hours
Practical-III	Practical based on H-V & H-VI	50 marks	6 hours

**SEMESTER-VI**

H-VII	Biochemistry and molecular biology	75 Marks	3 hours
H-VIII	Animal Physiology, Endocrinology and Microbiology	75 Marks	3 hours
Practical-IV	Practical based on H-VII & H-VIII	50 Marks	6 hours

## DETAILED SYLLABUS

SEMESTER-I

H - I (Non Chordates)

Term-end: 60

Internal : 15

**Unit-I**

1. Broad outline classification of the following non-chordate phyla and the types mentioned in each phylum with habit, habitat, morphology, anatomy and life history.
2. Protozoa-Euglena, Paramecium and Polystomella.
3. Porifera-Sycon.
4. Coelenterata : Aurelia and Ctenophora.

**Unit-II**

1. Phylum-Platyhelminthes: Fasciola and Taenia.
2. Nematelminthes: Ascaris
3. Annelida: Hirudo and Poligordius.

**Unit-III:**

1. Arthropoda : Prawn and Peripatus.
2. Mollusca :Pila and Sepia.
3. Echinodermata: Asterias

**Unit-IV:**

1. Parasitism and host specificity with reference to Trypanosoma, Plasmodium, Blood fluke and filarial worms.
2. Canal system, skeleton and development of porifera. .
3. Polymorphism in coelenterata.

**Unit - V:**

1. Mouth parts and feeding habits of insects.
2. Torsion in Gastropoda.
3. Pearl Culture.
4. Larval forms in Echinodermata.

SEMESTER-II

H - II (Cell Biology and Resource Biology)

Term-end: 60

Internal : 15

**Candidates are required to answer one question from each Unit.****Unit - I:**

1. Cell Concept, Prokaryote and eukaryote cell types.
2. Ultrastructure of typical animal cell. Structure and functions of sub-cellular components such as ribosome, mitochondria, endoplasmic reticulum, Golgi bodies, Lysosomes and nucleolus.
3. Plasmamembrane. (Structure and function).

**Unit-II:**

1. Resolving power of microscopes.
  - i) Compound microscope.
  - ii) Electron microscope
2.
  - i) Autoradiography.
  - ii) Cell Fraction and Centrifugation.
  - iii) Microtomy and colorimetry.

**Unit - III :**

1. Centrioles and basal bodies: Structure and Chemical composition; origin of cilia, basal bodies, and centrioles.
2. Structure of chromosomes and their behaviour during cell division (Mitosis and meiosis).
3. Lamp brush and polytene chromosomes.

**Unit - IV :**

1. Definition of resource, renewable resource: Forestry with reference to social forestry; Aquaculture and its scope in Orissa.
2. Energy and its conservation - only commercial source of energy such as Coal, Petroleum, Natural gas, nuclear fuels and electricity.

**Unit - V :**

1. Habit, breeding and distribution (in Orissa) of the following wild mammals: Tiger, Deer and Elephant.
2. Wild life of India, mode of Wild life conservation.
3. Life history and culture methods of silk moth (Tassar Silkmoth) and Honeybee.

**Practical - I Practical (Non Chordates, Cell & Resource Biology) 50 marks**

- A. Dissections: Students are required to dissect and study the anatomical features of the following types: Earthworm, Leech, Prawn, Cockroach, Fresh water mussel, Apple Snail, Sepia and Starfish **12 marks**
- B. Microscopic preparation of the following, Amoeba, Euglena, Paramecium, Spicules and Gemmules of sporges, Hydrozoan colonies, Green gland and statocyst of prawn, Crustacean Larvae, Mouth parts of Mosquito, Tube feet of starfish. **5 marks**
- C. Study of museum specimens related to theory Paper - I
- D. Identification of bacterial cells using Gram's stain and study of slides dealing with subcellular components.
- E. Collection, study and identification of different stages of silkworm and honeybees and other resources relating to theory Paper - II.  
(C) + (D) + (E) =16 marks
- F. Field Study report to be assigned by the Teacher. **5 marks**
- G. Viva - Voce.
- H. Class record, collection  
(G) + (H) = 12 marks

**SEMESTER-III****H - III (Chordata)****Term-end: 60****Internal : 15****Candidates are required to answer one question from each Unit.****Unit - I :**

1. Broad outline classification of the Phylum chordata upto orders, but upto sub - classes in case of Protochordates, Agratha, Pisces, Aves and mammals.
2. Habit, habitat and morphological organization of Hemichordata : Balanoglossus.
3. Urochordata : Herdmania.

**Unit - II :**

1. Cephalochordata : Amphioxus.
2. Agnatha : Petromyzon.
3. Pisces: Scoliodon.

**Unit -III :**

1. Amphibia: Rana or Bufo.
2. Reptilia: Calotes.
3. Aves: Columba - Anatomical organs (only circulatory and respiratory system).

**Unit - IV :**

1. Comparative anatomy of vertebrates from evolutionary point of view of the following system.
  - i) Integumentary system
  - ii) Blood Vascular system.
  - iii) Urinogenital system.
2. Phylogeny and inter - relationship of Protochordate groups.
3. Affinities of Cyclostomata.

**Unit - V:**

1. Parental care and neotany in Amphibia.
2. Biting mechanism of snakes.
3. Origin and migration of birds.
4. Salient features and affinities of prototheria and Metatheria.

**SEMESTER-IV****H - IV (Ecology and Evolution)****Term-end: 60****Internal : 15****Candidates are required to answer one question from each unit.****Unit. -I:**

1. Definition, scope and sub-divisions of Ecology, Biosphere, components of Biosphere.

2. Ecosystem: Concept of ecosystem, structural component of an ecosystem, the pond as an aquatic (Fresh water) ecosystem.
3. Food - Chain, Food-web, Trophic level and elementary concept on energy flow in ecosystem.

**Unit - II:**

1. Temperature and light pH, salinity, Humidity as ecological factors.
2. Biogeochemical cycles: Carbon, nitrogen and oxygen cycle.
3. Concept of population and concept of Biotic community.

**Unit - III:**

1. Biotic relationship: The intra specific and the inter specific interrelations. Social organisation of Termites and bees.
2. Interspecific relations: Symbiosis, Parasitism, Commensalism and mutualism, Mutualism between plants Species, between animal and plant and between animal species.
3. Concept of Pollution with particular reference to water and air.

**Unit-IV:**

1. Definition and evidences in support of organic evolution with reference to comparative anatomy, palaeontology, embryology and comparative physiology and biochemistry. Geological Time Scale.
2. Theories of evolution: Lamarckism and Darwinism, Neo-Darwinism. 3. Isolation: Isolating agents- Geographical, Spatial and reproductive.

**Unit - V:**

1. Adaptations. .
2. Geographical distribution of animals: (Zoo Geographical realms).
3. Evolution of man.
4. Evolution of horse.

**Practical: II Practical (Chordates, Ecology Evolution) 50 Marks****Dissection:**

**Calotes** - Circulatory & Cranial Systems Hyoid apparatus. Scoliodon/Bony fish -Internal ear, Bird - Flight muscles. **10 marks + 4 marks**

**Mounting** - Feathers of birds, Ampulae of Lorenzene, scales of fishes. **4 marks**

Study of museum specimen related to theory paper III **6 marks**

**Ecology :**

- a) Study of model ecosystem like pond ecosystem.
- b) Measurement of pH of different water samples; measurement of O<sub>2</sub> contents by Winkler's method.
- c) Quantification of fish respiration. **6 marks**

Evolution : Sports on evolution of man, horse / adaptations	<b>6 marks</b>
Field study report to be assigned by the teacher	<b>4 marks</b>
Viva voce, Record, Collection	<b>10 marks</b>

**SEMESTER-V**

**H - V Animal Development and Genetics** **Term-end: 60**

**Internal : 15**

**Candidates are required to answer one question from each Unit.**

**Unit - I:**

1. Gametogenesis, structure of male and female gametes.
2. Mechanism of fertilization and its significance.
3. Cleavage - its rule, types, mechanism, role of yolk in cleavage.

**Unit -II:**

1. Outlines of development of Amphioxus, Frog and Chick with reference to cleavage, gastrulation and origin of three germ layers.
2. Fate of germ layers - listing of derivatives of germ layers.

**Unit - III:**

1. Cyto- differentiation, induction and organizer concept (Spemann's expt)
2. Types of Placenta and placentation in mammals.

**Unit -IV :**

1. Concept of heredity, Mendelian principle of inheritance, Back Cross; Test Cross, Incomplete dominance, Co-dominance, Epistasis,
2. Linkage and crossing over, Chromosome mapping.
3. Concept of multiple alleles, interaction of genes.

**Unit - V :**

1. Sex-linked inheritance: Sex linkage in Drosophila and man, (Haemophilia and colour blindness).
2. Determination of Sex in Drosophila, Man, birds, bees, grasshopper.
3. Sex anomalies of man - Turner syndrome, Klinefelter's and autosomal abnormality. Down's syndrome.

**H - VI (Taxonomy, Biostatistics, Ethology and Biotechnology)**

**Term-end: 60**

**Internal : 15**

**Five questions to be answered not leaving any Unit**

**Unit - I :**

1. Definition of Taxonomy, artificial and natural Classification and their meaning, Binomial Classification.

2. The species concept, Race and sub-species.
3. Five kingdom system of classification of life: Monera, Protista, Fungi, Plantae and Animalia - Knowledge of each kingdom in brief.

**Unit -II:**

1. Use and scope of Biometry.
2. Average: Arithmetic Mean, Median and Mode.
3. Frequency distribution, graphical representation of data (Frequency, Polygon, Histogram)
4. Dispersion of data and measurement of standard deviation.
5. 't' test and Chi-square test.

**Unit-III :**

1. Concept of animal behaviour.
2. Innate behaviour - Kineses and Taxes.
3. Learned behaviour such as conditioned Reflex.
4. Concept of biological clock.
5. Circadian rhythm, Photoperiod effect.

**Unit-IV :**

1. Concept of Genetic Engineering/Biotechnology.
2. Elementary idea about restriction endonucleases and Plasmid.
3. Elementary knowledge about recombinant DNA technology and its application.
4. Transgenic animals and their utility. .

**Unit- V :**

1. Application of Biotechnology in medicine. (Hybridoma technology, Vaccine' preparation).
2. Application of Biotechnology in Agriculture.
3. (Pest & herbicide resistant crop, antisense technology). Application of- Biotechnology in cleaning environmental pollution.

**Practical- III**

**Practical**

**50 marks**

**Ani. Dev., Genetics, Taxonomy, Ethology,  
Biostatistics and Biotechnology**

1. **Animal Development:**
  - a. Study from W.M. preparation of different developmental stages of Frog and chick embryos.
  - b. Study from microtome - Section preparation of different developmental Stages of frog and chick. (a & b - observation from purchased slides). **12 marks**
  - c. Whole mount preparation of chick embryos of 24, 48 & 72 hours old. **6 marks**

2. **Genetics:**  
 a. Temporary aceto - carmine (or orcein) squash preparation of onion root tips to study mitosis **6 marks**  
 b. Temporary aceto - carmine (or orcein) Squash preparation of grasshopper testis to study meiosis  
 c. Preparation of mitotic chromosomes from bone marrow of rat/mice
3. **Biostatistics:**  
 Statistical problems can be given to the students for solving (Problems may involve 'Chi' - square test, t-test, mean, median, drawing of histogram, graphs etc.) (Students may be supplied with a mixture of pulses of 2 different colours, e.g. Green & Black (say mung and biri) or of 2 different sizes- assuming that they belong to the same sp. They are to sort them out-count them separately and analyse statistically, if they, follow 3:1 Mendalian, Principle. Mixture may contain 29: 92, 30: 93, 30: 88...) **10 marks**
4. Viva voce **6 marks**
5. Collection, Practical Record **10 marks**

### SEMESTER-VI

**H - VII Biochemistry and Molecular Biology** **Term-end: 60**  
**Internal : 15**

**Candidates are required to answer one question from each Unit.**

**Unit - I :**

- Structure, types and significance of biomolecules such as amino acids, carbohydrates, proteins and lipids.
- Structure of hormones and Vitamins.

**Unit - II:**

- Enzymes: Chemical nature of enzymes, classification, mechanism of enzyme action, kinetics and factors affecting enzyme actions.
- Physical and chemical properties of protoplasm.
- Antigen and antibody (elementary idea.)

**Unit - III:**

- Ionic products of water, Hydrogen ion concentration (pH) and its determination.
- Buffers and buffering actions.
- Metabolic pathways such as glycolysis, TCA cycle and electron transport system in cells.

**Unit-IV:**

- Structure and Chemical composition of DNA and RNA and their types.
- Replication of DNA, Evidences of semi conservative replication.
- Molecular concepts of genes - Split genes, exon and introns, one gene one polypeptide hypothesis.

**Unit - V:**

- Genetic code, deciphering of genetic code, and its properties.
- Protein synthesis (Central dogma) - transcription and the process of translation in ribosomes.
- Regulation of Gene Action or regulation of protein synthesis (Jacob and Monod operon model) in prokaryotes.

**H-VIII Animal Physiology, Endocrinology and Microbiology**

**Term-end: 60**

**Internal : 15**

**Candidates are required to answer one question from each Unit.**

**Unit - I :**

- Structure and function of Neurons, conduction of nerve impulse - neurotransmitters and synapse.
- Mechanism of muscle contraction with reference to twitch, summation, tetanic conditions, fatigue.
- Structure of nephron, mechanism of urine formation and function of loop of Henle in mammals.

**Unit - II:**

- Physiology of digestion of carbohydrates, fats, and proteins in man.
- Composition and function of mammalian blood, clotting & Agglutination.
- Physiological types of heart, cardiac cycle, Regulation of heart beat.
- Blood group: ABO and Rh - factor.

**Unit - III:**

- Respiration: Mechanism and control of breathing; Transport of respiratory gases - O<sub>2</sub> and CO<sub>2</sub>
- Oxygen equilibrium curves, Root and Bohr's effect.
- Hormones of Pituitary, thyroid and adrenal glands, their functional effects.
- Hormonal control of Reproduction (Mammalian).

**Unit - IV:**

- Chemical nature of hormones and Pheromones; Peptide and Amino acid derivative hormones with examples & sources.
- Elementary knowledge of hormones of insects, peptide hormones of the pancreas.
- Mechanism of Hormones (Protein & Steroid) action.

**Unit - V:**

- Virus: Characteristic, Size, Structure and mode of infection of Bacterial viruses (Phage).

2. Viral disease of Man: Influenza, Small pox and Mumps. (Elementary Knowledge).
3. Bacterial structure, types, multiplication and life cycle; Bacterial disease: Tuberculosis, Diphtheria & Leprosy.
4. Antibiotics (nature & action in brief).

**Practical - IV: Practical 50 marks**

**Animal Physiology, Microbiology, Biochemistry & Molecular Biology.**

1. **Animal Physiology:** 10 marks
  - a) Effect of temperature on rate of heart beat.
  - b) Measurement of metabolic rates in small animals.
  - c) Total count RBC & WBC by hemocytometer.
  - d) Preparation of hematin crystals.
2. **Microbiology:** 10 marks
  - a) Enumeration of micro - organisms.
  - b) Microbiological quality of milk.
  - c) Isolation of Staphylococci.
3. **Biochemistry :** 10 marks
  - a) Estimation of casein content in milk.
  - b) Assay of urease activity.
  - c) Assay of amylase activity.
  - d) Extraction of lipid.
4. **Molecular Biology-** Spot models etc. 6 marks
5. **Viva voce** 6 marks
6. **Record** 8 marks

**BOOKS RECOMMENDED**

**Theory:**

1. Text Book Of Zoology, Vol-I, Macmillan (Parker & Haswell)
2. Life Of Invertebrate, Vikas (Prasad)
3. Invertebrate Zoology, S.Chand & Co. (E. L. Jordan)
4. Invertebrate Zoology, Nagin & Co. (Nigam)
5. Invertebrate (Vol .I To VII) Mac-Graw Hill (Hyman)
6. Proto Zoology, Today Tomorrow Book Series (Kurdo)
7. Book Of Zoology (Sedgwick)
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9. An Introduction To Protozoa (Coelenterata, Annelida, Echinodermata) (G.S. Sandhu)

10. Cell Biology, Himalayan Publ. (C.B. Power)
11. Cell Structure And Function (Lowely And Cickerites)
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13. Cytology And Genetics (Sawson)
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16. Fundamentals Of Ecology, Tata Mcgraw Hill (Dash)
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18. Concepts Of Ecology, Prentice Hall (Kormondy)
19. A Wild Life Sanctuary, (S.K. Tiwary)
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30. Cell Physiology (Geese)
31. The Vertebrate Body (Bert And Tayler)
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33. Elementary Human Physiology (Resers)
34. Biochemistry (Lehinsen)
35. Molecular Genetics (Woodward And Woodward)
36. Molecular Biology Of Genes (Watson)
37. Molecular Biology (Frei Felder)
38. Comparative Embryology Of Verts (Nelson)
39. An Introduction To Embryology (Balinsky)
40. Chordate Embryology (Verma And Agarwal)
41. Modern Embryology (Bodemere)
42. Principle Of Animal Taxonomy (Simpson)

43. Principles Of Systematic Zoology (Mayer)
44. Bio Resource Ecology (Anathkrishnan)
45. Introductory Practical Biostatitics (Mishra & Mishra)
46. A Text Book Of Animal Behaviour (Harjinder Singh)
47. Quantitative Zoology (Simpson)

**Practical :**

1. Practical Invert. (Lull)
2. Practical Invert Zoology (Srivastav)
3. Vertebrate Practical Zoology (Banarjee)
4. Experimental Physiology (Siddiqi)
5. Ecological Methods For Field And Laboratory Investigation (Michel)
6. General Zoological Micro Techniques (Welsner)

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**MINOR ELECTIVES****SEMESTER-I****MATHEMATICS AND STATISTICS FOR BIOLOGICAL STUDENTS**

This paper shall be of 100 marks (80 marks for Term-end Examination and 20 marks for Internal Assessment Examination) and is of 03 hours duration. There shall be 10 (long and short) questions selecting two questions from each unit. Out of which 05 questions are to be answered; questions should carry equal marks.

**Full Marks : 100 (80 + 20)****Duration : 3 hours****Unit-I****Calculus:**

- a) Functions of different types of real functions, viz (polynomial Trigonometry and exponential functions)
- b) Differential Calculus: Concepts of limits with simple problems, Derivative of sum product  
And quotient of functions, Application of derivatives in finding tangent and normal of standard curves, Elementary knowledge of partial derivatives.
- c) Anti Derivative: Defination of anti derivative, anti-derivative of simple functions, integration as the reverse process of differentiation, Integration by parts, simple problems of integration and solution of differential equation of type  $dy/dx = Kf(x)$  and  $dy/dx = f(x)g(x)$ .

**Unit-II**

- a) Determinants: its evaluation matrices, operation, Transpose and inverse and rank of matrices, solution of linear equations.
- b) Preliminaries of coordinate geometry, linear equations and inequations and their graphical solution, Straight line, circle parabola, ellipse, hyperbola, with their graphs (equation in simple forms without derivations) simple problem solving.

**Unit-III**

Counting Principles, permutation and combinations, Binomial Theorem, Probability, Independent events, Concept of Expectations.

**Unit-IV**

- a) Collection and representation of data, frequency distribution measures of central tendency (mean, median and mode), measures of dispersions (Range, Mean deviation, Standard deviation and variance).
- b) Idea of populations and sample moments, Skewness and Kurtosis, Concept of random variables, Univariate Distributions: Binomial, Poisson and Normal distributions.
- c) Bivariate Distribution, Scatter Diagram, Correlation and regression coefficients

**Unit-V**

Test of significance, Null and Alternative hypothesis, level of significance, Type-I error and Type-II error, Test of Mean and variance of Normal population (large Sample Test) Test of Equality of two means and test of equality of two variances of two normal populations, test based on chi-square, t and F statistics.

**Books Recommended:**

1. Elements of Mathematics, Vol. I & II. Orissa State Bureau of Text book preparation and production, Pustak Bhawan, Bhubaneswar.
2. Statistical Methods and concepts by M.N. Das (Wiley Eastern Limited)
3. Statistical Methods by S. Gupta

**SEMESTER-I****BIOLOGY (MINOR ELECTIVE)**

(For Physical Science Stream)

**Full Marks : 100 (80 + 20)**

**Duration : 3 hours**

This paper shall be of 100 marks (80 marks for Term-end Examination and 20 marks for Internal Assessment Examination) and is of 03 hours duration. There shall be 10 (long and short) questions selecting two questions from each unit. Out of which 05 questions are to be answered; questions should carry equal marks.

**Unit-I The Living World**

Life; Life Process; Origin, evolution and maintenance of life; Varieties of living organisms : Two kingdom and five kingdom classification; Scope of life sciences. Bio-molecules (life molecules) : Fundamental knowledge on the chemistry and biological importance of water, carbohydrates, amino acids, proteins, lipids and nucleic acids.

**Unit-II The Cell**

Discovery; Cell theory; Prokaryotic and eukaryotic cells; Plant and animal cells; Ultra structure of a typical cell : Structure and function of cell wall, plasma membrane, chloroplast, mitochondrion, endoplasmic reticulum, Golgi complex, lysosome, microbodies, ribosome, nucleus, nucleolus and chromosome.

**Unit-III Microbes, Plants and Animals**

Salient features of viruses and bacteria; General characteristics of algae, fungi, bryophytes, pteridophytes and gymnosperms (no classification or type study); Structure and life cycle of a typical flowering plant; General characteristics of non-chordates and chordates; important features of various invertebrate and vertebrate phyla (no classification or type study).

**Unit-IV Nature of living beings**

Plant nutrition : Photosynthesis in plants; Nitrogen fixation and nitrogen cycle. Human physiology : Food, diet and digestion; Blood, its composition, function and circulation; Breathing and cellular respiration; Excretion; Sense organs and their function; Physiology of reproduction; Principles of heredity : Chromosomal basis of sex determination in man.

**Unit-V Applications of Biology**

Economic importance of plants with special reference to medicinal plants commonly used; Forest wealth and its conservation; Wild life management Germplasm conservation; Use of bio fertilizers; Preliminary idea about plant cell and tissue culture; Hereditary diseases with special reference to sex linked diseases; Communicable diseases including STD and AIDS; Biotechnology : General principles of genetic engineering and its applications.

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**MAJOR ELECTIVE****CHEMISTRY**

There shall be two papers. Each paper shall carry 100 marks (80 marks of Term-end Examination and 20 marks Internal Assessment Examination) and is of 03 hours duration. There shall be 10 (long and short) questions in each paper selecting two questions from each unit. Out of which 05 questions are to be answered; questions should carry equal marks.

**SEMESTER-III****Paper - I****80+20 Marks****Unit - I**

- a) Atomic structure: Bohr's model of atom and limitations. Sommerfeld's model, de- Broglie matter waves. Heisenberg uncertainty principle, Schrodinger Wave equation, Significance of Wave function, Normal and Orthogonal Wave functions, Quantum numbers, shape of s,p,d orbitals, Stability of completely filled and half filled subshell.
- b) **Chemical bondings**  
i) Ionic bond: General Characteristics, Lattice Energy, Solvation Energy, Born - Haber Cycle, Polarising Power and. Polarisability. Fajan's Rule, % of ionic character from dipole moment and Electronegativity difference.

**Unit-II**

- a) Covalent bonds: General Characteristics, Valence Bond approach- Concept of Resonance & Resonance Energy, Directional Characteristics of Covalent bond, Concept of hybridization, Deduction of geometry of the following types of molecules or ions: AB<sub>2</sub>E, AB<sub>3</sub>E, AB<sub>4</sub>E, AB<sub>2</sub>E<sub>2</sub>, AB<sub>5</sub>E and AB<sub>5</sub>E (E represents lone pair of electrons). Qualitative treatment of Molecular Orbital Theory: Bonding, antibonding, non-bonding molecular orbitals, MO configuration of H<sub>2</sub>, N<sub>2</sub>, O<sub>2</sub>, F<sub>2</sub>, CO, NO, HF and their ions.
- b) Co-ordination Compounds:  
Werner's theory, Nomenclature of complexes, Valence bonds interpretation of octahedral tetrahedral and Square planar complexes.

**Unit-III**

- a) Kinetic Theory of gases:  
Derivation of gas equation  $PV = \frac{1}{3} nmc^2$ , and its application in the derivation of Boyle's Law, Charles's Law, Dalton's Law of partial Pressure, "Laws of diffusion and Avogadro's Law. Gas Constant, Behaviour of real gases, Van der Waal's equation of state.
- b) Chemical Kinetics:  
Rate of reaction, order and molecularity of a reaction, Zero, first & second order reaction, half-life of a reaction, General method for determination of order of

reactions, Effect. of temperature on reaction rates, Collision theory of reaction rate.

**Unit - IV**

- a) **Adsorption and Surface Phenomena:**  
Physisorption and Chemisorption, adsorption isotherm, derivation of Freundlich and Langmuir adsorption isotherms and their applications.
- b) **Homogeneous Equilibria:**  
Law of mass action, Le-Chateliers principle, their application to :  
(i) Dissociation of PCl<sub>5</sub>  
(ii) Dissociation of N<sub>2</sub>O<sub>4</sub>  
(iii) Manufacture of NH<sub>3</sub>  
(iv) Hydrolysis of Ethyl acetate.

**Unit - V Thermodynamics:**

- a) Thermodynamic concepts:  
State, System, surrounding path, intensive and extensive properties.
- b) The first Law of Thermodynamic:  
The Law, Enthalpy, Energy, heat capacities, isothermal and adiabatic processes.
- c) Thermochemistry:  
Hess and Kirchoff's Laws: Calculations based on these laws (Heat of formation, heat of reaction and heat of combustion).
- d) Second Law of Thermodynamics:  
The Law, concept of the free energy, entropy and thermodynamic criteria of equilibrium, Effect of temperature and pressure on equilibrium: Relation between equilibrium constant and free energy.

**SEMESTER-VI****CHEMISTRY****Paper - II****80+20 marks****Unit - I**

- a) **Reactions intermediates:**  
(i) Carbocation : Formation, Stability and Structure.  
(ii) Carbanion : Formation, Stability and Structure.
- b) **Reactions in Organic compounds:**  
i) Reaction Mechanisms: SN<sub>1</sub>, SN<sub>2</sub>, E<sub>1</sub>, E<sub>2</sub>, AdN, AdE (Full Forms, Explanation with examples, details not required).
- c) **Stereochemistry:**  
i) Stereoisomerism: Conformational Isomerism of ethane, n-butane, Cyclohexane, axial and equatorial bonds, boat and chair conformation and their energy calculation.

- ii) Sawhorse. Newman and Fischer projection formula of molecules containing C- C bond.
- iii) Configurational isomerism: Optical isomerism, concept of mirror image with simple examples, conditions for optical activity, plane polarised light and optical rotation, specific rotation, optical isomers of lactic, threonic and tartaric acids, Enantiomers and diastereoisomers, Racemic modification. Geometrical isomerism with simple examples.

**Unit - II**

- a) **Organometallic compounds:** Grignard's reagent Its preparation, structure, synthetic uses as carbanion precursor.
- b) **Esters containing active methylene group:**
- (i) Acetoacetic Ester: Synthesis, Synthetic uses (synthesis of alkane, ketone and acid), structure of acetoacetic ester, keto enol tautomerism.
- (ii) Malonic ester: Preparation and synthetic uses (synthesis of alkane, ketone and acid).
- (c) **Carbohydrates:**  
Classification, Configuration of sugars, Glucose and fructose (Osazone formation, mutarotation), Elucidation of the structure of D - Glucose (open chain and Ring structure), interconversion of sugars.

**Unit - III**

- a) Aromatic Hydrocarbon: Aromatic substitution reactions (S<sub>Ar</sub>N1, S<sub>Ar</sub>N2 and S<sub>Ar</sub>E2) Electrophilic substitution (halogenation and nitration, determination of structure of benzene.
- b) Nitrohydrocarbons: Preparation (S<sub>Ar</sub>E1 & S<sub>Ar</sub>E2 of hydrocarbons), properties reduction of nitrobenzene and TNT.
- c) Aromatic Amines: Preparation (Reduction of nitro compounds), properties, diazo reaction, alkylation to quaternary salts, Basicity, Phenylhydrazine, Structure and Synthetic uses of benzene diazonium salt, comparison with aliphatic amines.
- d) Phenols: Preparation (diazo reaction and fusion), Properties (acidity, reactions with alkyl and aryl halides, esterification, electrophilic substitution, Kolbe synthesis, Reimer - Tieman reaction, Diazonium coupling with alcohols.

**Unit - IV**

- a) Aryl aldehydes & Ketones: Preparation (Etard's reactions, Friedel Craft reaction), Properties (addition reactions with HCN, phenylhydrazine, hydroxylamine semicarbazide, alcohol), Cannizzaro, Benzoin and Perkin & Iodoform reactions.
- b) Aryl Carboxylic acid: Preparation (Oxidation Hydrolysis of nitriles, Grignard's reaction) Properties (acidity, reactions with PCl<sub>5</sub>, SOCl<sub>2</sub>, alcohol, NH<sub>3</sub> and electrophilic substitution reactions).

**Unit -V**

- a) Electrochemistry: Specific, Equivalent & Molar conductances, Laws, variation of conductance with concentration for strong and weak electrolytes, determination of degree of ionization, solubility product & degree of hydrolysis conductometric titrations, reversible cells and simple idea on redox potential.
- b) Acid and Bases: Lewis concept, Lowry - Bronsted concept, relative strength of acids and bases, pH, theory of acid - base indicators, buffer solutions, buffer capacity and buffer range.

**Books recommended:****Inorganic Chemistry:**

1. Principle of Inorganic Chemistry, B.R.Puri, L.R.Sharma & K.C.Kala, S.L.N.Chand & Co.
2. Text Book of Inorganic Chemistry, P.L.Soni, Sultan Publication,
3. Concise Inorganic Chemistry, J.D. Lee, ELBS. Modern College Chemistry (Inorganic), S.Guru, B.K. Mohapatra, R.C.Mishra, &K.K.Sharma, Kalyani Publication.

**Organic Chemistry:**

1. Advanced Organic Chemistry, B.S.Bhal & A.Bhal, S.Chand & Co.
2. Organic Chemistry, P.L.Soni & H.M. Chawal, S.Chand & Co.
3. Fundamentals of Organic Chemistry, Solomons, Jhon Wiley.
4. Organic Chemistry, L.G.Wade Jr., Prentice Hall.

**Physical Chemistry:**

1. Principles of Physical Chemistry, B.R.Puri & L.R. Shrama, S.L.N. Chand & Co.
2. Essentials of Physical Chemistry, B.S.Bahi & G.D.Tuli, S.Chand & Co.
3. Physical Chemistry, G.M. Borrow, McGraw Hill.
4. Modern College Chemistry (Physical), R.C.Acharya & Y.R. Shrama, Kalyani Publication.

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**LIFE SCIENCE**

There shall be two papers. Each paper shall carry 100 marks (80 marks of Term-end Examination and 20 marks Internal Assessment Examination) and is of 03 hours duration. There shall be 10 (long and short) questions in each paper selecting two questions from each unit. Out of which 05 questions are to be answered; questions should carry equal marks.

**SEMESTER-III****Paper - I****80+20 marks**

**Unit -I** Life, its origin and evolution, Diversity of life, outline survey of diversity: Plants, Animal, Micro organisms (Pathogen, Parasite, Saprophytes, Chemotrophs, Symbiotics & Commensals).

**Unit -II**

Cell as basic unit of life, structural organisation of cell, Prokaryotes and Eukaryotes, cellular organelles (Nucleus, Mitochondrion, Chloroplast, Endoplasmic reticulum, Golgi apparatus, Ribosomes), cell membrane, cell cycle and divisions.

**Unit -III**

Biophysical Chemistry: Interaction in biological system: Intra and inter molecular forces, Vanderwaal force, hydrophilic interaction. Water as universal solvent, properties of aqueous solution, pH, buffer. Thermodynamics and its application to biological system.

**Unit - IV**

Biomolecules in cell Carbohydrate, Lipid, Protein, nucleic acid (RNA & DNA) with their structure. ATP, the energy rich compound in the cell.

**Unit - V**

DNA as genetic material, central Dogma & Reverse transcription, DNA replication. Transcription and Translation, Genetic code, Regulation of gene action in bacteria.

**SEMESTER-VI****Paper - II****80+20 marks****Unit - I Enzymes**

Properties, classification, Mechanism of enzyme action and regulation, Enzyme Kinetics and inhibition, cofactors.

**Unit - II Biological processes**

Photosynthesis, Respiration & Energy yielding mechanisms, Physiology of digestion and assimilation, Physiology of excretion, Basic concepts of transmission of impulse and Hormonal integration.

**Unit -III Basic concept of genetic engineering**

Concept of gene; Recombinant DNA technology; its application in the field of agriculture, medicine, food and industrial production.

**Unit - IV Organism and Environment:**

Dynamics of environment, concept of Ecosystem, Population and Community, Energy flow and nutrient cycling, Food chain, Food web, population dynamics and regulation in nature, Ecosystem development and concept of climax in Ecological system, Biodiversity and its significance.

**Unit -V Instrumentation for biological sciences:**

Microscopy, Chromatography, Centrifugation, Spectroscopy & pH metry.

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**MATHEMATICS**

(Students having Mathematics at the +2 stage are only eligible to take this elective)  
There shall be two papers. Each paper shall carry 100 marks (80 marks of Term-end Examination and 20 marks Internal Assessment Examination) and is of 03 hours duration. There shall be 10 (long and short) questions in each paper selecting two questions from each unit. Out of which 05 questions are to be answered; questions should carry equal marks.

**SEMESTER-III****Paper - I****80+20 Marks****Unit -I Differential Calculus**

Partial Differentiation, Maxima, Minima, Singularities, Tracing of curve, curvature

**Unit - II Integral Calculus**

Definite integral, Area, Length, Volume, solid of revolution.

**Unit - III Differential equations**

Solution of equations of first and second order, higher degree, linear equations with constant coefficient.

**Unit IV Probability**

Elementary concept of probability distribution, distribution function, finding the expectation, variance, standard deviation with special emphasis on Binomial, Poisson and Normal Distribution.

**Unit - V Statistical Methods**

Collection and Representation of Data, frequency distribution, measures of central tendency, measures of dispersions, co-relation and regression analysis, index number, time series analysis.

**Books Prescribed:**

1. Text Book of Differential Calculus by Gorakh Prasad, Pothisala Pvt. Ltd., Allahabad.
2. Text Book of integral Calculus by Gorakh Prasad, Pothisala Pvt.Ltd., Allahabad.
3. Elements of Probability Theory by D.Pratihari, & S.P. Mohanty, Kalyani Publishers, New Delhi.
4. Introduction to Numerical and Statistical Methods By P.Mukharjee & K.Chatterjee, Somnath Prakashan, Calcutta.
5. Elements of Ordinary Differential Equations by J.Sinha Roy & S.Padhi, Kalyani Publishers, New Delhi, Ch-2, 3, 4.

**SEMESTER-VI****Paper - II****80+20 Marks****Unit - I Algebra**

Group Theory: Definition of a Group, Some examples of Group, Sub-Groups and normal sub-groups, Homomorphism, Ring Theory: Definition and examples of Ring, some special Classes of rings, Homomorphism,

**Unit - II Linear algebra**

Solution of linear equation, Homogeneous and Non - Homogeneous equation by Gauss Method, Matrix, Orthogonality, rank, eigen value.

**Unit - III Numerical Methods**

Approximation of numbers and errors, finite differences, interpolation, numerical integration, solution of systems of linear equations.

**Unit - IV Operation Research**

Solution of linear Programming problem by graphical and simplex method.

**Unit V Mathematical Method**

Laplace Transform, Fourier Transforms.

**Books Prescribed**

1. Topic in Algebra by I.N. Herstein, Vikash Publ. Pvt.Ltd. Chapter - 2 (2.1 - 2.4, 2.6, 2.7) chapter - 3 (3.1 - 3.3)
2. Programming in FORTRAN 77 by V.Rajaraman, PHI, New Delhi.
3. Introduction to Numerical & Statistical Methods by P.Mukharjee & K.Chatterjee, Somnath Prakashan, Calcutta, Chapter - 1,2,3,5,7
4. B.S.Goel & S.K.Mittal, Pragati Prakashini, Meerut.
5. Advanced Engineering Mathematics by E.Krey & Zig, Wilet Eastern Ltd., N.D.
6. Advanced Engineering Mathematics by B.S.Grewal Khanna Publisher, N.D.

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**PHYSICS (Major Elective)**

There shall be two papers. Each paper shall carry 100 marks (80 marks of Term-end Examination and 20 marks Internal Assessment Examination) and is of 03 hours duration. There shall be 10 (long and short) questions in each paper selecting two questions from each unit. Out of which 05 questions are to be answered; questions should carry equal marks.

**SEMESTER-III****PAPER-I****80+20 Marks****Unit-I**

Conservation of Linear and angular momentum, moment of Inertia, Sphere and Cylinder, Simple harmonic motion, variation of acceleration due to gravity, Newton's Law of gravitation of kepler's Law, Satellite Launching Elastic Constants and relation, Surface tension, Pressure difference across a curved surface, viscous motion, Bernoulli's and Poiseuille's equation and applications.

**Unit-II**

Heat and Temperature, Laws of Thermodynamics, Thermodynamical Processes, Thermodynamical scale of temperature Heat Engine, Carnot's Cycle, Maxwell's relation and applications, Transport phenomenon.

**Unit-III**

Wave and oscillation : Free, damped and forced vibration and resonance, Equation of wave motion and solution, velocity of longitudinal and transverse waves, Progressive and Stationary waves characteristics of Sound, echo, ultrasonic wave and application.

**Unit-IV**

Nature of light, Huygen's principle, Interference, biprison, binocular, Newton's Rings, Diffraction, Fraunhofer and Fresnel diffraction, Tons plate, Diffraction at single slit, double slit and grating, Normal and anomalous dispersion.

**Unit-V**

Concept of relativity, Michelson-morley's experiment postulates of special theory of relativity, Lorentz transformation equation, length contraction, time dilation, variation of mass with velocity, equivalence of mass and energy.

**SEMESTER-VI****PAPER-II****80+20 Marks****Unit-I**

Electrostatic field and potential, Gayes theorem and application to spherical shell, charged sheet, kivchotl's law and application, Biot Savart's law Amper's law Faraday's law self induction of a coil, Mutual induction of two coils, Transient phenomenon in LCR Circuits. AC in L-R, R-C, and L-C-R Circuits, Impedance, power factor, wattles current and resonance, Interaction between a current carrying conductor and an external magnetic field, Hysteresis, properties of magnetic materials.

**Unit-II**

Inadequacy of classical mechanics, de Bvoglie's matter wave, Davison Gevmer experiment, Uncertainty principle, Gammaray microscope, wave function, Normalization, schrodinger equation of matter wave, application-Particle in a box.

**Unit-III**

Crystal and crystal structure, diamond and zinc blend structure, racipocal lattice, Bragg's law, simple idea of Nuclear physics, discovery of nucleus, Bhor's model of hydrogen atom, quantisation of angular momentum feeman effect, photoelectric effect.

**Unit-IV**

Semiconductor, P-N junction, rectification, idea of filter, PNP - transistor, amplification. Criteria for self oscillation, Hartlay's and colpitt's Oscillator. C.R.O. and its application, VTVM and its application.

**Unit-V**

History of Computers, binary numbers Boolean algebra, logic gates, various units of computers.

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