

COURSE CATALOGUE

(Academic Session 2016-17 onwards)

for

B.Sc. Life Sciences

and

B.Sc. Physical Sciences

Under

CHOICE BASED CREDIT SYSTEM



COLLEGE OF BASIC SCIENCES

CSK HIMACHAL PRADESH KRISHI VISHVA VIDYALAYA

PALAMPUR 176062

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Choice Based Credit System

The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.

Types of Courses:

Courses in a programme will be of three kinds: Core, Elective and Ability Enhancement Courses.

- i) **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
- ii). **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.
 - a) **Discipline Specific Elective (DSE) Course:** Elective courses offered under the main discipline/subject of study is referred to as Discipline Specific Elective.
 - b) **Generic Elective (GE) Course:** An elective course chosen from an unrelated discipline/subject, with an intention to seek exposure beyond discipline/s of choice is called a Generic Elective.
- iii). **Ability Enhancement Courses (AEC):** The Ability Enhancement (AE) Courses will be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC).
 - a) **Ability Enhancement Compulsory Courses (AECC):**
These courses are based upon the content that leads to Knowledge enhancement i.e. i) English Communication and ii) Environmental Science. These are mandatory for the undergraduate programmes.
 - b) **Skill Enhancement Courses (SEC):** These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge and should contain both theory and lab/hands-on/training/field work.

Implementation of CBCS:

- 1) To implement the CBCS, the syllabi for the core and elective papers for undergraduate programme of College of Basic Sciences have been prepared as per UGC guidelines.
- 2) Credit score earned by a student for any elective paper has to be included in the student's overall score tally irrespective of whether the paper is offered by the parent university (degree awarding university/institute) or not.
- 3) The number of seats per elective paper will be as per the facility and infrastructure available.
- 4) An undergraduate degree in the College of Basic Sciences will be awarded if a student completes four core papers each in three disciplines of choice, two Ability Enhancement Compulsory Courses (AECC), minimum four Skill Enhancement Courses (SEC) and two papers each from a list of Discipline Specific Elective papers based on three disciplines of choice selected above, respectively.
- 5) For the purpose of computation of work-load the following mechanism will be adopted:
 - i) 1 Credit = 1 Theory period of one hour duration
 - ii) 1 Credit = 1 Tutorial period of two hour duration
 - iii) 1 Credit = 1 Practical period of two hour duration
- 6) The credit(s) for each theory paper/practical/tutorial and scheme will be as per Table No.1 & 2.
- 7) The Universities/Institutes may offer any number of choices of papers from different disciplines under Generic Elective and Discipline Specific Elective as per the availability of the courses/faculty.
- 8) Universities/Institutes may evolve a system/policy about Extra Curricular Activities/ General Interest and Hobby Courses/Sports/NCC/NSS/Vocational courses/related courses on their own.
- 9) A student can opt for more number of Elective and AE Elective papers than proposed under the model curriculum of UGC. However the total credit score earned will not exceed 140 credits for UG Program degree.
- 10) The new scheme of UG courses should be given due consideration while framing the admission eligibility requirement for PG/ Technical courses in Indian Universities/Institutions to ensure that students following inter and multi-disciplinary format under CBCS are not at a disadvantage. It is suggested that wherever required, obtaining 24 credits in particular discipline may be considered as the minimum eligibility, for admission in the concerned discipline, for entry to PG/Technical courses in Indian Universities/Institutions.

Table: -1 : Details of Courses Undergraduate (B.Sc.)

Course	*Credits	
	Theory+ Practical	Theory+Tutorials
<u>I. Core Course (6 Credits)</u>		
(12 Papers)	12X4= 48	12X5=60
04 Courses from each of the 03 disciplines of choice		
Core Course Practical I Tutorial*	12X2=24	12X1=12
(12 Practical I Tutorials*)		
04 Courses from each of the 03 Disciplines of choice		
<u>II. Elective Course (6 Credits)</u>		
(6 Papers)	6x4=24	6X5=30
Two papers from each discipline of choice including paper of interdisciplinary nature.		
Elective Course Practical I Tutorials*	6 X 2=12	6X1=6
(6 Practical / Tutorials*)		
Two Papers from each discipline of choice including paper of interdisciplinary nature		
<ul style="list-style-type: none"> • Optional Dissertation or project work in place of one Discipline elective paper (6 credits) in 6th Semester 		
<u>III. Ability Enhancement Courses</u>		
1. Ability Enhancement Compulsory Courses (AECC)		
(2 Papers of 2 credits each)	2 X 2=4	2X2=4
Environmental Science		
English/Hindi/MIL Communication		
2. Skill Enhancement Courses (SEC)		
(4 Papers of 2 credits each)	4 X 2=8	4 X 2=8
	<hr/>	<hr/>
	Total credit= 120	Total credit= 120

*wherever there is practical there will be no tutorials and vice –versa

Table – 2 : Proposed scheme for B.Sc. three year programme under Choice Based Credit System

Year	Semester	Core Course (CC) (12)	Ability Enhancement Compulsory Course (AECC) (2)	Skill Enhancement Course (SEC) (4)	Discipline Specific Elective (DSE) (6)	GI/Hobby/Sports/NCC /NSS related course (Non-creditable)
First	Odd	CC1(Discipline A) CC2(Discipline B) CC3(Discipline C)	AECC1 (English Communication)			NCC/NSS
	Even	CC4(Discipline A) CC5(Discipline B) CC6(Discipline C)	AECC2 (Environmental Science)			NCC/NSS
Second	Odd	CC7(Discipline A) CC8(Discipline B) CC9(Discipline C)		SEC1		NCC/NSS
	Even	CC10(Discipline A) CC11(Discipline B) CC12(Discipline C)		SEC2		NCC/NSS
Third	Odd			SEC3	DSE1 (Discipline A) DSE2 (Discipline B) DSE3 (Discipline C)	
	Even			SEC4	DSE4 (Discipline A) DSE5 (Discipline B) DSE6 (Discipline C)	

B.Sc.
Life Sciences

Details of Courses to be offered to B.Sc. Life Sciences (Semester-wise)

YEAR	Sem-ester	Discipline/Subject	Type of Course	Course				
				No.	Title	Cr.Hrs.		
First	First	Botany	CC-I-A	Bot.111	Biodiversity (Microbes, Algae, Fungi and Archegoniate)	4+2		
		Zoology	CC-I-B	Zoo.111	Animal Diversity	4+2		
		Chemistry	CC-I-C	Chem.111	Conceptual Organic Chemistry	4+2		
		English	AECC-I	Eng.111	English Communication	2+0		
		Gen.Int./ Hobby			Ort.111	Orientation	1+0(NC)	
		Gen.Int./ Hobby			NCC/NSS	NCC/NSS	0+2(NC)	
	Total Credit Hours in Semester-I = 20 + 3 (NC)							
	Second	Second	Botany	CC-II-A	Bot.121	Plant Ecology and Taxonomy	4+2	
			Zoology	CC-II-B	Zoo.121	Comparative Anatomy and Developmental Biology of Vertebrates	4+2	
			Chemistry	CC-II-C	Chem.121	Molecules of Life	4+2	
			Env. Sci.	AECC-II	Env.121	Environmental Studies	3+0	
			Gen.Int./ Hobby			NCC/NSS	NCC/NSS	0+2(NC)
Total Credit Hours in Semester-II = 21 + 2 (NC)								
Second	First	Botany	CC-III-A	Bot.211	Plant Anatomy and Embryology	4+2		
		Zoology	CC-III-B	Zoo.211	Physiology and Biochemistry	4+2		
		Chemistry	CC-III-C	Chem.211	Chemical Bonding, Transition Metal & Coordination Chemistry	4+2		
		Computer	SEC-I	Comp.211	Computer Application	2+1		
		Gen.Int./ Hobby			NCC/NSS	NCC/NSS	0+2(NC)	
	Total Credit Hours in Semester-III = 21 + 2 (NC)							
	Second	Second	Botany	CC-IV-A	Bot.221	Plant Physiology and Metabolism	4+2	
			Zoology	CC-IV-B	Zoo.221	Genetics and Evolutionary Biology	4+2	
			Chemistry	CC-IV-C	Chem.221	Physical Chemistry for the Biosciences	4+2	
				SEC-II	<i>Any one of the following:</i>			
			Statistics		Stat.221	Elements of Statistics	2+1	
			Computer		Comp.221	Databases with MS Access	2+1	
Gen.Int./ Hobby			NCC/NSS	NCC/NSS	0+2(NC)			
Total Credit Hours in Semester-IV = 21 + 2 (NC)								

Third	First	Botany	DSE-1-A	<i>Any one of the following:</i>			
				Bot.311	Analytical Techniques in Plant Sciences	4+2	
				Bot.312	Cell and Molecular Biology	4+2	
		Zoology	DSE-1-B	<i>Any one of the following:</i>			
				Zoo.311	Applied Zoology	4+2	
				Zoo.312	Aquatic Biology	4+2	
		Chemistry	DSE-1-C	<i>Any one of the following:</i>			
				Chem.311	Analytical Methods in Chemistry	4+2	
				Chem.312	Instrumental Methods of Chemical Analysis	4+2	
			SEC-III	<i>Any one of the following:</i>			
		Botany		Bot.313	Medicinal Botany	2+1	
		Zoology		Zoo.313	Aquarium Fish Keeping	2+1	
		Chemistry		Chem.315	Chemistry of Cosmetics & Perfumes	2+1	
		Microbiology		Micro.311	Techniques in Clinical Microbiology	2+1	
						Total Credit Hours in Semester-V = 21	
	Second	Botany	DSE-2-A	<i>Any one of the following:</i>			
				Bot.321	Research Methodology	4+2	
				Bot.322	Economic Botany and Biotechnology	4+2	
		Zoology	DSE-2-B	<i>Any one of the following:</i>			
				Zoo.321	Immunology	4+2	
				Zoo.322	Reproductive Biology	4+2	
Chemistry		DSE-2-C	<i>Any one of the following:</i>				
			Chem.321	Bioinorganic & Environmental Chemistry	4+2		
			Chem.322	Quantum Chemistry, Spectroscopy & Photochemistry	4+2		
		SEC-IV	<i>Any one of the following:</i>				
Botany			Bot.323	Ethnobotany	2+1		
Zoology			Zoo.323	Public Health and Hygiene	2+1		
Chemistry			Chem.325	Analytical Clinical Biochemistry	2+1		
Microbiology			Micro.321	Fermentation Technology	2+1		
					Total Credit Hours in Semester-VI = 21		
				TOTAL CREDIT HOURS TO BE STUDIED = 125 + 9 (NC)			

Details of Courses to be offered to B.Sc. Life Sciences (Discipline-wise)

Discipline/ Subject	Type of Course	Course		
		No.	Title	Cr.Hrs.
Botany (Discipline-A)	CC	Bot.111	Biodiversity (Microbes, Algae, Fungi and Archegoniate)	4+2
		Bot.121	Plant Ecology and Taxonomy	4+2
		Bot.211	Plant Anatomy and Embryology	4+2
		Bot.221	Plant Physiology and Metabolism	4+2
	DSE1	Bot.311	Analytical Techniques in Plant Sciences	4+2
		Bot.312	Cell and Molecular Biology	4+2
	DSE2	Bot.321	Research Methodology	4+2
		Bot.322	Economic Botany and Biotechnology	4+2
			<i>Total Credit Hours to be studied in Discipline – A</i>	<i>36</i>
Zoology (Discipline-B)	CC	Zoo.111	Animal Diversity	4+2
		Zoo.121	Comparative Anatomy and Developmental Biology of Vertebrates	4+2
		Zoo.211	Physiology and Biochemistry	4+2
		Zoo.221	Genetics and Evolutionary Biology	4+2
	DSE1	Zoo.311	Applied Zoology	4+2
		Zoo.312	Aquatic Biology	4+2
	DSE2	Zoo.321	Immunology	4+2
		Zoo.322	Reproductive Biology	4+2
			<i>Total Credit Hours to be studied in Discipline – B</i>	<i>36</i>
Chemistry (Discipline-C)	CC	Chem.111	Conceptual Organic Chemistry	4+2
		Chem.121	Molecules of Life	4+2
		Chem.211	Chemical Bonding, Transition Metal & Coordination Chemistry	4+2
		Chem.221	Physical Chemistry for the Biosciences	4+2
	DSE1	Chem.311	Analytical Methods in Chemistry	4+2
		Chem.312	Instrumental Methods of Chemical Analysis	4+2
	DSE2	Chem.321	Bioinorganic & Environmental Chemistry	4+2
		Chem.322	Quantum Chemistry, Spectroscopy & Photochemistry	4+2
			<i>Total Credit Hours to be studied in Discipline – C</i>	<i>36</i>

Ability Enhancement Courses	AECC-I	Eng.111	English Communication	2+0
	AECC-II	Env.121	Environmental Studies	3+0
			<i>Total Credit Hours to be studied in AECC</i>	<i>05</i>
Skill Enhancement Courses	SEC-I	Comp.211	Computer Application	2+1
	SEC-II	Stat.221	Elements of Statistics	2+1
		Comp.221	Databases with MS Access	2+1
	SEC-III	Bot.313	Medicinal Botany	2+1
		Zoo.313	Aquarium Fish Keeping	2+1
		Chem.315	Chemistry of Cosmetics & Perfumes	2+1
		Micro.311	Techniques in Clinical Microbiology	2+1
	SEC-IV	Bot.323	Ethnobotany	2+1
		Zoo.323	Public Health and Hygiene	2+1
		Chem.325	Analytical Clinical Biochemistry	2+1
		Micro.321	Fermentation Technology	2+1
			<i>Total Credit Hours to be studied in SEC</i>	<i>12</i>
GI/Hobby	Gen.Int./Hobby	Ort.111	Orientation	1+0(NC)
		NCC/NSS	National Cadet Corps/National Service Scheme	0+8(NC)
			<i>Total Credit Hours to be studied in GI/Hobby</i>	<i>09(NC)</i>
			TOTAL Credit Hours for Degree	125+9(NC)
Note: Universities may include more options or delete some from the lists of Discipline Specific and Skill Enhancement Courses.				

BOTANY

(DISCIPLINE – A)

CORE COURSES:

Bot.111 Biodiversity (Microbes, Algae, Fungi and Archegoniate) 4+2

THEORY (60 Lectures)

UNIT-I: Microbes: Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Citrus canker and AIDS. Economic importance; Structure, nutrition, reproduction and economic importance and general account of cyanobacteria. **(10 Lectures)**

UNIT-II: Algae: General characters, classification and economic importance, important features and life history of Chlorophyceae-*Volvox*, *Oedogonium*, Bacillariophyceae- diatoms, Xanthophyceae-*Vaucheria*, Phaeophyceae-*Ectocarpus*, Rhodophyceae-*Polysiphonia*. **(12 Lectures)**

UNIT-III: Fungi: General Characters, range of thallus organization, cell wall composition, nutrition, classification and economic importance, important feature and life history of Mastigomycotina – *Albugo*, *Phytophthora*, Zygomycotina-*Rhizopus*; Ascomycotina-*saccharomyces*, *Eurotium*, *Peziza*; Basidimycotina-*Puccinia*, *Agaricus*; Deuteromycotina- *Cercospora*; *Colletortichum*.
Definition, symptom, classification and etiology of following diseases: White rust, late blight of potato, early blight of potato, apple scab, loose smut of wheat, rust of wheat, red rot of sugarcane.
General account of lichens. Mycorrhizae: classification & significance. **(12 Lectures)**

UNIT-IV: Introduction to Archegoniate: Unifying features of archegoniates, Transition to land habit, Alternation of generations. **(2 Lectures)**

UNIT-V: Bryophytes: General characteristics, adaptations to land habit, range of thallus organization, classification (upto family), Morphology, structure, reproduction and life history of Marchantia and Funaria, (Developmental details not to be included) economic and ecological importance with special reference to Sphagnum. **(10 Lectures)**

UNIT-VI: Pteridophytes: General characteristics, classification (upto family); Morphology, anatomy and reproduction and life history of *Selaginella*, *Equisetum* and *Pteris* (Developmental details not to be included). evolution of stele, heterospory and origin of seed habit; general account of fossil pteridophyta with special reference to Rhynia; Ecological importance of Pteridophytes. **(8 Lectures)**

UNIT-VII: Gymnosperms: General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included). Ecological and economical importance. **(6 Lectures)**

PRACTICAL

1. Study of representative member of Algae, Bacteria and Viruses;
2. Symptomology of some diseases: citrus canker, bacterial blight of paddy, TMV, little leaf of brinjal etc.

3. Gram staining of bacteria: Sterilization method.
4. Morphological study of representative members of Fungi-*Peronospora*, *Albugo*, *Mucor*, *Pilobolus*, *Yeast*, *Emericella*, *Chaetomium*. *Pleospora*, *Morchella*, *Melanspora*, *Phallus*, *Polyporus*, *Drechslera*, *Phoma*, *Penicillium*, *Aspergillus*, *Colletotrichum*.
5. Symptomology of disease specimens-White rust, downy mildew, powdery mildew, rusts smuts, ergot, groundnut leaf spot and citrus canker;
Lichens: Study of growth forms of lichens (crustose, foliose & fruticose)
6. Sterilization method, preparation of media and stains.
7. ***Marchantia***- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
8. ***Funaria***- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
9. ***Selaginella***- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
10. ***Equisetum***- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry) (temporary slides); t.s. rhizome (permanent slide).
11. ***Pteris***- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
12. ***Cycas***- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
13. ***Pinus***- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarf shoot, t.s. needle, t.s. stem, l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. & r.l.s. stem (permanent slide).

SUGGESTED READINGS

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson. Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan. Publishers Pvt. Ltd., Delhi.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John. Wiley and Sons (Asia), Singapore. 4th edition.
5. Raven, P.R., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
7. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
8. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

Bot.121 Plant Ecology and Taxonomy

4+2

THEORY (60 Lectures)

UNIT-I: Plants and environment: Ecological factors: Atmosphere (gaseous composition). Water (properties of water and water cycle), light (global radiation, photosynthetically active radiation), temperature, soil (development, soil profiles, physico-chemical properties) and biota. (4 Lectures)

UNIT-II: Ecological adaptations: Morphological, anatomical and physiological responses of plants to water (hydrophytes and xerophytes), temperature (thermoperiodicity and vernalization), light (photoperiodism, heliophytes and sciophytes) and salinity. (4 Lectures)

UNIT-III: Population ecology: Definition, Population characteristics, population dynamics & regulation, ecotypes, ecads. (4 Lectures)

UNIT-IV: Community ecology: Definition, Community characteristics, Biological spectrum, Ecological succession. (4 Lectures)

UNIT-V: Ecosystems: Structure (biotic and abiotic components) ecological pyramids, and function of ecosystems; food chain, food web, energy flow; biogeochemical cycles of carbon, nitrogen and phosphorus. (8 Lectures)

UNIT-VI: Biogeographical regions of India: General account of biogeographical regions of India, Vegetation types of India: Forests and grasslands (6 Lectures)

UNIT-VII: Introduction to Plant Taxonomy: Angiosperm-origin and evolution, some examples of primitive angiosperms; Angiosperm taxonomy, brief history, aims and functional components (taxonomy, holotaxonomy,) identification keys, taxonomic literature; botanical nomenclature, principles and rules, taxonomic ranks, type concept, principle of priority. (10 Lectures)

UNIT-VIII: Classification: Classification of angiosperms, salient feature of the systems proposed by Bentham and Hooker and Engler and Prantl. (3 Lectures)

UNIT-IX: Taxonomical Evidences: Major contribution of cytology, phytochemistry and taxometrics to taxonomy; (3 Lectures)

UNIT-X: Diversity of Flowering Plants: Study of diversity of flowering plants as illustrated by members of the families- Brassicaceae, Malvaceae, Rutaceae, Fabaceae, Apiaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Euphorbiaceae and Poaceae. (14 Lectures)

PRACTICAL

1. Determination of minimum quadrat size for the study of herbaceous vegetation through species area curve method.
2. Determination of minimum quadrat number of pre-determined size for the study of herbaceous vegetation through species area curve method.
3. Quantitative analysis of herbaceous vegetation for frequency and comparison with Raunkiaer's frequency distribution law.
4. Study of instruments used to measure microclimatic variables: soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
5. Determination of pH, porosity and moisture content of soil of minimum three different habitats.
6. To estimate transparency, pH and temperature of different water bodies.
7. To estimate dust holding capacity of the leaves of different plant species.

This list is only indicative. Teachers may select plant available in their locality.

Study of inflorescence, flower in the following families : **Brassicaceae**- *Brassica*, *Alyssum*, *Iberis*, *Coromopus*; **Malvaceae**- *Hibiscus*, *Abutilon*; **Rutaceae**- *Murraya*, *Citrus*; **Fabaceae**-*Lathyrus*, *Cajanus*, *Melilotus*, *Trigonella*, **Apiaceae**-*Coriandrum*, *Foeniculum*, *Anethum* **Apocynaceae**-*Vinca*, *Thevetia*, *Nerium*; **Asclepiadaceae**- *Calotropis*; **Solanaceae**-*Solanum*, *Whithania*, *Datura*; **Lamiaceae**-*Ocimum*, *Salvia*; **Euphorbiaceae**- *Euphorbia*, *Phyllanthus* and **Poaceae**- *Avena*, *Triticum*, *Hordaeum*, *Poa*, *Sorghum*.

SUGGESTED READINGS

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
3. Simpson, M.G. (2006). *Plant Systematics*. Elsevier Academic Press, San Diego, CA, U.S.A.

4. Singh, G. (2012). *Plant Systematics: Theory and Practice*. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
5. Sharma, O.P. (2011). *Plant Taxonomy*. Tata Mc Graw –Hill publishing company, New Delhi. 2nd edition.

Bot.211 Plant Anatomy and Embryology

4+2

THEORY (60 Lectures)

UNIT-I: Meristematic and Permanent Tissues: The shoot apex and its histological organization, the root apical meristem, simple and complex tissues. **(8 Lectures)**

UNIT-II: Organs: Structure of dicot and monocot stem, root and leaves, vascularisation of primary shoot in monocotyledons and dicotyledons, formation of internodes, **(8 Lectures)**

UNIT-III: Secondary Growth: Vascular cambium-structure and function, formation of secondary xylem, a general account to wood structure in relation to conduction of water and minerals, characteristics of growth rings, sapwood and heartwood, role of woody skeleton, secondary phloem structure- function relationship, periderm. Secondary growth in root **(8 Lectures)**

UNIT-IV: Adaptive and Protective Systems: Epidermis, cuticle and stomata, general account of adaptations in xerophytes and hydrophytes. **(6 Lectures)**

UNIT-V: Structural Organization of Flower: Flower: A modified shoot, structure and varieties of flower, function, microsporangium and megasporangium development, the male and female gametophytes development, Structure and types of ovules; Types of embryo sacs, **(14 Lectures)**

UNIT-VI: Pollination and Fertilization: Types of pollination, attraction and rewards for pollinators, pollen pistil interaction, self-incompatibility; double fertilization: fruit development and maturation, formation of seed, significance of seed. **(8 Lectures)**

UNIT-VII: Embryo and Endosperm: Endosperm and embryo, endosperm types, embryo endosperm relationship, Apomixis and Embryony: Definition, types and practical application. **(8 Lectures)**

PRACTICAL

1. Anatomy of primary and secondary growth in monocots and dicots using hand sections (or prepared slides).
2. Structure of secondary phloem and xylem, (growth rings in wood).
3. Microscopic study of wood in T.S., T.L.S/ and R.L.S; field study of diversity in leaf shape, size, thickness, surface properties.
4. Internal structure of leaf; structure and development of stomata (using epidermal peels of leaf.); anatomy of root- primary and secondary structure.
5. Examination of a wide range of flowers available in the locality and methods of their pollination;
6. Structure of anther, microsporogenesis (using slides) and pollen grains (using whole mounts),
7. Study of pollen viability using in vitro pollen germination.
8. Structure of ovule and embryo sac development (using serial sections).
9. Nuclear and Cellular endosperm.
10. Embryo development in monocots and dicots (using slides/ dissections).
11. Germination of non-dormant and dormant seeds.

SUGGESTED READINGS

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). *Embryology of Angiosperms*. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). *Plant Anatomy*. The Benjamin/Cummings Publisher, USA.

3. Vasistha,P.C. (1988). Plant Anatomy.Pradeep Publications Jalandher.
4. S. N. Pandey and Ajanta Chadha, (1996).Plant Anatomy and Embryology, Vikas Publishing House PVT Limited Noida, New Delhi.
5. Evert F.Ray (2006). Esau's Plant Anatomy.John Wiley & Sons,Inc.publication,USA.

Bot.221 Plant Physiology and Metabolism

4+2

THEORY (60 Lectures)

UNIT-I: Plant-water relation: Importance of water to plant life, physical properties of water, diffusion and osmosis, absorption, transportation of water and transpiration, physiology of stomata. **(8 Lectures)**

UNIT-II: Mineral nutrition: Essential macro and micro-elements and their role, mineral uptake, deficiency and toxicity symptoms. **(6 Lectures)**

UNIT-III: Transports of organic substances: Mechanism of phloem transport, source-sink relationship, factors affecting translocations. **(4 Lectures)**

UNIT-IV: Photosynthesis: Significance, historical aspects, photosynthetic pigments, action spectra and enhancement effect, concept of two photo systems, z-scheme, photophosphorylation, Calvin cycle, C-4 pathway, CAM plants, photorespiration. **(12 Lectures)**

UNIT-V: Respiration: ATP-The biological energy currency, aerobic and anaerobic respiration, Krebs cycle, electron transport mechanism (chemiosmotic theory), redox-potential, oxidative phosphorylation. **(8 Lectures)**

UNIT-VI: Enzymes: Basics of enzymology: Structure and properties, regulation of enzyme activity, mechanism of action and inhibition. **(4 Lectures)**

UNIT-VII: Nitrogen metabolism: Biology of nitrogen fixation, importance of nitrate reductase and its regulation, ammonium assimilation. **(6 Lectures)**

UNIT-VIII: Growth and development: Definitions; phases of growth and development, kinetics of growth; seed dormancy, seed germination and factor of their regulation; concept of photoperiodism; physiology of flowering; florigen concept; physiology of senescence, fruit ripening, plant hormones-auxins, gibberellins, cytokinins, abscisic acid and ethylene, history of their discovery, biosynthesis and mechanism of action; photo morphogenesis; phytochromes ,discovery, physiological role and mechanism of action. **(12 Lectures)**

PRACTICAL

1. To study the permeability of plasma membrane using different concentrations of organic solvents;
2. To study the effect of temperature on permeability of plasma membrane;
3. To study preparation of standard curve of protein and determine the protein content in unknown samples.
4. To study the enzyme activity of catalase and peroxidase as influenced by pH and temperature;
5. Comparison of the rate of respiration of various plant parts.
6. Separation of chloroplast pigments by solvent method;
7. Determination of osmotic potential of vacuolar sap by plasmolytic method.
8. Determining of water potential of any tuber.
9. Separation of amino-acids in the mixture of paper chromatography and their identification by comparison with standards.
10. Bioassay of auxin, cytokinin, GA, ABA and ethylene using appropriate plant material.

SUGGESTED READINGS

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
4. Pandey, S.N., Sinha, B.K. (1986). Plant Physiology, Vikas Publisher.
5. Noogle, G. Ray & George, J. Fritz (2013). Introductory Plant Physiology, PHI learning Private limited, Delhi.

DISCIPLINE SPECIFIC ELECTIVE

Bot.311 Analytical Techniques in Plant Sciences

4+2

THEORY (60 Lectures)

UNIT-I: Imaging and related techniques: Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy - sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching. **(20 Lectures)**

UNIT-II: Cell fractionation: Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl₂ gradient, analytical centrifugation, ultracentrifugation, marker enzymes. **(11 Lectures)**

UNIT-III: Radioisotopes: Use in biological research, auto-radiography, pulse chase experiment **(5 Lectures)**

UNIT IV: Spectrophotometry: Principle and its application in biological research **(7 Lectures)**

UNIT-V: Chromatography: Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography. **(9 Lectures)**

UNIT-VI: Characterization of proteins and nucleic acids: Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE **(8 Lectures)**

PRACTICAL

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PeR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separate DNA (marker) using AGE.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze

- etching, negative staining, positive staining, fluorescence and FISH).
11. Preparation of permanent slides (double staining).

SUGGESTED READINGS

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing co. Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.
5. Wilson, K., Walker, J (2006). Principles and techniques of Biochemistry and Molecular Biology. Cambridge University Press, New York, USA. 6th edition.

Bot.312 Cell and Molecular Biology

4+2

THEORY (60 Lectures)

UNIT-I: Techniques in Biology: Principles of microscopy; Light Microscopy; Phase contrast microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; **(8 Lectures)**

UNIT-II: Cell as a unit of Life: The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components. **(2 Lectures)**

UNIT-III: Cell Organelles:

Mitochondria: Structure and function.

Chloroplast: Structure and function.

ER, Golgi body: Structures and roles.

Peroxisomes, Glyoxisomes and vacuole: Structures, composition, functions in animals and plants

Nucleus: Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief).

Chromosome organization:

Morphology, centromere and telomere, chromosome alternation, deletions, duplications, translocations, inversions. variation in chromosome number, aneuploidy, polyploidy **(22 Lectures)**

UNIT-IV: Cell Membrane and Cell Wall: The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall. **(6 Lectures)**

UNIT-V: Cell Cycle: Overview of Cell cycle, Mitosis and Meiosis; **(6 Lectures)**

UNIT-VI: Regulation of gene expression: Prokaryotes: Lac operon and Tryptophan operon ; and in Eukaryotes. **(6 Lectures)**

PRACTICAL

1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
2. Study of the photomicrographs of cell organelles
3. To study the structure of plant cell through temporary mounts.
4. Study of mitosis and meiosis (temporary mounts and permanent slides).
5. Study the effect of temperature, organic solvent on semi permeable membrane.
6. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.

7. Measure the cell size (either length or breadth diameter) by micrometry.
8. Study the structure of nuclear pore complex by photograph (from Gerald Karp) Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
9. Study DNA packaging by micrographs.
10. To study cell structure from onion leaf peels.
11. Demonstration of staining and mounting method;
12. Comparative study of cell structure in onion cells, *Hydrilla* and *Spirogyra*
13. Study of electron micrograph of viruses, bacteria, cyanobacteria and eukaryotic cells for comparative cellular organization.

Suggested Readings

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Powar, C.B. (1983). Cell Biology. Himalaya Publishing House, Bombay. 3rd Edition.

Bot.321 Research Methodology

4+2

THEORY 60 Lectures)

UNIT-I: Basic concepts of research: Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research. **(10 Lectures)**

UNIT-II: General laboratory practices: Common calculations in botany laboratories. Understanding the details on the label of reagent bottles. Molarity and normality of common acids and bases. Preparation of solutions. Dilutions. Percentage solutions. Molar, molal and normal solutions. Technique of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling. **(12 Lectures)**

UNIT-III: Data collection and documentation of observations: Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissue specimens and application of scale bars. The art of field photography. **(6 Lectures)**

UNIT-IV: Overview of Biological Problems: History; Key biology research areas, Model organisms in biology (A Brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics, Proteomics- Transcriptional regulatory network. **(6 Lectures)**

UNIT-V: Methods to study plant cell/tissue structure: Whole mounts, peel mounts, squash preparations, clearing, maceration and sectioning; Tissue preparation: living vs fixed, physical vs chemical fixation, coagulating fixatives, non-coagulant fixatives; tissue dehydration using graded solvent series; Paraffin and plastic infiltration; Preparation of thin and ultrathin sections. **(6 Lectures)**

UNIT-VI: Plant microtechniques: Staining procedures, classification and chemistry of stains. Staining equipment. Reactive dyes and fluorochromes (including genetically engineered protein labeling with GFP and other tags). Cytogenetic techniques with squashed plant materials. **(12 Lectures)**

UNIT-VII: The art of scientific writing and its presentation: Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Powerpoint presentation. Poster

presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism. **(8 Lectures)**

PRACTICAL

1. Experiments based on chemical calculations.
2. Plant microtechnique experiments.
3. The art of imaging of samples through microphotography and field photography.
4. Poster presentation on defined topics.
5. Technical writing on topics assigned.

SUGGESTED READINGS

1. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.
3. Ruzin, S.E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.

Bot. 322 Economic Botany and Biotechnology

4+2

THEORY (60 Lectures)

UNIT-I: Origin of Cultivated Plants: Concept of centres of origin, their importance w.r.t. Vavilov's work. **(2 Lectures)**

UNIT-II: Cereals: Origin, morphology and uses of Rice, Wheat, Maize. **(6 Lectures)**

UNIT-III: Legumes: General account with special reference to Gram. **(4 Lectures)**

UNIT-IV: Spices: General account with special reference to Clove. **(6 Lectures)**

UNIT-V: Beverages: Tea (Morphology, processing and uses). **(4 Lectures)**

UNIT-VI: Oils and Fats: General description with special reference to Mustard. **(4 Lectures)**

UNIT-VIII: Fibre Yielding Plants: General description with special reference to Cotton (Botanical name, family, part used, morphology and uses). **(4 Lectures)**

UNIT-VIII: Plants of Utility: General account of sources of firewood, timber, medicinal plants **(4 Lectures)**

UNIT-IX : Introduction to biotechnology. **(2 lecture)**

UNIT-X: Recombinant DNA Techniques: Tools and techniques of recombinant DNA technology; cloning vectors; genomic and cDNA library techniques of gene mapping and chromosomes walking; Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection, salient achievement in crop biotechnology. **(18 lecture)**

UNIT-XI: Plant Tissue Culture: Micropropagation, basic aspects of plant tissue culture; cellular totipotency, differentiations and morphogenesis; haploid production through androgenesis and gynogenesis; brief account of embryo & endosperm culture with their applications. **(8 lecture)**

PRACTICAL

1. Study of the morphology, structure and simple micro chemical tests of the food storing tissues in rice, wheat, maize,
2. Microscopic examination of starch in rice, wheat, maize.
3. Study of cotton flowers, sectioning of the cotton ovules/ developing seeds to trace the origin and development of cotton fibres.
4. Microscopic study of cotton and test for cellulose.
5. Tests for lignocelluloses.
6. Study of hand sections of mustard.
7. Staining of oil drops by Sudan III and Sudan Black.
8. Field visits to study sources of firewood (10plants), timber-yielding trees (10) and preparation of their list mentioning special features.
9. Examination and brief description of hand section of clove.
10. Preparation of an illustrated inventory of 10 medicinal plants used in indigenous systems of medicine or allopathy along with their botanical and common names, part used and diseases/ disorders for which they are prescribed.
11. Study of the characteristic structural features of tea leaves.
12. Demonstration of technique of micropropagation by using different experiments, e.g. axillary buds, shoot meristems;
13. Demonstration of the technique of anther culture.
14. Isolation of protoplasts from different tissues using commercially available enzymes.
15. Demonstration of root and shoot formation from the apical and basal portion of stem segments in liquid medium containing different hormones.
16. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

SUGGESTED READINGS

1. Kochhar, (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, Bit., Pasternak, (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
4. M.W. Strickberger (2008). Genetics. Phi Learning Publishers
5. E.J. Gardener, M.J. Simmons and D.P. Snustad (2010). Principles of Genetics. 6th ed. Wiley India Pvt. Ltd.
6. B.D. Singh (2004) Fundamental of Genetics. Kalyani Publishers. New Delhi.
7. P.K. Gupta (1990) Genetics. Rastogi Publishers. New Delhi.

PRACTICAL

1. Study of the following specimens:
Amoeba, Euglena, Plasmodium, Paramecium, Sycon, Hyalonema, Euplectella, Obelia, Physalia, Aurelia, Tubipora, Metridium, Taenia solium, Male and female Ascaris lumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria and Antedon, Balanoglossus, Herdmania, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla, Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis. Any six common birds from different orders; *Sorex, Bat, Funambulus, Loris.*
2. Study of the following permanent slides:
T.S. and L.S. of *Sycon*, Study of life history stages of *Taenia* and *Fasciola*, T.S. of Male and female *Ascaris*.
3. An "**animal album**" containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.
4. Mounting of scales of fishes.

SUGGESTED READINGS

1. Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders, International Edition.
2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis, III Edition, Blackwell Science*
3. Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
4. Modern Text Book of Zoology-Vertebrates by-R.L.Kotpal, Rastogi Publications
5. Modern's Zoology Vol.I- Vertebrate Zoology by –Ashok Sabharwal and Dr. S.K.Malhotra

Zoo 121 Comparative Anatomy and Developmental Biology of Vertebrates 4+2

THEORY (60 Lectures)

- UNIT-I: Integumentary System: Structure, function and development of its derivatives. (5 Lectures)
- UNIT-II: Skeletal System: Evolution of visceral arches. (3 Lectures)
- UNIT-III: Digestive System: Brief account of alimentary canal and digestive glands, Structure of stomach in cattle. (6 Lectures)
- UNIT-IV: Circulatory System: Evolution of heart and aortic arches. (8 Lectures)
- UNIT-V: Respiratory System: Accessory respiratory organs. (6 Lectures)
- UNIT-VI: Urino Genital System: Evolution and succession of kidney and genital ducts. (6 Lectures)
- UNIT-VII: Nervous System: Evolution of cerebral hemispheres and cerebellum. (6 Lectures)
- UNIT-VIII: Sense Organs Types of receptors. (6 Lectures)
- UNIT-IX: Early Development, Blastulation and Gastrulation: Types of eggs, gametogenesis, fertilization, cleavage; Process of blastulation and gastrulation in *Amphioxus*, frog and chick; Fate map construction in frog and chick; Metamorphosis in frog. (7 Lectures)
- UNIT-X: Extra Embryonic Membranes and Placentation: Embryonic and extra embryonic membranes in birds and mammals; Placenta in mammals, Implantation, Parturition and Lactation.

(7 Lectures)

PRACTICAL

1. Comparative study of various systems of vertebrates studied in theory through charts.
2. Frog - Study of developmental stages - whole mounts and sections through permanent slides - cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.
3. Chick-13-18 hrs, 24-33 hrs, 36-48 hrs, 48-72 hrs.
4. Study of the different types of placenta- histological sections through permanent slides or photomicrographs.
5. Examination of gametes-Frog/Rat- sperm and ova through permanent slides or photomicrographs.

SUGGESTED READINGS

1. Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education.
2. Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies.
3. Modern Text Book of Zoology-Vertebrates By-R.L. Kotpal, Rastogi Publications
4. Modern's Zoology Vol.I- Vertebrate Zoology By –Ashok Sabharwal and Dr. S.K.Malhotra
5. Gilbert, S. F. (2006). *Developmental Biology*, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.

Zoo 211 Physiology and Biochemistry

4+2

THEORY (60 Lectures)

UNIT-I: Nutrition, Digestion and Absorption: Nutritional requirements, composition, function and regulation of salivary, gastric, pancreatic, hepatic and intestinal juices. Mechanism of absorption.

(5 Lectures)

UNIT-II: Circulation : Composition and function of blood and lymph, haemopoiesis, blood groups, Rh factor, blood coagulation, structure and function of haemoglobin, structure, origin and conductance of heart beat, pace maker system, cardiac cycle, blood pressure, electrocardiogram-an elementary idea.

(5 Lectures)

UNIT-III: Respiration : Mechanism and control of breathing; transport of oxygen and carbon dioxide, oxygen dissociation curves of Haemoglobin and Myoglobin, Bohr's effect and chloride shift.

(4 Lectures)

UNIT-IV: Excretion: Nitrogenous wastes, urine formation and water balance.

(3 Lectures)

UNIT-V: Muscles: Types of muscles, structure of skeletal muscle cell, mechanical and biochemical basis of muscle contraction, muscle fatigue.

(4 Lectures)

UNIT-VI: Nervous System: Structure of neuron, nature, origin and propagation of nerve impulse, synaptic junctions, myoneural junctions.

(4 Lectures)

UNIT-VII: Skeletal System: Bone and their types, ossification; joints and articulation.

(2 Lectures)

UNIT-VIII: Endocrines and Reproduction: Detailed structure of pituitary glands, nature and functions of pituitary hormones, feedback relationships with other endocrines; Gonadal hormones, estrous cycle, implantation, parturition, lactation.

(10 Lectures)

UNIT-IX: Elementary Idea of Analytical and Separation Techniques: Ultracentrifugation, electrophoresis and chromatography.

(2 Lectures)

UNIT-X: Chemical Nature of Protoplasm: Chemistry of carbohydrates, proteins, lipids and nucleic acids. **(4 Lectures)**

UNIT-XI: Enzymes and Co-Enzymes: Definition, nature, functions; Specificity and classification of enzymes and co-enzymes, enzyme action; high energy compound: phosphagens, phosphate bonding, formation of ATP, energy release and oxidation mechanism. **(4 Lectures)**

UNIT-XII: Carbohydrate Metabolism: Glycolysis, Krebs's Cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain. **(7 Lectures)**

UNIT-XIII: Lipid Metabolism: Oxidation of fatty acids; fate of glycerol. **(3 Lectures)**

UNIT-XIV: Protein Metabolism: Transamination, Deamination and Ornithine Cycle. **(3 Lectures)**

PRACTICAL

1. Estimation of the haemoglobin and blood cell (RBC and WBC) counts.
2. Study of endocrine glands of rat.
3. Histology of mammalian pituitary, parathyroid, thyroid, pancreas, ovary, testes and adrenal gland.
4. Study of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage.
5. Qualitative and quantitative tests for carbohydrates, lipids, proteins, amino acids; separation of amino acids by paper chromatography.
6. Determination of pH and use of pH meter.
7. Estimation of reducing and non-reducing sugars.
8. Study of human salivary activity in relation to pH and temperature.
9. Study of metabolism through charts.

SUGGESTED READINGS

1. Tortora, G.J. and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley & Sons, Inc.
2. Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
3. Modern's Zoology. Biochemistry and Mammalian physiology by – Sabharwal and Sabharwal.
4. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H. Freeman and Co.
5. Talwar, G.P. & Srivastava, M. Textbook of Biochemistry and Human Biology, 3rd Ed. PHI Learning.

Zoo.221 GENETICS AND EVOLUTIONARY BIOLOGY

4+2

THEORY (60 Lectures)

UNIT-I: Introduction to Genetics and Heredity: Mendel's work on transmission of traits, Principles of inheritance, Chromosome theory of inheritance, Incomplete dominance and co- dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Molecular basis of Genetic Information. **(8 Lectures)**

UNIT-II: Mutations and Chromosomal Aberrations: Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations; structural and numerical alteration of chromosomes. **(8 Lectures)**

UNIT-III: Linkage, Crossing Over, Chromosomal Mapping and Human Genetics : Linkage, crossing over; one, two or three point crossovers, chromosomal mapping, Interference and coincidence, chromosomal and genetic disorders; genetic code and Wobble's hypothesis. **(8 Lectures)**

UNIT-IV: Sex Determination: Chromosomal mechanisms, sex linked inheritance, extra-chromosomal inheritance, dosage compensation. **(7 Lectures)**

UNIT-V: Concept and Theories of Organic Evolution: Concept and evidences of organic evolution; Theories of organic evolution: Lamarckism, Darwinism, mutation and synthetic theory; Origin of life. **(7 Lectures)**

UNIT-VI: Fossils and Processes of Evolutionary Change: Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse and human; Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection. **(8 Lectures)**

UNIT-VII: Species Concept: Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric). **(6 Lectures)**

UNIT-VIII: Realms and Adaptations: A brief account of zoo-geographical regions; adaptations and adaptive radiations. **(8 Lectures)**

PRACTICAL

1. Adaptive modifications in the beaks and feet of birds and mouth parts of insects.
2. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
3. Study of Linkage, recombination, gene mapping using charts.
4. Study of Human Karyotypes (normal and abnormal).
5. Study of fossil evidences from plaster cast models and pictures.
6. Study of homology and analogy from suitable specimens/ pictures.
7. Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors.
8. Phylogeny of human being with diagrams/models.
9. Project report on chromosomal and genetic disorders.

SUGGESTED READINGS

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co.
4. Hall, B. K. and Hallgrímsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers.
5. Text book of evolution by Bir Bala Rastogi

DISCIPLINE SPECIFIC ELECTIVE COURSES

Zoo.311 APPLIED ZOOLOGY

4+2

THEORY (60 Lectures)

UNIT-I: Introduction to Host-Parasite Relationship: Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis. **(8 Lectures)**

UNIT-II: Epidemiology of Diseases: Brief account of arthropods as direct agents of diseases-malaria, filariasis and plague; Epidemic diseases such as typhoid, cholera and small pox, their occurrence and eradication programmes. **(8 Lectures)**

UNIT-III: Protozoans and Helminthes: Brief account of diseases caused by:

Pathogenic protozoa: *Entamoeba*, *Trypanosoma*, *Leishmania*, *Giardia*, *Trichomonas*.

Pathogenic helminthes: *Fasciolopsis*, *Schistosomiasis*, *Echinococcus*, *Ancylostoma*, *Trichinella*, *Wuchereria*, *Dracunculus* and *Oxyuris*. **(8 Lectures)**

UNIT-IV: Insects of Economic Importance : Biology, Control and damage caused by *Helicoverpa armigera*, *Pyrilla perpusilla* and *Papilio demoleus*, *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum* **(8 Lectures)**

UNIT-V: Insects of Medical Importance : Medical importance and control of *Pediculus humanus corporis*, *Anopheles*, *Culex*, *Aedes*, *Xenopsylla cheopis*. **(8 Lectures)**

UNIT-VI: Toxicity and Pest Management : Definition of toxicity, classification of toxicants, toxic agents and their modes of action; study and identification of major crop pest, common house hold pest, stored grain pests, common plant protection appliances and pest control. **(8 Lectures)**

UNIT-VII: Economic Zoology: Brief account of sericulture, lac culture, poultry farming, apiculture and pisciculture. **(12 Lectures)**

PRACTICAL

1. Study of histopathological slides, pathogenic protozoans and parasitic helminthes and their life stages through permanent slides/photomicrographs or specimens.
2. Study of arthropod vectors associated with human diseases.
3. Study of insect damage to different plant parts/stored grains through damaged products/photographs.
4. Identification of cultivable prawns, crabs, lobsters, food fishes, ornamental and exotic fishes.
5. Study of different stages of silkworm and honey bee from egg to adult stage.
6. Visit to poultry farm or animal breeding centre/ apiary. Submission of visit report.
7. Maintenance of freshwater aquarium.

SUGGESTED READINGS

1. Park, K. (2007). *Preventive and Social Medicine*. XVI Edition. B.B Publishers.
2. Arora, D. R and Arora, B. (2001). *Medical Parasitology*. II Edition. CBS Publications and Distributors.
3. Atwal, A.S. (1986). *Agricultural Pests of India and South East Asia*, Kalyani Publishers.
4. Hafez, E. S. E. (1962). *Reproduction in Farm Animals*. Lea & Fabiger Publisher
5. Economic Zoology by Shukla and Upadhyay, Merrut, India.

Zoo.312 AQUATIC BIOLOGY

4+2

THEORY (60 Lectures)

UNIT-I: Aquatic Biomes: Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs. **(13 Lectures)**

UNIT-II: Freshwater Biology: **Lakes**: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico-chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes-Nitrogen, Sulphur and Phosphorous.

Streams: Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes. **(20 Lectures)**

UNIT-III: Marine Biology: Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds. **(12 Lectures)**

UNIT-IV: Management Of Aquatic Resources : Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment- BOD and COD. **(15 Lectures)**

PRACTICAL

1. Determine the area of a lake using graphimetric and gravimetric method.
2. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
3. Determine the amount of Turbidity/transparency, Dissolved Oxygen, Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake/ water body.
4. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance. ¶
5. A Project Report on a visit to a Sewage treatment plant/Marine bio-reserve/Fisheries Institutes.

SUGGESTED READINGS

1. Anathakrishnan : Bioresources Ecology 3rd Edition
2. Goldman : Limnology, 2nd Edition
3. Odum and Barrett : Fundamentals of Ecology, 5th Edition
4. Pawlowski : Physicochemical Methods for Water and Wastewater Treatment, 1st Edition
5. Trivedi and Goyal : Chemical and biological methods for water pollution studies

Zoo.321 IMMUNOLOGY

4+2

THEORY (60 Lectures)

UNIT-I: Overview of the Immune System : Introduction to basic concepts in immunology, components of immune system, principles of innate and adaptive immune system. **(13 Lectures)**

UNIT-II: Cells and Organs of the Immune System : Haematopoiesis, Cells of immune system and organs (primary and secondary lymphoid organs) of the immune system. **(12 Lectures)**

UNIT-III: Antigens : Basic properties of antigens and antibodies, Structure, classes and function of antibodies, monoclonal antibodies, B and T cell epitopes, haptens and adjuvants, hypersensitivity. **(15 Lectures)**

UNIT-IV: Working of the Immune System and its role in Health: Structure and functions of MHC, exogenous and Endogenous pathways of antigen presentation and processing, Basic properties and functions of cytokines, Complement system: Components and pathways. Gell and Coombs' classification and brief description of various types of hypersensitivities, Introduction to concepts of autoimmunity and immunodeficiency, vaccines and its types. **(20 Lectures)**

PRACTICAL

1. Demonstration of lymphoid organs.
2. Histological study of spleen, thymus and lymph nodes through slides/ photographs.
3. Preparation of stained blood film to study various types of blood cells.
4. ABO blood group determination.

5. Demonstration of
 - a. ELISA
 - b. Immunoelectrophoresis
 - c. PCR
 - d. Flow cytometer
 - e. Fluorescence microscope
6. Project report

SUGGESTED READINGS

1. Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). *Immunology*, VI Edition. W.H. Freeman and Company.
2. David, M., Jonathan, B., David, R. B. and Ivan R. (2006). *Immunology*, VII Edition, Mosby, Elsevier Publication.
3. Abbas, K. Abul and Lechtman H. Andrew (2003.) *Cellular and Molecular Immunology*. V Edition. Saunders Publication.

Zoo.322 REPRODUCTIVE BIOLOGY

4+2

THEORY (60 Lectures)

UNIT-I: Reproductive Endocrinology : Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo - hypophyseal - gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.

(15 Lectures)

UNIT-II: Functional anatomy of Male Reproduction: Outline of histology of male reproductive system in rat and human; Testis: Cellular functions, germ cell, stem cell renewal; Spermatogenesis: kinetics and hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract.

(15 Lectures)

UNIT-III: Functional anatomy of Female Reproduction: Outline of histology of female reproductive system in rat and human; Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation, changes in the female tract; Ovum transport in the fallopian tubes; Sperm transport in the female tract, fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto - maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation.

(20 Lectures)

UNIT-IV: Reproductive Health : Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning.

(10 Lectures)

PRACTICAL

1. Observation of live sperms in physiological saline using phase contrast optics.
2. Use of colchicines in arresting anaphase movements (onion root tips); meiosis in grasshopper testis.
3. Study of various organelles under microscope or by using pictographs.
4. Study of animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.

5. Examination of vaginal smear rats from live animals.
6. Surgical techniques: principles of surgery in endocrinology. Ovariectomy, hysterectomy, castration and vasectomy in rats.
7. Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
8. Sperm count and sperm motility in rat.
9. Study of modern contraceptive devices.

SUGGESTED READINGS

1. Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press.
2. Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.
3. Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.
4. Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information Programme.
5. Modern's Zoology. Biochemistry and Mammalian physiology by – Sabharwal and Sabharwal.

CHEMISTRY

(DISCIPLINE – C)

CORE COURSES

Chem.111 Conceptual Organic Chemistry

4+2

THEORY (60 Lectures)

UNIT 1: Stereochemistry: Writing of Fischer projection, Newmann and Sawhorse projection and Wedge formulae. Interconversion of one type of structural representation into another type.

Conformations: Restricted rotation about single bonds, Various conformations of Ethane, Butane, Ethane-1,2-diol and Cyclohexane. Relative stability of different conformations in terms of energy.

Geometrical Isomerism: Requirements for a molecule to show geometrical isomerism, cis- trans and E/ Z notation along with CIP rules for geometrical isomers.

Optical Isomerism: Optical activity, specific and molar rotation, chirality, enantiomerism, diastereoisomerism, racemic mixtures and their resolution by salt formation method.

Relative and absolute configuration: D/L nomenclature system for configuration of carbohydrates (difference between d/l and D/L notations). Threo and Erythro designation. R- and S- configuration (upto two chiral centres). **(18 Lectures)**

UNIT-II: Addition Reactions : Alkenes and Alkynes: Hydrogenation, addition of halogens, Hydrohalogenation (Markovnikov's and anti-Markovnikov's addition), hydration, hydroxylation (cis and trans), oxymercuration-demercuration, hydroboration-oxidation, ozonolysis. Reactivity of alkenes vs alkynes.

Aldehydes and ketones: (formaldehyde, acetaldehyde, benzaldehyde, acetone) Addition of sodium bisulphite, hydrogen cyanide and alcohols.

Addition- elimination reactions with ammonia and its derivatives

Name reactions: Aldol, cross aldol, Claisen, Knoevenagel, Cannizzaro, cross Cannizzaro

Substitution Reactions

Free radical substitution reactions: Halogenation of alkanes, allylic compounds and alkyl benzenes.

Nucleophilic substitution reactions: Alkyl, allyl and benzyl halides – substitution of halogen by some common nucleophiles. Mechanism of S_N1 and S_N2 reactions (stereochemistry, nature of substrate, nucleophile and leaving group)

Benzene diazonium chloride: Replacement of diazo group. **(14 Lectures)**

UNIT-III : Alcohols, amines and phenols: Substitution of active hydrogen, replacement of hydroxyl group in alcohols (using PCl₅, SOCl₂ and HI)

Carboxylic acid derivatives: Hydrolysis ; **Ethers:** Cleavage by HI; **Electrophilic Substitution Reactions (aromatic compounds):** General mechanism of electrophilic substitution reactions (nitration, halogenation, sulphonation, Friedel Crafts alkylation and acylation), directive influence of substituents. **Elimination Reactions:** Alkyl halides (dehydrohalogenation, Saytzeff's rule), vicinal dihalides (dehalogenation), alcohols (dehydration), Quaternary ammonium salts (Hofmann's elimination). Mechanism of E₁ and E₂ reactions (nature of substrate and base), elimination vs substitution. **(14 Lectures)**

UNIT-IV: Oxidation : Aromatic side chain: Oxidation with potassium permanganate, potassium

dichromate

Alcohols: Oxidation with potassium permanganate, potassium dichromate, catalytic dehydrogenation and Oppenauer oxidation. Oxidation of 1,2-diols with periodic acid and lead tetraacetate.

Aldehydes: Oxidation with potassium permanganate, chromic acid and Tollen's reagent

Ketones: Oxidation with potassium permanganate, sodium hypiodite (iodoform reaction) and Baeyer-Villiger oxidation

Reduction:

Aldehydes and Ketones: Catalytic hydrogenation, reduction with sodium borohydride, lithium aluminium hydride, Clemmensen, Wolff-Kishner

Carboxylic acids and their derivatives: Lithium aluminium hydride, sodium-ethanol and Rosenmund reduction.

Nitro compounds: Acidic, alkaline and neutral reducing agents, lithium aluminium hydride and electrolytic reduction. **(14 Lectures)**

PRACTICAL

1. Purification of organic compounds by crystallization using the following solvents:

a. Water

b. Alcohol

2. Determination of the melting points of organic compounds by electrically heated melting point apparatus).

3. Determination of optical activity by using polarimeter

Organic preparations: Carry out the following preparations using 0.5 - 1 g of starting compound. recrystallize the product and determine the melting point of the recrystallized sample.

4. To prepare acetanilide by the acetylation of aniline.

5. To prepare p- bromoacetanilide.

6. Benzoylation of aniline or β -naphthol by Schotten-Baumann reaction

7. Hydrolysis of benzamide or ethyl benzoate.

8. Semicarbazone derivative of one the following compounds: acetone, ethyl methyl ketone, diethylketone, cyclohexanone, benzaldehyde.

9. Oxidation of benzaldehyde by using alkaline potassium permanganate.

SUGGESTED READINGS

1. Modern Approach to Organic Chemistry By B.Sc 1st year by Sehgal.

2. Stereo Chemistry by P.S. Kalsi.

3. Organic Chemistry by Paula Yurkanis Bruice.

4. Reaction Mechanism by O. P. Aggarwal.

5. Modern Organic Chemistry By M.K.Jain and S.C. Sharma.

6. Concise Inorganic Chemistry by J.D. Lee.

7. Advance Organic Chemistry Reaction Mechanism and Structure by Jerry March.

8. Organic Chemistry by SM Mukherji, SP Singh and RP Kapoor, Vol. I, II & III, New Age International Publishers

9. Organic Chemistry (Volume 1) by I. L Finar,

10. Modern Approach to Organic Chemistry By B.Sc 1nd year by Sahgal.

11. Modern Organic Chemistry by M.K. Jain and S.C. Sharma

12. New College Chemistry Vol. I and II by M.K. Jain, S.C. Sharma and Kishor Sharma

13. Fundamentals of Organic Chemistry by J.E McMurry.

For lab

1. Vogel's Text Book of Qualitative Organic analysis (revised) J. Bassett, R.C Cdenney, G H Jettery and J Mendhan, ELBS.

2. Laboratory Manual in Organic Chemistry, R K Bansal.

3. Experimental Organic Chemistry Vol. I & II, P R Singh, D S Gupta and K S Bajpai.

4. Systematic Practical Chemistry for B.Sc 1st, 2nd and 3rd year by P.C Kamboj

THEORY (60 Lectures)

UNIT-I: Carbohydrates: Classification of carbohydrates, reducing and non-reducing sugars, General properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of glucose (Fischer proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosachharides, structure of disachharides (sucrose, maltose, lactose) and polysachharides (starch and cellulose) excluding their structure elucidation. **(12 Lectures)**

UNIT-II: Amino Acids, Peptides, Proteins and Enzymes: Classification of Amino Acids, Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Mechanism of enzyme action, factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition (competitive and non-competitive inhibition including allosteric inhibition). **(20 Lectures)**

UNIT-III: Nucleic Acids and Lipids : Components of Nucleic acids: Adenine, guanine, thymine and cytosine (structure only), other components of nucleic acids, nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic code, Biological roles of DNA and RNA: Replication, Transcription and Translation. Introduction to lipids, classification. Oils and fats: Common fatty acids present in oils and fats, omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol). **(20 Lectures)**

UNIT-IV: Concept of Energy in Biosystems : Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy. Outline of catabolic pathways of Carbohydrates - Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of fats and proteins. Interrelationships in the metabolic pathways of proteins, fats and carbohydrates. **(8 Lectures)**

PRACTICAL

1. Separation of amino acids by paper chromatography
3. Action of salivary amylase on starch
4. Effect of temperature on the action of salivary amylase on starch.
5. To determine the saponification value of an oil/fat.
6. To determine the iodine value of an oil/fat
7. Differentiate between a reducing/non reducing sugar.
8. Extraction of DNA from onion/ cauliflower
9. To synthesize aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC.

SUGGESTED READINGS

1. Modern Approach to Organic Chemistry by Sehgal.
2. Organic Chemistry (*Volume I*), by I. L. Finar.
3. Organic Chemistry (*Volume II*), by I. L. Finar.
4. Lehninger's Principles of Biochemistry 7th Ed. By D. L. Nelson, & M. M. Cox

For lab

1. Vogel's Textbook of Practical Organic Chemistry by B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith, A.R. Tatchell.

Chem.211 Chemical Bonding, Transition Metal & Coordination Chemistry 4+2

THEORY (60 Lectures)

UNIT-I: The Covalent Bond, Structure of molecules, Intermolecular forces and Molecular Orbital Approach: Valence bond approach, Concept of resonance in various organic and inorganic compounds, Hybridization and structure, equivalent and non-equivalent hybrid orbitals, Bent's rule and its applications, VSEPR model for predicting shapes of molecules and ions containing lone pairs, sigma and pi bonds van der Waals forces, Hydrogen bonding and its applications, effects of these forces on melting point, boiling point and solubility.

LCAO method, symmetry and overlap for s-s, s-p and p-p combinations, MO treatment of homonuclear diatomic molecules of 2nd period (B₂, C₂, N₂, O₂, F₂) and heteronuclear di-atomic molecules (CO, NO) and their ions. **(28 Lectures)**

UNIT-II: Transition Elements (3d series): General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.

Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

(12 Lectures)

UNIT-III: Coordination Chemistry : Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT. IUPAC system of nomenclature. Coordination compounds in biological systems: Fe, Cu, Co, Mn, Ni, Zn and heavy metal ions

(10 Lectures)

UNIT-IV: Crystal Field Theory : Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for *O_h* and *T_d* complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination. **(10 Lectures)**

PRACTICAL

Titrimetric Analysis:

Preparations of standard solutions (concept of primary and secondary standards), Different units of concentration (molarity, molality, normality and formality)

(A) Titrations involving Acids-Bases:

Principles of acid-base titrations, Principle behind selection of an appropriate indicator.

1. Standardization of NaOH solution (standard solution of oxalic acid to be prepared)
2. Determination of concentration of carbonate and hydroxide present in a mixture.
3. Determination of concentration of carbonate and bicarbonate present in a mixture.
4. Determination of concentration of free alkali present in soaps/detergents/shampoos.

(B) Titrations involving redox reactions:

Concept of electrode potential, principle behind selection of an appropriate indicator.

5. Standardization of KMnO₄ solution (standard solution of Mohr's salt to be prepared).
6. Determination of concentration of Fe(II) in Mohr's salt and/or K₂Cr₂O₇ using diphenylamine/ N-phenylanthranilic acid as internal indicator (standard solution of K₂Cr₂O₇ and /or Mohr's salt to be prepared).

7. Determination of iron content in ores / alloys using appropriate redox titration.

(C) Complexometric Titrations

Principles of complexometric titrations

8. Determination of concentration of Mg (II) & Zn (II) by titrimetric method using EDTA.
9. Determination of concentration of Ca/Mg in drugs or in food samples.
10. Determination of concentration of total hardness of a given sample of water by complexometric titration.

SUGGESTED READINGS

1. Modern Approach to Inorganic Chemistry by SP Jauhar.
2. Principles of Inorganic Chemistry By Puri, Sharma and Kalia.
3. Inorganic Chemistry by James E Huheee.
4. Advanced Inorganic Chemistry by F.A .Cotton and G Wilkinson.
5. Concise Inorganic Chemistry by J.D. Lee.

For lab

1. Vogel's Text Book of Qualitative Inorganic analysis (revised) J. Bassett, R.C. Cdenney, G. H. Jettery and J. Mendhan.
2. Standard Methods of Chemical Analysis by W. W. Scott.
3. Experimental inorganic Chemistry by W. G. Paimer
4. Systematic Practical Chemistry for B.Sc 1st, 2nd and 3rd year by P.C Kamboj.

Chem.221 Physical Chemistry for the Biosciences

4+2

THEORY

(60 Lectures)

UNIT-I: Chemical Energetics : Review of the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formation, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature - Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances. **(10 Lectures)**

UNIT-II : Chemical and Ionic Equilibrium : Free energy change in a chemical reaction. Thermodynamic derivation of the Law of Chemical Equilibrium. Distinction between ΔG and ΔG^0 , Le Chatelier's principle. Relationships between K_p , K_c and K_x for reactions involving ideal gases. Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts - applications of solubility product principle. **(20 Lectures)**

UNIT-3: Chemical Kinetics : The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero and first order reactions. Half-life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Enzyme kinetics. **(8 Lectures)**

UNIT-V: Spectroscopy and Photochemistry : Introduction to spectroscopy: Electromagnetic radiation, fundamental definitions, electromagnetic spectrum, introduction to concepts of absorption and emission spectroscopy, Beer-Lambert's law.

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations, IR spectrum, fingerprint and group frequency regions and their significance, Hooke's law and vibrational frequency. Factors affecting vibrational frequency.

Characterization of functional groups: alkanes, alkenes, alkynes (only alicyclic systems), aldehydes,

ketones, carboxylic acids and their derivatives, hydroxy compounds and amines. Study of hydrogen bonding.

Electronic Spectroscopy: Electronic transitions, singlet and triplet states, dissociation and predissociation.

UV spectroscopy: Types of electronic transitions, UV spectrum, λ_{\max} , ϵ_{\max} , chromophores, auxochromes, bathochromic shift, hypsochromic shift (definitions and elementary examples) and solvent effect. Characteristic UV transitions in common functional groups.

General applications of UV spectroscopy including distinction between cis-trans isomers. Woodward rules for calculating λ_{\max} in the following systems: Conjugated dienes: alicyclic, homoannular, heteroannular. α, β -unsaturated aldehydes and ketones.

Application of UV and IR in solving structures of simple molecules.

Laws of photochemistry. Fluorescence and phosphorescence. Quantum efficiency and reasons for high and low quantum yields. Primary and secondary processes in photochemical reactions. Photochemical and thermal reactions. **(22 Lectures)**

PRACTICAL

(I) Thermochemistry

1. Determination of heat capacity of a calorimeter for different volumes.
2. Determination of the enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of integral enthalpy of solution of salts (endothermic and exothermic).

(II) pH-metric and conductometric measurements

4. Preparation of sodium acetate-acetic acid buffer solutions and measurement of their pH.
5. Conductometric titrations of (i) strong acid vs strong base (ii) weak acid vs strong base
6. Determination of dissociation constant of a weak acid.

(III) Study the kinetics of the following reactions:

7. Initial rate method: Iodide-persulphate reaction
8. Integrated rate method:
 - a. Acid hydrolysis of methyl acetate with hydrochloric acid.
 - b. Saponification of ethyl acetate

(IV) Colorimetry

9. Verification of Lambert-Beer's Law for potassium dichromate/ potassium permanganate solution.
10. Determination of $pK_{\text{(indicator)}}$ for phenolphthalein.
11. Study the kinetics of interaction of crystal violet with sodium hydroxide colorimetrically.

SUGGESTED READINGS

1. Principles of Physical Chemistry by Puri, Sharma and Pathania.
2. Physical Chemistry by S.C.Khetarpal, G.S, Sharma and R.K. Kalia.
3. Modern Approach to Physical Chemistry by S. Kiran.
4. A text Book of Physical Chemistry by K.K.Sharma and I.K. Sharma
5. Physical Chemistry by P.N.Kapil and S.K.Guglani.
6. Elements of Physical Chemistry by Puri, Sharma and Pathania.

For lab

1. Experimental Physical Chemistry by B.D Khosla
2. Selected experimental in Physical Chemistry, Vol. I by J N Gurtu and R Kapoor.
3. Experimental Physical Chemistry by J C Ghose.
4. Systematic Practical Chemistry for B.Sc 1st, 2nd and 3rd year by P.C Kamboj

DISCIPLINE SPECIFIC ELECTIVE

THEORY (60 Lectures)

UNIT-I : Qualitative and quantitative aspects of analysis: Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

(6 Lectures)

UNIT-II: Optical methods of analysis: Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument.

(6 Lectures)

UNIT-III: Basic principles of quantitative analysis :Estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

(6 Lectures)

UNIT-IV: Infrared Spectrometry : Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope substitution.

(8 Lectures)

UNIT-V: Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

(8 Lectures)

UNIT-VI: Electroanalytical methods: Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pK_a values.

(7 Lectures)

UNIT-VII: Separation techniques: Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions.

(7 Lectures)

UNIT-VIII: Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media. Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: GLC, TLC and HPLC.

(12 Lectures)

PRACTICAL**I. Separation Techniques****1. Chromatography:**

(a) Separation of mixtures

(i) Paper chromatographic separation of Fe^{3+} , Al^{3+} , and Cr^{3+} .

(ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the R_f values.

(b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their R_f values.

II. Solvent Extractions:

2. To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni- DMG complex in chloroform, and determine its concentration by spectrophotometry.

3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

4. Determination of Na, K using flame photometric techniques.

III Spectrophotometry

1. Determination of dissolved oxygen in water.
2. Determination of chemical oxygen demand (COD).
3. Determination of Biological oxygen demand (BOD).
4. Determine the composition of the ferric-salicylate/ ferric-thiocyanate complex by Job's method.

SUGGESTED READINGS

1. Vogel's Textbook of Quantitative Chemical Analysis by G.H Jeffery, , J. Mendham & R.C. Denney.
2. Basic Concepts of Analytical Chemistry. By . S.M.Khopkar.
3. Principles of Instrumental Analysis, by D.A Skoog,. F.J Holler. & T.A Nieman.
4. Laboratory Hand Book of Chromatographic and applied Methods,by Mikes.
5. Principles of Physical Chemistry by Puri, Sharma and Pathania

For Lab

1. Vogel's Textbook of Quantitative Chemical Analysis by G.H Jeffery, , J. Mendham & R.C. Denney.
2. Basic Concepts of Analytical Chemistry. By . S.M.Khopkar.
3. Principles of Instrumental Analysis, by D.A Skoog,. F.J Holler. & T.A Nieman.
4. Laboratory Hand Book of Chromatographic and applied Methods,by Mikes.

Chem.312 Instrumental Methods of Chemical Analysis

4+2

THEORY

(60 Lectures)

UNIT-I: Introduction to spectroscopic methods of analysis: Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation. (6 Lectures)

UNIT-II: Molecular spectroscopy: Infrared spectroscopy:

Interactions with molecules: absorption and scattering. means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection. (8 Lectures)

UNIT-III: UV-Visible/ Near IR : Emission, absorption, fluorescence and photoacoustic. excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and SIN), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoacoustic, fluorescent tags). (8 Lectures)

UNIT-IV: Separation techniques : Chromatography: Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis. (8 Lectures)

UNIT-V: Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser

desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation). **(8 Lectures)**

UNIT-VI: Elemental analysis : Mass spectrometry (electrical discharges). Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences). **(8 Lectures)**

UNIT-VII: NMR spectroscopy : Principle, Instrumentation, Factors affecting chemical shift, Spin coupling, Applications. **(4 Lectures)**

UNIT-VIII: Electroanalytical Methods: Potentiometry & Voltammetry **(6 Lectures)**

UNIT-IX: Radiochemical Methods : X-ray analysis and electron spectroscopy (surface analysis) **(4 Lectures)**

PRACTICAL

1. Safety Practices in the Chemistry Laboratory
2. Determination of the isoelectric precipitation of proteins (casein from milk).
3. Titration curve of an amino acid.
4. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.)
5. Separation of Carbohydrates by Chromatography
6. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption
7. Quantitative Analysis by Gas Chromatography
8. Quantitative Analysis by HPLC

SUGGESTED READINGS

1. Principles of Instrumental Analysis by D.A. Skoog, F.J. Holler & T.A. Nieman.
2. Physical Chemistry by P.W. Atkins.
3. Fundamentals of Molecular Spectroscopy by C.N. Banwell.
4. Physical Chemistry by W.J. Moore.

For Lab

1. Vogel's Textbook of Quantitative Chemical Analysis by G.H Jeffery, , J. Mendham & R.C. Denney.
2. Basic Concepts of Analytical Chemistry. By . S.M.Khopkar.
3. Principles of Instrumental Analysis, by D.A Skoog,. F.J Holler. & T.A Nieman.
4. Laboratory Hand Book of Chromatographic and applied Methods, by Mikes.
5. Principles of Instrumental Analysis by D.A. Skoog, F.J. Holler & T.A. Nieman.

Chem.321 Bioinorganic & Environmental Chemistry

4+2

THEORY (60 Lectures)

UNIT-I: Bio-Inorganic Chemistry : A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+ , K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones). **(12 Lectures)**

UNIT-II: Environment and its segments : Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur. Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in

atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution. Pollution by SO₂, CO₂, CO, NO_x, H₂S and other foul smelling gases. Methods of estimation of CO, NO_x, SO_x and control procedures. Effects of air pollution on living organisms and vegetation.

(12 Lectures)

UNIT-III: Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.

(4 Lectures)

UNIT-IV: Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems. Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment).

(6 Lectures)

UNIT-V: Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal.

Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.

(8 Lectures)

UNIT-VI: Energy & Environment : Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc. Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

(10 Lectures)

UNIT-VII: Biocatalysis : Introduction to biocatalysis: Importance in "Green Chemistry" and Chemical Industry.

(8 Lectures)

PRACTICAL

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO₃ and potassium chromate).
6. Estimation of total alkalinity of water samples (CO₃²⁻, HCO₃⁻) using double titration method.
7. Measurement of dissolved CO₂.
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Paper chromatographic separation of Fe³⁺, Al³⁺ and Cr³⁺ or paper chromatographic separation of Ni²⁺, Co²⁺, Mn²⁺ and Zn²⁺

SUGGESTED READINGS

1. Modern Approach to Inorganic Chemistry by SP Jauhar.
2. Principles of Inorganic Chemistry By Puri, Sharma and Kalia.
3. Inorganic Chemistry by James E Huhee.
4. Environmental Chemistry by A.K. De.
5. Environmental Pollution Analysis S. M. Khopkar.

For Lab

1. Environmental Chemistry by A.K. De.
2. Environmental Pollution Analysis S. M. Khopkar.

THEORY (60 Lectures)

UNIT-I: Quantum Chemistry : Black-body radiation, Planck's radiation law, photoelectric effect, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect. De Broglie hypothesis, Heisenberg's uncertainty principle, Sinusoidal wave equation, Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box. **(10 Lectures)**

UNIT-II: Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2^+ . Bonding and antibonding orbitals. Qualitative extension to H_2 . Comparison of LCAO-MO and VB treatments of H_2 (only wavefunctions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH). Localised and non-localised molecular orbitals treatment of triatomic (BeH_2 , H_2O) molecules. Qualitative MO theory and its application to AH_2 type molecules. **(14 Lectures)**

UNIT-III: Molecular Spectroscopy : Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution. **(4 Lectures)**

UNIT-IV: Vibrational spectroscopy : Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches. **(5 Lectures)**

UNIT-V: Raman spectroscopy : Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion. **(4 Lectures)**

UNIT-VI: Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model. **(4 Lectures)**

UNIT-VII: Nuclear Magnetic Resonance (NMR) spectroscopy : Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules. **(5 Lectures)**

UNIT-VIII: Electron Spin Resonance (ESR) spectroscopy : Its principle, hyperfine structure, ESR of simple radicals. **(2 Lectures)**

UNIT-IX: Photochemistry : Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence. **(12 Lectures)**

PRACTICAL**UV/Visible spectroscopy**

I. Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J

molecule⁻¹, kJ mol⁻¹, cm⁻¹, eV).

II. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of K₂Cr₂O₇. III. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colourimetry

I. Verify Lambert-Beer's law and determine the concentration of CuSO₄/KMnO₄/K₂Cr₂O₇ in a solution of unknown concentration

II. Determine the concentrations of KMnO₄ and K₂Cr₂O₇ in a mixture.

III. Study the kinetics of iodination of propanone in acidic medium.

IV. Determine the amount of iron present in a sample using 1,10-phenanthroline.

V. Determine the dissociation constant of an indicator (phenolphthalein).

VI. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.

VII. Analyse the given vibration-rotation spectrum of HCl(g)

SUGGESTED READINGS

1. Fundamentals of Molecular Spectroscopy by Banwell, & McCash.
2. Introductory Quantum Chemistry by A. K. Chandra,
3. Principles of Physical Chemistry by Puri, Sharma and Pathania.
4. Physical Chemistry by S.C.Khetarpal, G.S, Sharma and R.K. Kalia.
5. Modern Approach to Physical Chemistry by S. Kiran.
6. A text Book of Physical Chemistry by K.K.Sharma and I.K. Sharma
7. Physical Chemistry by P.N.Kapil and S.K.Guglani.
8. Elements of Physical Chemistry by Puri, Sharma and Pathania.

For Lab

1. Experimental Physical Chemistry by B.D Khosla
2. Selected experimental in Physical Chemistry, Vol. I by J N Gurtu and R Kapoor.
3. Experimental Physical Chemistry by J C Ghose.
4. Systematic Practical Chemistry for B.Sc 1st, 2nd and 3rd year by P.C Kamboj

ABILITY ENHANCEMENT COURSES

(AEC)

Eng.111 English Communication 2+0

THEORY (30 Lectures)

UNIT-I: Introduction: Theory of Communication, Types and modes of Communication (6 lectures)

UNIT-II: Language of Communication: Verbal and Non-verbal (Spoken and Written), Personal, Social and Business, Barriers and Strategies, Intra-personal, Inter-personal and Group communication (6 lectures)

UNIT-III: Speaking Skills: Monologue, Dialogue, Group Discussion, Effective Communication/ Mis-Communication, Interview, Public Speech (6 lectures)

UNIT-IV: Reading and Understanding: Close Reading, Comprehension, Summary Paraphrasing, Analysis and Interpretation, Translation (from Indian language to English and vice-versa) Literary/Knowledge, Texts (6 lectures)

UNIT-V: Writing Skills: Documenting, Report Writing, Making notes, Letter writing (6 lectures)

SUGGESTED READINGS:

1. *Fluency in English* - Part II, Oxford University Press, 2006.
2. *Business English*, Pearson, 2008.
3. *Language, Literature and Creativity*, Orient Blackswan, 2013.
4. *Language through Literature* (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas

Env.121 Environmental Studies 3+0

THEORY (45 Lectures)

Unit-I: **Multidisciplinary nature of environmental studies**
Definition, scope and importance; need for public awareness. (2 lecture)

Unit-II: **Natural resources**

Renewable and non-renewable resources

- Natural resources and associated problems:
 - a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
 - b) Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams - benefits and problems.
 - c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
 - d) Food resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizer-pesticides problems, water logging, salinity, case studies.
 - e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources: Land as resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of individual in conservation of natural resources
- Equitable use of resources for sustainable life styles. (8 lectures)

Unit-III: **Ecosystems**

- Concept of an ecosystem
- Structures and function of an ecosystem
- Producers, consumers and decomposers
- Energy flow in ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystems:
 - a) Forest ecosystem
 - b) Grassland ecosystem
 - c) Desert ecosystem
 - d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) (6 lectures)

Unit-IV: **Biodiversity and its conservation**

- Introduction- Definition: genetic, species and ecosystem diversity
- Biogeographical classification of India
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, national and local levels
- India as a mega-biodiversity nation
- Hot-spots of biodiversity
- Threats to biodiversity: Habitat loss, poaching of wild life, man-wild life conflicts
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity (7 lectures)

Unit-V: **Environmental pollution** Definition, causes, effects and control measures of:

- a) Air pollution
 - b) Water pollution
 - c) Soil pollution
 - d) Marine pollution
 - e) Noise pollution
 - f) Thermal pollution
 - g) Nuclear hazards
- Solid waste management: Causes, effects and control measures of rural, urban and industrial waste
 - Fireworks hazards: Types, causes, effects on environment and human health, measures to reduce the usage of fireworks
 - Pollution case studies
 - Disaster management: Floods, earthquakes, cyclone and landslides (9 lectures)

Unit-VI: **Social issues and the environment**

- From unsustainable to sustainable developments
- Resettlement and rehabilitation of people: Its problems and concerns. Case studies
- Environmental ethics: Issues and possible solutions with special reference to role of Indian and other religions and cultures in environmental conservation
- Climate change, global warming, ozone layer depletion, acid rain, nuclear accidents and holocaust. Case studies.
- Waste land reclamation
- Environment Protection Act
- Air (Prevention and control of pollution) Act
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act

- Issues involved in enforcement of environmental legislation (5 lectures)

Unit-VII: **Human population and the environment**

- Population growth, variation among Nations.
- Environment and human health
- Environmental movements: Chipko, silent valley and Bishnois of Rajasthan
- Role of information technology in environment and human health. Case studies. (3 lectures)

Unit VIII: **Field work**

- Visit to local area to document environmental assets – river/forest/grassland/hill/mountains
- Visit to local polluted site – urban/rural/industrial/agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems – pond, river, hill slopes etc. (5 lectures)

SUGGESTED READINGS:

1. Carson, R. 2002. *Silent Spring*. Mifflin Harcourt.
2. Gadgil, M; and Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. Of California Press.
3. Gleeson, B. And Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H.1993. *Water in crises*. Pacific Institute for studies in Dev.; Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J; Gary K.Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K.2013. Threats from Indian Himalayan Dams. *Science*, 339: 36-37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams* (pp.29-64). Zed Books.
8. McNell, Johan R. 2000. *Something New Under the Sun: An Environmental History of the Twentieth Century*.
9. Odum, E.P; Odum, H.T. and Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I. L; Gerba, C. P. & Brusseau, M. L. 2011. *Environmental and Pollution Science*. Academic Press.
11. Rao, M. N. & Datta, A. K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H; Hassenzahl, D. M. & Berg, L.R. 2012. *Environment*. 8 th. Edition. John Wiley & Sons.
13. Rosencranz, A; Divan, S., & Noble, M.L.2001. *Environmental Law and Policy in India...* Tripathy 1992.
14. Sengupta, R. 2003. *Ecology and economics: An approach to sustainable development*. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S. R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
16. . Sodhi, N.S., Gibson, L. & Raven, P. H. (eds.). 2013. *Conservation Biology: voices from the Tropics*, John Wiley & Sons.
17. Thapar, V. 1998. *Land of the Tiger: A Natural History of Indian Subcontinent*.
18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
19. Wilson, E.O. 2006. *The Creation: An appeal to save life on earth*. New York: Norton
20. World Commission on Environment and Development. 1987.. *Our common Future*. Oxford University Press

21. Purohit, S.S. and Rajive Rajan. 2007. Ecology, Environment and Pollution. Agro-bios (India)
22. Sharma, P.D. 2010. Ecology and Environment. Rastogi Publications, Meerut-25000 (India)
23. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner. 2. Bharucha Erach, the Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email: mapin@icenet.net (R).
24. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press. 1140p.
25. Jadhav, H. & Bhosale, V.M. 1995.Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p.
26. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol I and II, Enviro Media (R)
27. Trivedi R.K. and P.K. Goel, Introduction to air pollution, Techno-Science Publications (TB)

SKILL ENHANCEMENT COURSES

(SEC)

SEC-I:

Comp.211 Computer Application

2+1

THEORY (15 Lectures)

UNIT-I: General introduction to computer: definition, characteristics, advantages and limitations of computer, functions of computer, computer organisation. **(5 Lectures)**

UNIT-II: Input and Output devices: Keyboard, Mouse, scanner, MICR, OCR, OMR, Microphone, Monitors (CRT, LCD, LED), Speakers, Printers (Impact and Non-impact) **(5 Lectures)**

UNIT-III: Memory Unit: Primary memory-RAM, Rom and Cache, Secondary memory devices-paper tape, magnetic tape, magnetic disk, Optical disk. **(5 Lectures)**

UNIT-IV: Hardware and Software: Hardware, Software-System Software, Application software and their types. **(4 Lectures)**

UNIT-V: Languages: machine, assembly and high level languages. **(4 Lectures)**

UNIT-VI: Number system: Decimal, Binary, Octal and Hexadecimal number systems, conversion from one number system to another, Binary addition and subtraction, complement method of subtraction (1's complement and 2's complement method) **(7 Lectures)**

PRACTICAL

Working with WINDOWS operating systems: understanding explorer, file/folder attributes, coping and moving files/folders, Understanding Word processing using MS Word, Creating, Editing, Formatting and saving a document in MSWORD; using mail merge in MS Word, Understanding Electronic Spreadsheets using MS Excel, Creating, Editing and Saving a spreadsheet with MSEXCEL. Use of in-built functions and writing user defined expressions in MS Excel. Creating Graphs in MS Excel. Building presentations with MS PowerPoint.

SUGGESTED READINGS:

1. Fundamentals of Computers by E Balagurusamy, McGraw Hill Education.
2. Computer Fundamentals by Anita Goel, Pearson Education.
3. Introduction to Information Technology by Rajaraman V, PHI.
4. Computer Fundamentals by P. K. Sinha, BPB Publications.
5. Introduction to Computers by Peter Norton, McGraw Hill Education.
6. MS Office 2000 Complete by Sybex, Bpb Publications
7. Learning Ms Office 2010 by Bangia, Khanna Publisher
8. Learning Computer Fundamentals, MS Office and Internet & Web Technology Paperback by Dinesh Maidasani, Laxmi Publications.

SEC-II:

Stat.221 Elements of Statistics

2+1

THEORY (30 Lectures)

UNIT I: Definition, scope and limitations of statistics; presentation and summarization of statistical data; frequency distribution and its graphical representation; measures of central tendency, dispersion, skewness and kurtosis. **(15 Lectures)**

UNIT II: Definition and concept of probability; additive and multiplication law of probability (without proof). **(3 Lectures)**

UNIT III: Correlation: Types of correlation and identification through scatter diagram, computation of correlation coefficient. Linear Regression: Fitting of regression equations; Y on X and X on Y; properties of correlation and regression coefficients. **(3 Lectures)**

UNIT IV: Elements of sampling: Simple random sampling, sampling distribution, standard error; tests of significance, large sample test - SND test for means, single sample and two samples; small sample tests for mean: Student's t-test, Fisher's t-test and Paired t-test: F test. **(6 Lectures)**

UNIT V: Analysis of variance for one-way and two-way classified data. **(3 Lectures)**

PRACTICAL

Construction and graphical representation of frequency distribution; calculations of measures of central tendency, dispersion, skewness and kurtosis; correlation and regression analysis; one sample and two sample standard normal deviation tests for mean; Student's t-test, Fisher's t-test and paired t-test; F-test; analysis of variance – one way and two way classified data.

SUGGESTED READINGS

1. Fundamental of Statistics Vol. I by A.M. Goon, M.K. Gupta and B. Dasgupta
2. Fundamental of Statistics Vol. II by A.M. Goon, M.K. Gupta and B. Dasgupta
3. Statistical Methods by S.P. Gupta
4. A Text Book of Agricultural Statistics by R. Rangaswamy
5. Statistical Techniques in Agricultural and Biological Research by D. Raghavarao
6. Practical Manual in Statistics for Undergraduate Students by Manoj Bhargava and Kamlesh Singh

Comp.221 Databases with MS Access

2+1

THEORY (30 Lectures)

UNIT-I: Understanding Databases: Introduction to data, database and Database Systems, Introduction to simple MS Access Objects i.e. tables, queries, forms, reports. **(6 Lectures)**

UNIT-II: Database Design: Basics of Database Normalization, Building tables in MS Access, fields and their data types in MS Access, using primary key in MS Access, Entering data into MS Access Tables with sorting and ordering of records **(6 Lectures)**

UNIT-III: Introduction to Queries: Introduction to CRUD Queries and simple Joins, Building of queries in MS Access. **(6 Lectures)**

UNIT-IV: MS Access Forms: Designing of Simple Forms using simple controls like text box, labels, combo boxes and List Boxes, Switchboards, validating data. **(6 Lectures)**

UNIT-V: MS Access Reports: Designing of Simple Reports-Controls, Headers and Footers for Page, report and Group. **(6 Lectures)**

PRACTICAL

Introduction to Microsoft Access 2007; understanding Access menus, understanding datasheet view and design view, Creating database, adding records to database, Adding and Editing of fields and records.

Creating and running a query, building query from wizard, understanding SQL view for queries in MS Access, specifying criteria in a query, using calculated fields in query.

Creating Form using Auto Form and form wizard, Adding controls to a Form, building switchboard in MS Access.

Creating Reports using wizard, Adding Control to a report, formatting reports, adding calculated control, viewing and printing of report in MS Access.

SUGGESTED READINGS:

1. Fundamentals of Database Systems by R. Elmasri, S.B. Navathe, Pearson Education.
2. Database System Concepts by A. Silberschatz, H.F. Korth, S. Sudarshan, McGraw Hill.
3. An Introduction to Database Systems by C.J. Date, Pearson Education
4. Microsoft Access 2013 Bible by Michael Alexander and Dick Kusleika, Wiley
5. Microsoft Access 2010: Step by Step by Cox, PHI
6. Problem- Solving Cases in Microsoft Access and Excel by Ellen Monk and Gerard S. Cook, Cengage Learning India Private Limited
7. Microsoft Office Access 2007: The Complete Reference by Virginia Andersen, McGraw Hill Education

SEC-III:

Bot.313 Medicinal Botany

2+1

THEORY (30 Lectures)

UNIT-I: History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences; Definition and Scope-Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umooor-e- tabiya, tumors treatments/ therapy, polyherbal formulations. **(10 Lectures)**

Unit-II: Conservation of endangered and endemic medicinal plants. Definition: endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens. Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding. **(10 Lectures)**

UNIT-III: Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany. folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases. **(10 Lectures)**

PRACTICAL:

Visit to herbal Garden/ Botanical garden /National Park, Lay out of Nursery , Nursery Preparation- nursery mixture preparation, poly bags filling, sowing, pricking, cuttings, layering, grafting and budding. Inventorization of important medicinal plants of the region, their identification and uses.

SUGGESTED READINGS

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.
3. T. Pullaiah, 2006. Biodiversity in India. Regency Publications, New Delhi
4. A K Chopra , 2007. Medicinal Plants: Conservation, Cultivation and Utilization. Daya Publishing House. New Delhi.

Zoo.313 Aquarium Fish Keeping**2+1****THEORY (30 Lectures)**

UNIT-I: Introduction to Aquarium Fish Keeping : The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes. **(6 Lectures)**

UNIT-II: Biology of Aquarium Fishes: Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish. **(6 Lectures)**

UNIT-III: Food and Feeding of Aquarium Fishes: Use of live fish feed organisms, Preparation and composition of formulated fish feeds. **(6 Lectures)**

UNIT-IV: Fish Transportation: Live fish transport – Fish handling, packing and forwarding techniques. **(6 Lectures)**

UNIT-V: Maintenance of Aquarium: General Aquarium maintenance - budget for setting up an Aquarium Fish Farm as a Cottage Industry. **(6 Lectures)**

PRACTICAL

1. Study of Exotic and Endemic species of Aquarium fishes through specimens /charts/pictures.
2. Setting up an aquarium and their maintenance.
3. Culture of common aquarium fish feed.
4. Study of morphological characters of fresh water and marine aquarium fishes.
5. Field visit

SUGGESTED READINGS

1. Brymer, J.H.P. Ilif. (1967) Guide to tropical fish keeping.
2. Dutta, R. (1972) Tropical fish setting up and maintenance of fresh water and marine aquarium.
3. Spotte A. (1979) Sea water aquarium. John Wiley.

Chem.315 Chemistry of Cosmetics & Perfumes**2+1****THEORY (30 Lectures)**

Unit-I: A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, sun tan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. **(15 Lectures)**

Unit-II : Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone. **(15 Lectures)**

PRACTICAL

1. Preparation of talcum powder.
2. Preparation of shampoo
3. Preparation of enamels.
4. Preparation of hair remover
5. Preparation of face cream
6. Preparation of nail polish and nail polish remover.

SUGGESTED READINGS

1. E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
2. P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
3. Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

Micro.311 Techniques in Clinical Microbiology

2+1

THEORY (30 Lectures)

Unit-I: Historical introduction, Bacteriology, Virology, Parasitology and Medical Mycology

(8 Lectures)

Unit-II: Morphology, physiology and identification of microorganisms of clinical significance, Normal microflora of human body, Different methods of sterilization and disinfection **(10 Lectures)**

Unit-III: Infection, Immunity and Immunological techniques

(6 Lectures)

Unit-IV: Common diseases in human beings caused by bacteria, viruses and fungi

(6 Lectures)

PRACTICAL

1. Sterilization techniques in medical microbiology
2. Microbiological processing of clinical samples both aerobic and anaerobic
3. Staining techniques, identification and characterization of causative microorganisms
4. Antibiotic sensitivity test
5. Techniques involved in antigen antibody reactions
6. Methods of preservation of clinically important microorganisms
7. Methods for clinical waste disposal

SUGGESTED READINGS

1. Ananthanarayan, Paniker, ArtiKapil "Ananthanarayan & Paniker Textbook Of Microbiology 9th Edition" Universities Press, 2013.
2. Brooks G. F., Carroll K. C., Butel J. S., and Morse S. A., "Jawetz, Melnick & Adelberg's Medical Microbiology 26th Edition" McGraw Hill Education, 2013.
3. David Greenwood, Richard C. B. Slack, Michael R. Barer and Will L Irving "Greenwood Medical Microbiology, 18th Edition" Churchill Livingstone, 2012.
4. Patrick R. Murray, Ken S. Rosenthal and Michael A. Pfaller "Medical Microbiology, 7th Edition" Elsevier, 2013.
5. Michael J. Pelczar, and ECS Chan "Microbiology: An Application Based Approach" Tata McGraw Hill, 2010

SEC-IV:

Bot.323 Ethnobotany

2+1

THEORY (30 Lectures)

UNIT-I: Ethnobotany: Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses. **(6 Lectures)**

UNIT-II: Methodology of Ethnobotanical studies: a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places. **(6 Lectures)**

UNIT-III: Role of ethnobotany in modern Medicine: Medico-ethnobotanical sources in India; Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadirachta indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*. Role of ethnobotany in modern medicine with special example *Rauvolfia serpentina*, *Trichopus zeylanicus*, *Artemisia sp*, *Withania sp*.

Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management). **(10 Lectures)**

UNIT-IV: Ethnobotany and legal aspects: Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge. **(8 Lectures)**

PRACTICAL

Identification of plant specimens : *Azadirachta indica*, *Ocimum sp.*, *Vitex negundo*, *Gloriosa superba*, *Pongamia sp.*, *Cassia sp.*, *Rauvolfia serpentina*, *Artemisia*, *Withania*. Collection of plant part used and uses. Preparation of herbarium of local plants of ethno botanical value. Seed collection and identification of these plants. Visit to a nearby herbal garden,

SUGGESTED READINGS

1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2. S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi - 1981
3. Lone et al., Palaeoethnobotany
4. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists,
5. Badola, H. K. (2001). *Medicinal plant diversity of H.P. Himalayan medicinal plants: potential and prospects*. Himavikas occasional publication no. 14. Nainital: Gyanodaya Prakashan. Lucknow, India.
6. S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.
7. Colton C.M. 1997. Ethnobotany - Principles and applications. John Wiley and sons - Chichester
8. Rama Rao, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra

Zoo 323 Public Health and Hygiene

2+1

THEORY (30 Lectures)

UNIT-I: Introduction: Definition, scope, significance and objectives of public health. **(4 Lectures)**

UNIT-II: Concept and Determinants of Health : Concept of primary health care, biological, socio-economic, behavioral, cultural, environmental and geographical. **(6 Lectures)**

UNIT-III: Health Policies and Acts: Introduction, goals and need of different health policies and legal health aspects. **(10 Lectures)**

UNIT-IV Personal Hygiene: Introduction and scope of personal hygiene, Environmental and Housing Hygiene, Health laws for food safety and hygiene, International control of health, WHO.

(10 Lectures)

PRACTICAL

1. Demonstration of different aspects of public health through charts, pictures/videos.
2. Awareness of different environmental and housing hygiene through various programmes and Campaigns.
3. To organise different sanitation programmes.
4. Project reports.

SUGGESTED READINGS

1. Broadhurst, J. 1918. Home and community hygiene-a text book of personal and public health. Lippincott company.
2. Das. 1926. Manual of hygiene and Public health. A text book for medical and public health students.

Chem.325 Analytical Clinical Biochemistry

2+1

THEORY (30 Lectures)

Unit-I: Introduction: Carbohydrates, proteins, lipids, enzymes and nucleic acids **(18 Lectures)**

Unit-II: Biochemistry of disease: A diagnostic approach by blood/ urine analysis.

Blood: Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin.

Urine: Collection and preservation of samples. Composition and estimation of constituents of urine. **(12 Lectures)**

PRACTICAL

Identification and estimation of the following:

1. Carbohydrates – qualitative and quantitative.
2. Lipids – qualitative.
3. Determination of the iodine number of oil.
4. Determination of the saponification number of oil.
5. Determination of cholesterol using Liebermann- Burchard reaction.
6. Proteins – qualitative.
7. Determination of protein by the Biuret reaction.
8. Blood test
9. Urine test

SUGGESTED READINGS

1. T.G. Cooper: Tool of Biochemistry.
2. Keith Wilson and John Walker: Practical Biochemistry.
3. Alan H Gowenlock: Varley's Practical Clinical Biochemistry.
4. Thomas M. Devlin: Textbook of Biochemistry.

5. Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.
6. Talwar, G.P. & Srivastava, M. *Textbook of Biochemistry and Human Biology*, 3rd Ed. PHI Learning.
7. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry* 7th Ed., W. H. Freeman.
8. Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.

Micro.321 Fermentation Technology

2+1

THEORY (30 Lectures)

Unit-I :Perspectives of Fermentation Technology : An Introduction to Fermentation Process, Main components of a fermenter and their basic functions, Types of fermenters **(8 Lectures)**

Unit-II: Mother culture and their mass cultivation : Isolation and preservation of industrially important microorganisms, development of inocula for industrial fermentations **(5 Lectures)**

Unit-III: Fermentation Kinetics : An overview of aerobic and anaerobic fermentation processes and their application, Microbial growth kinetics in Batch, Fed batch and Continuous culture system their comparison and applications **(7 Lectures)**

Unit-IV: Recovery of Microbial products : Extraction of fermentation products, Primary product isolation and purification, **(4 Lectures)**

Unit-V: Single cell proteins, Strain improvement of industrially important microorganisms, Effluent treatment **(5 Lectures)**

PRACTICAL

1. Exposure to different parts of fermenter
2. Design and preparation of media for fermentation
3. Isolation and identification of industrially microorganisms
4. Preservation of Cultures for Fermentation Processes
5. Preparation of mother culture/starter culture
6. Wine production and its quality check
7. Demonstration of vinegar production using fruit juice
8. Detection of industrially important enzymes produced by microorganisms

SUGGESTED READINGS

1. Peter F.Stanbury, Allan Whitaker and Hall S. J., "Principles of Fermentation Technology 2nd Edition" Butterworth-Heinemann, 1999.
2. Michael L.Shuler and FikretKargi, "Bioprocess Engineering Basic concepts", Prentice Hall, 1992.
3. Willey J. M., Sherwood L.M. and Woolverton C. J., "Prescott,Harley and Klein's Microbiology 8th Edition", McGraw Hill Higher Education, 2013.

GENERAL INTEREST / HOBBY COURSES

Ort.111 Orientation

1+0 (NC)

THEORY (15 Lectures)

Introduction to the university vis-à-vis college-history, functions, organizational set-up; Academic programmes, regulations bodies Academic (ICAR/UGC/VCI), Human resources, Committees on students; welfare; Interaction of fresh students with Dean, faculty members and senior students; Interaction of fresh students with the in-charges of sports, NCC and NSS programmes and Hostel Wardens; Visit to different colleges, directorates; library, health centre and Students' Welfare Organization and interaction with their heads; Familiarization with common terms (Academic year, semester, Choice Based Credit System (CBCS), courses, credit hours, grade point, advisor, tutor, counsellor, SGPA/CGPA/OCGPA etc.); Advisory/counselling system; Minimum class attendance, mass absence, credit load, make-up examination, evaluation of course work; Addition/withdrawal/repeating of course; Re-evaluation/Re-examination of answer sheets; Grading, calculation of SGPA/CGPA/OCGPA; Requirements for continuation/completion of the degree, NCC/NSS requirements, dropping from the university; Semester report, good standing; Conduct and discipline in the college with special reference to hostel rules, examination and ragging, management, Breach of discipline and punishments; Participation in extra-curricular activities; Scholarships/stipends/fellowships, Gold medals; Composition of Students' Association and its role for promoting academic atmosphere; Scope for placement (higher studies/jobs) of graduates in the world market with special reference to fellowships available, information sources and alumni placed, if any; Professional ethics and role of professional towards society.

NCC [(0+2) for First and (0+2) for Second Semester of First Year] 0+4(NC)

Introduction to: Defence services, system of NCC training, Leadership and NCC song, Foot drill, sizing, getting on parade, dismissing and falling out, saluting, marching, weapon training. Introduction and characteristics of weapons, judging distance, five discipline and five control orders, field signals, description of ground; conventional signs, general principles, First aid, Hygiene and sanitation; Camouflage and concealment, NCC annual training camp.

NCC [(0+2) for First and (0+2) for Second Semester of First Year] 0+4(NC)

Forming up in three ranks, open and close order march, dressing; Arms drill, shoulder arm, order arm, present arm, Guard of honour; Ceremonial; Weapon training-rifle bayonet, light machine gun, sten machine carbine, introduction and characteristics stripping, assembling and cleaning, loading, uploading and firing; Field craft, visual training, targets, battle craft; Section formation, section battle drill; scouts and patrols, ambush, field engineering; Map reading, grid systems, use of service protractor, prismatic compass and its use, Self-defence, precautions and training, attack and counter attacks, marching and searching, Civil defence, NCC annual training camp.

Note: One annual training camp is compulsory for award of degree.

NSS ***[(0+2) for First and (0+2) for Second Semester of Second Year]*** **0+4(NC)**

Orientation of NSS volunteers regarding National Service Scheme; formation of group/houses; Adoption of villages; Strategic Frame work: Communication for HIV/AIDS; Environment concerns and strategies in new millennium; Drug abuse, social policing in conflict situation; Role of youth: Disaster management through NSS; Understanding gender; Combating female foeticide; Deadly human diseases; Appointment of office bearers; visit to adopted villages and interaction with villagers to identify the needs and problems of the community; involving the community in the solutions of their problems; Campus beautification drive; Celebration of important days; Van mahotsava.

NSS ***[(0+2) for First and (0+2) for Second Semester of Second Year]*** **0+4(NC)**

Study of philosophy of NSS; Fundamental rights; Socio-economic structure of Indian society; Population problems; Brief of five year plan; Eradication of social evils; Awareness programmes related to HIV/AIDS; Chronic diseases, Cancer, TB etc.; Consumer acts and rights; Disaster management; Motivation of donation of blood and eyes etc.; Campus beautification; Environment enrichment and conservation; Celebration of important days; Van mahotsava; Health, Family welfare and nutrition.

Note: One NSS special camp is compulsory for award of degree.

NSS Special Camping Programme

Activities in the adopted villages

Environment enrichment and conservation

- Water Conservation
- Health, family welfare and nutrition programme
- Water conservation
- Health, family welfare and nutrition programme
- Literacy programme (adult education)
- Creating awareness for improvement of the status of women
- Assistance and guidance in poultry farming animal husbandry, care of animal health
- Self-employment programme.

B.Sc.

Physical Sciences

Details of Courses to be offered to B.Sc. Physical Sciences (Semester-wise)

YEAR	Sem-ester	Discipline/ Subject	Type of Course	Course				
				No.	Title	Cr.Hrs.		
First	First	Physics	CC-I-A	Phys.111	Mechanics	4+2		
		Mathematics	CC-I-B	Math.111	Differential Calculus	5+1*		
		Chemistry	CC-I-C	Chem.112	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	4+2		
		English	AECC-I	Eng.111	English Communication	2+0		
		Gen.Int./ Hobby			Ort.111	Orientation	1+0(NC)	
		Gen.Int./ Hobby			NCC/NSS	NCC/NSS	0+2(NC)	
					Total Credit Hours in Semester-I = 20 + 3 (NC)			
	Second	Second	Physics	CC-II-A	Phys.121	Electricity and Magnetism	4+2	
			Mathematics	CC-II-B	Math.121	Differential Equations	5+1*	
			Chemistry	CC-II-C	Chem.122	Chemical Energetics, Equilibria & Functional Group Organic Chemistry-I	4+2	
			Env. Sci.	AECC-II	Env.121	Environmental Studies	3+0	
			Gen.Int./ Hobby			NCC/NSS	NCC/NSS	0+2(NC)
					Total Credit Hours in Semester-II = 21 + 2 (NC)			
	Second	First	Physics	CC-III-A	Phys.211	Thermal Physics and Statistical Mechanics	4+2	
Mathematics			CC-III-B	Math.211	Real Analysis	5+1*		
Chemistry			CC-III-C	Chem.212	Solutions, Phase Equilibrium, Conductance, Electrochemistry & Functional Group Organic Chemistry-II	4+2		
Computer			SEC-I	Comp.211	Computer Application	2+1		
Gen.Int./ Hobby				NCC/NSS	NCC/NSS	0+2(NC)		
				Total Credit Hours in Semester-III = 21 + 2 (NC)				
Second		Second	Physics	CC-IV-A	Phys.221	Waves and Optics	4+2	
			Mathematics	CC-IV-B	Math.221	Algebra	5+1*	
			Chemistry	CC-IV-C	Chem.222	Transition Metal & Coordination Chemistry, States of Matter and Chemical Kinetics	4+2	
				SEC-II	<i>Any one of the following:</i>			
			Statistics		Stat.221	Elements of Statistics	2+1	
			Computer		Comp.222	Computer Programming using C Language	2+1	
			Gen.Int./ Hobby			NCC/NSS	NCC/NSS	0+2(NC)
				Total Credit Hours in Semester-IV = 21 + 2 (NC)				

Third	First	Physics	DSE-1-A	<i>Any one of the following:</i>			
				Phys.311	Solid State Physics	4+2	
				Phys.312	Elements of Modern Physics	4+2	
		Mathematics	DSE-1-B	<i>Any one of the following:</i>			
				Math.311	Matrices	5+1*	
				Math.312	Mechanics	5+1*	
		Chemistry	DSE-1-C	<i>Any one of the following:</i>			
				Chem.313	Chemistry of Main Group Elements, Theories of Acids and Bases	4+2	
				Chem.314	Quantum Chemistry, Spectroscopy & Photochemistry	4+2	
			SEC-III	<i>Any one of the following:</i>			
	Physics	Phys.313		Weather Forecasting	3+0		
	Mathematics	Math.313		Integral Calculus	3+0		
	Chemistry	Chem.315		Chemistry of Cosmetics & Perfumes	2+1		
					Total Credit Hours in Semester-V = 21		
	Second	Physics	DSE-2-A	<i>Any one of the following:</i>			
				Phys.321	Nuclear and Particle Physics	5+1*	
Phys.322				Digital, Analog and Instrumentation	4+2		
Mathematics		DSE-2-B	<i>Any one of the following:</i>				
			Math.321	Numerical Methods	5+1*		
			Math.322	Complex Analysis	5+1*		
Chemistry		DSE-2-C	<i>Any one of the following:</i>				
			Chem.323	Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy	4+2		
			Chem.324	Analytical Methods in Chemistry	4+2		
		SEC-IV	<i>Any one of the following:</i>				
Physics	Phys.323		Renewable Energy and Energy harvesting	3+0			
Mathematics	Math.323		Vector Calculus	3+0			
Chemistry	Chem.325		Analytical Clinical Biochemistry	2+1			
				Total Credit Hours in Semester-VI = 21			
				TOTAL CREDIT HOURS TO BE STUDIED = 125 + 9 (NC)			
*one credit hour is a period for tutorial							

Details of Courses to be offered to B.Sc. Physical Sciences (Discipline-wise)

Discipline/ Subject	Type of Course	Course		
		No.	Title	Cr.Hrs.
Physics (Discipline-A)	CC	Phys.111	Mechanics	4+2
		Phys.121	Electricity and Magnetism	4+2
		Phys.211	Thermal Physics and Statistical Mechanics	4+2
		Phys.221	Waves and Optics	4+2
	DSE1	Phys.311	Solid State Physics	4+2
		Phys.312	Elements of Modern Physics	4+2
	DSE2	Phys.321	Nuclear and Particle Physics	5+1*
		Phys.322	Digital, Analog and Instrumentation	4+2
			<i>Total Credit Hours to be studied in Discipline – A</i>	<i>36</i>
Mathematics (Discipline-B)	CC	Math.111	Differential Calculus	5+1*
		Math.121	Differential Equations	5+1*
		Math.211	Real Analysis	5+1*
		Math.221	Algebra	5+1*
	DSE1	Math.311	Matrices	5+1*
		Math.312	Mechanics	5+1*
	DSE2	Math.321	Numerical Methods	4+2
		Math.322	Complex Analysis	5+1*
			<i>Total Credit Hours to be studied in Discipline – B</i>	<i>36</i>
Chemistry (Discipline-C)	CC	Chem.112	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	4+2
		Chem.122	Chemical Energetics, Equilibria & Functional Group Organic Chemistry-I	4+2
		Chem.212	Solutions, Phase Equilibrium, Conductance, Electrochemistry & Functional Group Organic Chemistry-II	4+2
		Chem.222	Transition Metal & Coordination Chemistry, States of Matter and Chemical Kinetics	4+2
	DSE1	Chem.313	Chemistry of Main Group Elements, Theories of Acids and Bases	4+2
		Chem.314	Quantum Chemistry, Spectroscopy & Photochemistry	4+2
	DSE2	Chem.323	Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy	4+2
		Chem.324	Analytical Methods in Chemistry	4+2
			<i>Total Credit Hours to be studied in Discipline – C</i>	<i>36</i>

Ability Enhancement Courses	AECC-I	Eng.111	English Communication	2+0
	AECC-II	Env.121	Environmental Studies	3+0
			<i>Total Credit Hours to be studied in AECC</i>	<i>05</i>
Skill Enhancement Courses	SEC-I	Comp.211	Computer Application	2+1
	SEC-II	Stat.221	Elements of Statistics	2+1
		Comp.222	Computer Programming using C Language	2+1
	SEC-III	Phys.313	Weather Forecasting	3+0
		Math.313	Integral Calculus	3+0
		Chem.315	Chemistry of Cosmetics & Perfumes	2+1
	SEC-IV	Phys.323	Renewable Energy and Energy harvesting	3+0
Math.323		Vector Calculus	3+0	
Chem.325		Analytical Clinical Biochemistry	2+1	
			<i>Total Credit Hours to be studied in SEC</i>	<i>12</i>
GI/Hobby	Gen.Int./Hobby	Ort.111	Orientation	1+0(NC)
		NCC/NSS	National Cadet Corps/National Service Scheme	0+8(NC)
			<i>Total Credit Hours to be studied in GI/Hobby</i>	<i>09(NC)</i>
			TOTAL Credit Hours for Degree	125+9(NC)
Note: Universities may include more options or delete some from the lists of Discipline Specific and Skill Enhancement Courses.				
*one credit hour is a period for tutorial				

PHYSICS

(DISCIPLINE – A)

CORE COURSES:

Phys.111 Mechanics

4+2

THEORY (60 Lectures)

UNIT I: Vectors: Vector algebra, scalar and vector products, derivatives of a vector with respect to a parameter. Ordinary Differential Equations: 1st order homogeneous differential equations, 2nd order homogeneous differential equations with constant coefficients. Laws of Motion: Frames of reference, Newton's Laws of motion, dynamics of a system of particles, centre of Mass. **(20 Lectures)**

UNIT II: Momentum and Energy: Conservation of momentum, work and energy, conservation of energy, motion of rockets. Rotational Motion: Angular velocity and angular momentum, torque, conservation of angular momentum. **(11 Lectures)**

UNIT-III: Oscillations: Simple harmonic motion, differential equation of SHM and its solutions, kinetic and potential energy, total energy and their time averages, damped oscillations. **(6 Lectures)**

UNIT IV: Gravitation: Newton's Law of gravitation, motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). **(8 Lectures)**

UNIT V: Elasticity: Hooke's law, stress-strain diagram, elastic moduli, relation between elastic constants. Poisson's ratio: expression for Poisson's ratio in terms of elastic constants. Work done in stretching & work done in twisting a wire. Twisting couple on a cylinder. Determination of rigidity modulus by static torsion. Torsional pendulum: determination of Rigidity modulus and moment of inertia - η & σ by Searles method. **(8 Lectures)**

UNIT VI: Special Theory of Relativity: Constancy of speed of light, postulates of special theory of relativity. Length contraction. Time dilation. Relativistic addition of velocities. **(7 Lectures)**

SUGGESTED READINGS:

1. University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986. Addison-Wesley
2. Mechanics Berkeley Physics course, v.1: Charles Kittel, et. Al. 2007, Tata McGraw-Hill.
3. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
4. Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

PRACTICAL:

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope
2. To determine the Height of a Building using a Sextant
3. To determine the Moment of Inertia of a Flywheel

4. To determine the Young's Modulus of a Wire by Optical Lever Method
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle
6. To determine the Elastic Constants of a Wire by Searle's method
7. To determine g by Bar Pendulum
8. To determine g by Kater's Pendulum
9. To determine g and velocity for a freely falling body using Digital Timing Technique
10. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g

SUGGESTED READINGS:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.

Phys.121 Electricity and Magnetism

4+2

THEORY (60 Lectures)

UNIT I: Vector Analysis: Review of vector algebra (Scalar and Vector product), gradient, divergence, curl and their significance, vector integration. Line, surface and volume integrals of vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

(12 Lectures)

UNIT II: Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

(22 Lectures)

UNIT III: Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current, divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferromagnetic material.

(10 Lectures)

UNIT IV: Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field Maxwell's equations and Electromagnetic wave propagation: Equation of continuity of current, displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

(16 Lectures)

SUGGESTED READINGS:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education..

- Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
- Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.

PRACTICAL:

- To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses
- Ballistic Galvanometer:
 - Measurement of charge and current sensitivity
 - Measurement of CDR
 - Determine a high resistance by Leakage Method
- To compare capacitances using De'Sauty's bridge
- Measurement of field strength B & its variation in a Solenoid (Determine dB/dx)
- To study the Characteristics of a Series RC Circuit
- To study a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor
- To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
- To determine a Low Resistance by Carey Foster's Bridge
- To verify the Thevenin and Norton theorem
- To verify the Superposition, and Maximum Power Transfer Theorem

SUGGESTED READINGS:

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication

Phys.211 Thermal Physics & Statistical Mechanics

4+2

THEORY (60 Lectures)

UNIT I: Thermodynamic description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, various thermodynamical processes. **(8 Lectures)**

UNIT II: Applications of First Law: General Relation between C_P and C_V , work done during isothermal and adiabatic processes, compressibility and expansion coefficient, reversible and irreversible processes, second law, entropy, Carnot's cycle & theorem, entropy changes in reversible and irreversible processes, entropy-temperature diagrams. **(12 Lectures)**

UNIT III: Third law of thermodynamics, unattainability of absolute zero. Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and internal energy functions, Maxwell's relations and applications - Joule-Thompson Effect, Clausius- Clapeyron equation, expression for $(C_P - C_V)$, C_P/C_V , TdS equations. **(12 Lectures)**

UNIT IV: Kinetic theory of gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, mean free path (Zeroth order). Transport phenomena: Viscosity, conduction and diffusion (for vertical case), law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

(10 Lectures)

UNIT V: Theory of radiation: Blackbody radiation, spectral distribution, concept of energy density, derivation of Planck's law, deduction of Wien's distribution law, Rayleigh- Jeans law, Stefan Boltzmann Law and Wien's displacement law from Planck's law. Statistical mechanics: Phase space, macrostate and Microstate, entropy and thermodynamic probability, Maxwell-Boltzmann law, distribution of velocity. Quantum statistics: Fermi-Dirac distribution law, Bose-Einstein distribution law, comparison of three statistics. (18 Lectures)

SUGGESTED READINGS:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
4. Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill
5. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears & G.L.Salinger. 1988, Narosa
6. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
7. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications.

PRACTICAL:

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method
2. Measurement of Planck's constant using black body radiation
3. To determine Stefan's Constant
4. To determine the coefficient of thermal conductivity of Cu by Searle's Apparatus
5. To determine the Coefficient of Thermal conductivity of Cu by Angstrom's Method
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature
9. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system
10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off- Balance Bridge

SUGGESTED READINGS:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication

Phys.221 Waves and Optics

4+2

THEORY (60 Lectures)

UNIT I: Superposition of two collinear harmonic oscillations: Simple harmonic motion (SHM). Linearity and superposition principle. (1) oscillations having equal frequencies and (2) oscillations having different frequencies (Beats). Superposition of two perpendicular harmonic oscillations: Graphical and analytical methods. Lissajous Figures (1:1 and 1:2) and their uses.

(6 Lectures)

UNIT II: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, phase velocity. Plane waves, spherical waves, wave intensity. Fluids: Surface tension, synclastic and anticlastic surface, excess of pressure.- Application to spherical and cylindrical drops and bubbles, variation of surface tension with temperature, Jaegar's method. Viscosity: Viscosity, rate flow of liquid in a capillary tube, Poiseuille's formula, determination of coefficient of viscosity of a liquid, variations of viscosity of a liquid with temperature lubrication. Physics of low pressure: Production and measurement of low pressure, rotary pump, diffusion pump, molecular pump. Knudsen absolute gauge, penning and pirani gauge, detection of leakage.

(13 Lectures)

UNIT III: Sound: Simple harmonic motion, forced vibrations and resonance. Fourier's Theorem- application to saw tooth wave and square wave. Intensity and loudness of sound, decibels, intensity levels, musical notes, musical scale. Acoustics of buildings: Reverberation and time of reverberation, absorption coefficient, Sabine's formula, measurement of reverberation time, acoustic aspects of halls and auditoria.

(6 Lectures)

UNIT IV: Wave optics: Electromagnetic nature of light, definition and properties of wave front. Huygens Principle. Interference: Division of amplitude and division of wavefront. Young's double slit experiment. Lloyd's mirror & Fresnel's biprism. Phase change on reflection: Stokes' treatment. Interference in thin films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger fringes); fringes of equal thickness (Fizeau fringes).

(12 Lectures)

UNIT V: Newton's Rings: Measurement of wavelength and refractive index. Michelson's Interferometer: Construction and working. Idea of form of fringes (no theory needed), determination of wavelength, wavelength difference, refractive index, and visibility of fringes.

(4 Lectures)

UNIT VI: Diffraction: Fraunhofer diffraction, single and double slit. Multiple slits & diffraction grating. Fresnel diffraction: Half-period zones, zone plate. Fresnel diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis. Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.

(19 Lectures)

SUGGESTED READINGS:

1. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
2. Principles of Optics, B.K. Mathur, 1995, Gopal Printing
3. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication
4. University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986. Addison-Wesley

PRACTICAL:

1. To investigate the motion of coupled oscillators
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify $\lambda^2 - T$ Law
3. To study Lissajous Figures
4. Familiarization with Schuster's focussing; determination of angle of prism
5. To determine the Refractive Index of the Material of given Prism using Na Light

6. To determine Dispersive Power of the Material of a given Prism using Hg Light
7. To determine the value of Cauchy Constants of a material of a prism
8. To determine the Resolving Power of a Prism
9. To determine wavelength of sodium light using Fresnel Biprism
10. To determine wavelength of sodium light using Newton's Rings
11. To determine wavelength of (1) Sodium light using plane diffraction Grating
12. To determine the Resolving Power of a Plane Diffraction Grating

SUGGESTED READINGS:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication

DISCIPLINE SPECIFIC ELECTIVE COURSES:

Phys.311 Solid State Physics

4+2

THEORY (60 Lectures)

UNIT I: Crystal structure: Solids- amorphous and crystalline materials. Lattice translation vectors. Lattice with a basis. Unit Cell. Miller indices. Reciprocal lattice. Types of lattices. Brillouin zones. Diffraction of X-rays by crystals. Bragg's law. Atomic and geometrical factor.

(12 Lectures)

UNIT II: Elementary lattice dynamics: Lattice vibrations and phonons: Linear monoatomic and diatomic chains. Acoustical and optical phonons. Qualitative description of the phonon spectrum in solids. Dulong and Petit's law, Einstein and Debye theories of specific heat of solids (qualitative only). T^3 law.

(10 Lectures)

UNIT III: Magnetic properties of matter: Dia-, para-, ferri- and ferromagnetic materials. Classical Langevin theory of dia- and paramagnetic domains. Quantum mechanical treatment of paramagnetism. Curie's law. Weiss's theory of ferromagnetism and ferromagnetic domains. Discussion of B-H curve. Hysteresis and energy loss.

(12 Lectures)

UNIT IV: Dielectric properties of materials: Polarization, local electric field at an atom. Depolarization field. Electric susceptibility. Polarizability. Clausius Mosotti equation. Classical theory of electric polarizability. Normal and anomalous dispersion. Cauchy and Sellmeier relations. Langevin-Debye equation. Complex dielectric constant. Optical phenomena. Application: Plasma oscillations, plasma frequency, plasmons.

(10 Lectures)

UNIT V: Elementary band theory: Kronig Penny model, Band gaps, conductors, semiconductors and insulators, P and N type semiconductors. Conductivity of semiconductors,

mobility. Hall effect, Hall coefficient. Superconductivity: Experimental results. Critical temperature. Critical magnetic field. Meissner effect. Type I and type II superconductors.

(16 Lectures)

SUGGESTED READINGS:

1. Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt.Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
4. Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976, Cengage Learning
5. Solid State Physics, Rita John, 2014, McGraw Hill
6. Solid-state Physics, H. Ibach and H Luth, 2009, Springer
7. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
8. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

PRACTICAL:

1. Measurement of susceptibility of paramagnetic solution (Quinck's Tube Method)
2. To measure the Magnetic susceptibility of Solids
3. To determine the Coupling Coefficient of a Piezoelectric crystal
4. To measure the Dielectric Constant of a dielectric Materials with frequency
5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR) technique
6. To determine the refractive index of a dielectric layer using SPR technique
7. To study the PE Hysteresis loop of a Ferroelectric Crystal
8. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis
9. To measure the resistivity of a semiconductor (Ge) crystal with temperature (up to 150 °C) by four-probe method and to determine its band gap
10. To determine the Hall coefficient of a semiconductor sample

SUGGESTED READINGS:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication

Phys.312 Elements of Modern Physics

4+2

THEORY (60 Lectures)

UNIT I: Planck's law, Planck's constant and light as a collection of photons, photoelectric effect and Compton scattering. de Broglie wavelength and matter waves, Davisson-Germer experiment. Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra, Bohr's quantization rule and atomic stability, calculation of energy levels for

hydrogen like atoms and their spectra. Position measurement- gamma ray microscope thought experiment. **(13 Lectures)**

UNIT II: Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory, estimating minimum energy of a confined particle using uncertainty principle, energy-time uncertainty principle. Two slit interference experiment with photons, atoms and particles, linear superposition principle as a consequence. Matter waves and wave amplitude. **(6 Lectures)**

UNIT III: Schrodinger equation for non-relativistic particles, momentum and energy operators, stationary states, physical interpretation of wavefunction, probabilities and normalization. Probability and probability current densities in one dimension. One dimensional infinitely rigid box, energy eigenvalues and eigenfunctions, normalization. **(13 Lectures)**

UNIT IV: Quantum dot as an example, Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier. Size and structure of atomic nucleus and its relation with atomic weight. Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. **(10 Lectures)**

UNIT V: Nature of nuclear force, NZ graph, semi-empirical mass formula & binding energy. Radioactivity: stability of nucleus, law of radioactive decay, mean life and half-life, α - decay, β -decay - energy released, spectrum and Pauli's prediction of neutrino, γ -ray emission. **(13 Lectures)**

UNIT VI: Fission and fusion - mass deficit, relativity and generation of energy, fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235. Fusion and thermonuclear reactions. **(5 Lectures)**

SUGGESTED READINGS:

1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
2. Modern Physics, John R. Taylor, Chris D. Zafiratos, Michael A. Dubson, 2009, PHI Learning
3. Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill
4. Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
5. Modern Physics, R.A. Serway, C.J. Moses, and C.A. Moyer, 2005, Cengage Learning
6. Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill

PRACTICAL:

1. To determine value of Boltzmann constant using V-I characteristic of PN diode
2. To determine work function of material of filament of directly heated vacuum diode
3. To determine value of Planck's constant using LEDs of at least 4 different colours
4. To determine the ionization potential of mercury
5. To determine the wavelength of H-alpha emission line of Hydrogen atom
6. To determine the absorption lines in the rotational spectrum of Iodine vapour
7. To study the diffraction patterns of single and double slits using laser source and measure its intensity variation using Photosensor and compare with incoherent source – Na light
8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
9. To determine the value of e/m by magnetic focusing

SUGGESTED READINGS:

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing

House.

2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication

Phys.321 Nuclear & Particle Physics

5+1

THEORY (75 Lectures)

UNIT I: General properties of nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excited states. **(10 Lectures)**

UNIT II: Nuclear models: Liquid drop model approach, semi empirical mass formula and significance of various terms, condition of nuclear stability. Two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force. **(12 Lectures)**

UNIT III: Radioactivity decay: (a) Alpha decay: basics of α -decay processes, theory of α -emission, Gamow factor, Geiger Nuttall law, α -decay spectroscopy, (b) β -decay: energy kinematics for β -decay, positron emission, electron capture, neutrino hypothesis, (c) Gamma decay: Gamma rays emission & kinematics, internal conversion. **(10 Lectures)**

UNIT IV: Nuclear reactions: Types of reactions, conservation laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering). Interaction of nuclear radiation with matter: Energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation, Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter. **(16 Lectures)**

UNIT V: Detector for nuclear radiations: Gas detectors, estimation of electric field, mobility of particle, for ionization chamber and GM counter. Basic principle of scintillation detectors and construction of photo-multiplier tube (PMT). Semiconductor detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility). **(8 Lectures)**

UNIT VI: Particle accelerators: Accelerator facility available in India, Van-de Graaff generator (Tandem accelerator), linear accelerator, cyclotron, synchrotrons. Particle physics: Particle interactions, basic features, types of particles and its families. Symmetries and conservation laws: energy and momentum, angular momentum, parity, baryon number, lepton number, isospin, strangeness and charm, concept of quark model, color quantum number and gluons. **(19 Lectures)**

SUGGESTED READINGS:

1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
3. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004)

4. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
5. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
6. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP-Institute of Physics Publishing, 2004).
7. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
8. Theoretical Nuclear Physics, J.M. Blatt & V.F. Weisskopf (Dover Pub.Inc., 1991)

Phys.322 Digital and Analog Circuits and Instrumentation

4+2

THEORY (60 Lectures)

UNIT I: Digital circuits: Difference between analog and digital circuits. Binary numbers. decimal to binary and binary to decimal conversion, AND, OR and NOT Gates (realization using diodes and transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates. De Morgan's theorems. Boolean laws. Simplification of logic circuit using Boolean algebra. Fundamental products. Minterms and Maxterms. Conversion of a Truth table into an Equivalent Logic circuit by (1) Sum of products method and (2) Karnaugh map. Binary addition. Binary subtraction using 2's complement method). Half adders and Full adders and subtractors, 4-bit binary adder-subtractor. **(13 Lectures)**

UNIT II: Semiconductor devices and amplifiers: Semiconductor diodes: p and n type semiconductors. Barrier formation in pn junction diode. Qualitative idea of current flow mechanism in forward and reverse biased diode. PN junction and its characteristics. Static and dynamic resistance. Principle and structure of (1) LEDs (2) Photodiode (3) Solar cell. Bipolar junction transistors: n-p-n and p-n-p transistors. Characteristics of CB, CE and CC configurations. Active, cutoff, and saturation regions. Current gains α and β . Relations between α and β . Load line analysis of transistors. DC load line and Q- point. Voltage divider bias Circuit for CE amplifier. h-parameter equivalent circuit. Analysis of a single-stage CE amplifier using hybrid model. Input and output impedance. Current, voltage and power gains. Class A, B, and C amplifiers. **(17 Lectures)**

UNIT III: Operational amplifiers (Black box approach): Characteristics of an ideal and practical Op-Amp (IC 741), open-loop & closed-loop gain. CMRR, concept of virtual ground. Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Zero crossing detector. Sinusoidal oscillators: Barkhausen's criterion for self-sustained oscillations. Determination of frequency of RC oscillator. **(18 Lectures)**

UNIT IV: Instrumentations: Introduction to CRO: Block diagram of CRO. Applications of CRO: (1) Study of waveform, (2) Measurement of voltage, current, frequency, and phase difference. Power supply: Half-wave rectifiers. Centre-tapped and Bridge full-wave rectifiers. Calculation of Ripple factor and rectification, efficiency, basic idea about capacitor filter, Zener diode and voltage regulation. Timer IC: IC 555 Pin diagram and its application as astable & monostable multivibrator. **(12 Lectures)**

SUGGESTED READINGS:

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill.
3. Microelectronic Circuits, M.H. Rashid, 2ndEdn.,2011, Cengage Learning.

4. Modern Electronic Instrumentation & Measurement Tech., Helfrick&Cooper,1990, PHI Learning
5. Digital Principles & Applications, A.P. Malvino, D.P. Leach & Saha, 7th Ed.,2011, Tata McGraw Hill
6. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
7. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.
8. OP-AMP and Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd.

PRACTICAL:

1. To measure (a) Voltage, and (b) Frequency of a periodic waveform using a CRO
2. To verify and design AND, OR, NOT and XOR gates using NAND gates
3. To minimize a given logic circuit
4. Half adder, Full adder and 4-bit Binary Adder
5. Adder-Subtractor using Full Adder I.C.
6. To design an astable multivibrator of given specifications using 555 Timer
7. To design a monostable multivibrator of given specifications using 555 Timer
8. To study IV characteristics of PN diode, Zener and Light emitting diode
9. To study the characteristics of a Transistor in CE configuration
10. To design a CE amplifier of a given gain (mid-gain) using voltage divider bias
11. To design an inverting amplifier of given gain using Op-amp 741 and study its frequency response
12. To design a non-inverting amplifier of given gain using Op-amp 741 and study its frequency response
13. To study a precision Differential Amplifier of given I/O specification using Op- amp
14. To investigate the use of an op-amp as a Differentiator
15. To design a Wien Bridge Oscillator using an op-amp

SUGGESTED READINGS:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication

MATHEMATICS

(DISCIPLINE – B)

CORE COURSES:

Maths.111 Differential Calculus

5+1

THEORY (75 Lectures)

UNIT I: Limit and Continuity (ϵ and δ definition), Basic properties of limits, Properties of continuous functions. Classification of discontinuities. Uniform continuity (definition and examples). Differentiability. Successive differentiation. Leibnitz theorem. Indeterminate Forms. (20 Lectures)

UNIT II: Rolle's theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem. Solution of inequalities by mean value theorem and approximation (linear) by mean value theorem. Taylor's and Maclaurin theorems with various form of remainders. Taylor's and Maclaurin's series expansions of $\sin x$, $\cos x$, e^x , $\log(1+x)$, $(1+x)^m$ (20 Lectures)

UNIT III: Tangents and Normals, Concavity, Convexity and Points of inflexion of a function. Asymptotes and multiple points. Curvature. Basics of Curve tracing. Tracing of curves in Cartesian Coordinates. Parametric representation of curves and tracing of parametric curves. Polar coordinates and tracing of curves in polar coordinates. (15 Lectures)

UNIT IV: Limit and continuity of functions of two variables, partial differentiation change of variables, Jacobians. Partial Derivation and differentiability of real valued functions of two variables. Implicit function Theorem (case of two variables). Euler's Theorem on Homogenous functions. Taylor's Theorem for functions of two variables (20 Lectures)

SUGGESTED READING:

1. Shanti Narayan "Differential Calculus" Shyam Lal Charitable Trust, Ram Nagar, New Delhi.
2. Spectrum- Calculus, Sharma Publications, Jalandhar
3. A Text Book of Calculus, S. Dinesh & Co, Jalandhar

Maths.121 Differential Equations

5+1

THEORY (75 Lectures)

UNIT I: First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x , y , p . Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its

properties. Solving a differential equation by reducing its order.

(20 Lectures)

UNIT II: Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations. (20 Lectures)

UNIT III: Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method. (20 Lectures)

UNIT IV: Solution by Power Series method and its bases. Solution of Bessel, Legendre equations. Properties of Bessel and Legendre functions. Orthogonal functions. (15 Lectures)

SUGGESTED READING

1. D.A. Murray: Introductory course in differential equations, Orient Longman (India) 1967
2. J.N. Sharma and Kehar Singh, Partial Differential Equations for Engineers and Scientists. Narosa Publishing House.
3. S. L. Ross, Differential Equations, John Wiley Student Edition, Third Edition, 2004.
4. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.
5. Spectrum-Ordinary Differential Equations, Sharma Publications, Jalandhar
6. A Text Book of Ordinary Differential Equations, S. Dinesh & Co, Jalandhar
7. Spectrum-Partial Differential Equations, Sharma Publications, Jalandhar
8. A Text Book of Partial Differential Equations, S. Dinesh & Co, Jalandhar

Maths.211 Real Analysis

5+1

THEORY (75 Lectures)

UNIT I: Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of \mathbb{R} , Archimedean property of \mathbb{R} , intervals. Concept of cluster points and statement of Bolzano- Weierstrass theorem. (20 Lectures)

UNIT II: Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof). (20 Lectures)

UNIT III: Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence. (20 Lectures)

UNIT IV: Sequences and series of functions, Pointwise and uniform convergence. M_n -test, M - test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence. (15 Lectures)

Suggested Reading:

1. T.M. Apostel, Mathematical Analysis Narosa Publishing House N.D 1985.
2. R.R.Goldberg, Mathematical Analysis, Oxford & IBH publishing House, New Delhi.
3. D.Soma Sundrem & V. Chowdhari, Course in Mathematical Analysis, Narosa

Publishing House N.D 1985.

4. Shanti Narayan, A Course of Mathematical Analysis, S. Chand & Company, New Delhi.
5. Spectrum-Real Analysis, Sharma Publications, Jalandhar
6. A Text Book of Real Analysis, S. Dinesh & Co, Jalandhar
7. Spectrum-Sequences and Series, Sharma Publications, Jalandhar
8. A Text Book of Sequences and Series, S. Dinesh & Co, Jalandhar

Maths.221 Algebra

5+1

THEORY (75 Lectures)

UNIT I: Definition and examples of groups, examples of abelian and non-abelian groups, the group Z_n of integers under addition modulo n and the group $U(n)$ of units under multiplication modulo n . Cyclic groups from number systems, complex roots of unity, circle group, the general linear group $GL_n(n, R)$, groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group $Sym(n)$, Group of quaternions. **(20 Lectures)**

UNIT II: Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups. **(20 Lectures)**

UNIT III: Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, Z_n the ring of integers modulo n , ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. **(20 Lectures)**

UNIT IV: Subrings and ideals, Integral domains and fields, examples of fields: Z_p , Q , R , and C . Field of rational functions. **(15 Lectures)**

SUGGESTED READING

1. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
2. Joseph A Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa, 1999.
3. George E Andrews, *Number Theory*, Hindustan Publishing Corporation, 1984.
4. I.N. Herstein: "Topics in Algebra", Wiley Eastern Company, New Delhi, 1975.
5. Hoffman and R. Kunze; *Linear Algebra*, 2nd Edition, Prentice Hall of India, Delhi.
6. Vivek Shahi and Vikas Bist : *Algebra*, Narosa Publishing House.
7. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul ; *Basic Abstract Algebra* (2nd Edition)
8. Spectrum- *Abstract Algebra*, Sharma Publications, Jalandhar
9. A Text Book of *Abstract Algebra*, S. Dinesh & Co, Jalandhar

DISCIPLINE SPECIFIC ELECTIVE COURSES

Maths.311 Matrices

5+1

THEORY(75 Lectures)

UNIT I: \mathbb{R} , \mathbb{R}^2 , \mathbb{R}^3 as vector spaces over \mathbb{R} . Standard basis for each of them. Concept of Linear Independence and examples of different bases. Subspaces of \mathbb{R}^2 , \mathbb{R}^3 . Vector Space, Subspaces, Sum and Direct sum of Subspaces, Linear span. Linearly independent and linearly dependent subsets of a vector space. Finitely generated vector space. Existence theorem for basis of finitely generated vector space(statement only), Invariance of number of elements of basis sets. Dimension of vector space
(20 Lectures)

UNIT II: Translation, Dilation, Rotation, Reflection in a point, line and plane. Matrix form of basic geometric transformations. Interpretation of eigenvalues and eigenvectors for such transformations and eigenspaces as invariant subspaces.
(20 Lectures)

UNIT III: Types of matrices. Rank of a matrix. Invariance of rank under elementary transformations. Reduction to normal form, Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto four.
(15 Lectures)

UNIT IV: Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3. Computation of matrix inverses using elementary row operations. Rank of matrix. Solutions of a system of linear equations using matrices. Illustrative examples of above concepts from Geometry, Physics, Chemistry, Combinatorics and Statistics.
(20 Lectures)

SUGGESTED READING:

1. S. H. Friedberg, A. L. Insel and L. E. Spence, *Linear Algebra*, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
2. Richard Bronson, *Theory and Problems of Matrix Operations*, Tata McGraw Hill, 1989.
3. Spectrum- Algebra & Trigonometry, Sharma Publications, Jalandhar
4. A Text Book of Algebra & Trigonometry, S. Dinesh & Co, Jalandhar

Maths.312 Mechanics

5+1

THEORY (75 Lectures)

UNIT I: Conditions of equilibrium of a particle and of coplanar forces acting on a rigid Body, Laws of friction, Problems of equilibrium under forces including friction.
(20 Lectures)

UNIT II: Centre of gravity, Work and potential energy.
(20 Lectures)

UNIT III: Velocity and acceleration of a particle along a curve: radial and transverse components (plane curve), tangential and normal components (space curve)
(20 Lectures)

UNIT IV: Newton's Laws of motion, Simple harmonic motion, Simple Pendulum, Projectile Motion.
(15 Lectures)

SUGGESTED READING

1. M . Ray : A Text Book on Dynamics, S . Chand and co . , 1989 .
2. S . L . Loney: Elements of Statics and Dynamics .
3. Spectrum- Mechanics, Sharma Publications, Jalandhar
4. A Text Book of Mechanics, S. Dinesh & Co, Jalandhar
5. A.S. Ramsay, *Statics*, CBS Publishers and Distributors (Indian Reprint), 1998.2.
6. A.P. Roberts, *Statics and Dynamics with Background in Mathematics*, Cambridge University Press, 2003.

Maths.321 Numerical Analysis

5+1

THEORY(75 Lectures)

UNIT I: Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method, Newton's method, Secant method, LV decomposition, Gauss- Jacobi, Gauss-Siedel and SOR iterative methods. **(20 Lectures)**

UNIT II: Lagrange and Newton interpolation: linear and higher order, finite difference operators. **(18 Lectures)**

UNIT III: Numerical differentiation: forward difference, backward difference and central Difference. **(19 Lectures)**

UNIT IV: Integration: trapezoidal rule, Simpson's rule, Euler's method. **(18 Lectures)**

SUGGESTED READINGS

1. I.E. Balagurusamy, 'Numerical Methods', Tata McGraw Hill Co. New Delhi , 2004
2. Yashwant Kanetkar, Let us C, BPB Publications.
3. Spectrum- Numerical analysis -Lab, Sharma Publications, Jalandhar
4. A Text Book of Numerical analysis-Lab, S. Dinesh & Co, Jalandhar
5. B. Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India,
6. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 5th Ed., New age International Publisher, India, 2007.

Maths.322 Complex Analysis

5+1

THEORY (75 Lectures)

UNIT I: Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. **(20 Lectures)**

UNIT II: Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy-Goursat theorem, Cauchy integral formula. **(20 Lectures)**

UNIT III: Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples. **(20 Lectures)**

UNIT IV: Laurent series and its examples, absolute and uniform convergence of power series **(15 Lectures)**

SUGGESTED READINGS:

1. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications*, 8th Ed., McGraw - Hill International Edition, 2009.
2. Joseph Bak and Donald J. Newman, *Complex analysis*, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.

CHEMISTRY

(DISCIPLINE – C)

CORE COURSES:

Chem.112 Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons 4+2

THEORY (60 Lectures)

Section A: Inorganic Chemistry-1 (30 Periods)

UNIT-I: Atomic Structure: Dual nature of electron, Heisenberg's uncertainty principle, orbitals, Schrödinger wave equation, quantum numbers, orbital wave function, probability distribution curves, shapes of s, p, d and f orbital, Pauli's exclusion principle, Hund's rule of maximum multiplicity. Effective nuclear charge and screening effect, Slater's rule and its applications. **(14 Lectures)**

UNIT-II: Chemical Bonding and Molecular Structure: *Ionic Bonding*: General characteristics of ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

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

Concept of resonance and resonating structures in various inorganic and organic compounds. Molecular orbital approach of bonding (LCAO method) symmetry and overlap symmetry of molecular orbital, bonding in homonuclear molecules (H_2 , Be_2 , N_2 , N_2^+ , O_2 , O_2^- , O_2^{2-} , O_2^+ and Ne_2) and heteronuclear molecules (NO, CO, CN and their ions, HF & HCl). Comparison of VB and MO approaches. **(16 Lectures)**

Section B: Organic Chemistry-1 (30 Periods)

UNIT-III: Fundamentals of Organic Chemistry: Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule. **(8 Lectures)**

UNIT-IV: Stereochemistry: Conformations with respect to Ethane, Butane and Cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism;

Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis - trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems). **(10 Lectures)**

UNIT-V: Aliphatic Hydrocarbons: Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). *Preparation*: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions*: Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) *Preparation*: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); *cis* alkenes (Partial catalytic hydrogenation) and *trans* alkenes (Birch reduction). *Reactions*: *cis*- addition (alk. KMnO₄) and *trans*-addition (bromine),

Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) *Preparation*: Acetylene from CaC₂ and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO₄, ozonolysis and oxidation with hot alk. KMnO₄. **(12 Lectures)**

PRACTICAL

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO₄.
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO₄.
4. Estimation of Fe (II) ions by titrating it with K₂Cr₂O₇ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using Na₂S₂O₃.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)
2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)
 - (a) Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
 - (b) Identify and separate the sugars present in the given mixture by paper chromatography.

SUGGESTED READINGS

1. Modern Approach to Inorganic Chemistry for B.Sc 1st year by SP Jauhar.
2. Principles of Inorganic Chemistry By Puri, Sharma and Kalia.
3. Inorganic Chemistry by James E Huhee.
4. Advanced Inorganic Chemistry by F.A .Cotton and G Wilkinson.
5. Modern Approach to Organic Chemistry By B.Sc 1st year by Sahgal.
6. Stereo Chemistry by P.S. Kalsi.
7. Organic Chemistry by Paula Yurkanis Bruice.
8. Reaction Mechanism by O. P. Aggarwal.
9. Modern Organic Chemistry By M.K.Jain and S.C. Sharma.
10. Concise Inorganic Chemistry by J.D. Lee.

For Lab:

1. Vogel's Text Book of Qualitative Inorganic analysis (revised) J. Bassett, R.C. Cdenney, G. H. Jettery and J. Mendhan, ELBS.
2. Standard Methods of Chemical Analysis by W. W. Scott.
3. Experimental inorganic Chemistry by W. G. Paimer.
4. Vogel's Text Book of Qualitative Organic analysis (revised) J. Bassett, R.C Cdenney, G H Jettery and J Mendhan, ELBS.

5. Laboratory Manual in Organic Chemistry , R K Bansal.
6. Experimental Organic Chemistry Vol. I & II, P R Singh, D S Gupta and K S Bajpai.

Chem.122 Chemical Energetics, Equilibria & Functional Organic Chemistry-I 4+2

THEORY (60 Lectures)

Section A: Physical Chemistry-1 (30 Lectures)

UNIT-I: Chemical Energetics: Review of thermodynamics First Law of Thermodynamics Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature. Calculation of w , q , dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

Thermochemistry: Standard state, standard enthalpy of formation- Hess's Law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation.

Thermodynamics-II: Second law of thermodynamics: Need for the law, different statements of the law. Carnot cycle and its efficiency. Carnot theorem. Thermodynamic scale of temperature. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances. **(10 Lectures)**

UNIT-II: Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle Reaction isotherm and reaction isochore- Clapeyron equation and Clausius – Clapeyron equation, applications. **(8 Lectures)**

UNIT-III: Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts, applications of solubility product principle. **(12 Lectures)**

Section B: Organic Chemistry-2 (30 Lectures)

UNIT-IV: Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons

Preparation (Benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on Benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene). **(8 Lectures)**

UNIT-V: Alkyl and Aryl Halides:

Alkyl Halides (Upto 5 Carbons) Types Nucleophilic Substitution (S_N^1 and S_N^2) reactions. and S_Ni reactions.

Preparation: from alkenes and alcohols.

Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides: *Preparation*: (Chloro, bromo and iodo-benzene): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by $-OH$ group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).

Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

(8 Lectures)

UNIT-VI: Alcohols, Phenols and Ethers (Upto 5 Carbons): Alcohols: *Preparation*: Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO₄, acidic dichromate, conc. HNO₃). Oppeneauer oxidation. *Diols*: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol) *Preparation*: Cumene hydroperoxide method, from diazonium salts.

Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde)

Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, NaHSO₃, NH₂-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Ponndorf Verley reduction. **(14 Lectures)**

PRACTICAL

Section A: Physical Chemistry

Thermochemistry

- Determination of Water Equivalent of a thermos flask.
- Determination of heat of solution of KNO₃ and KCl.
- Determine the enthalpy of neutralization between strong acid and strong base.
- Determine the enthalpy of neutralization between strong acid and weak base.
- Determine the enthalpy of hydration of CuSO₄.
- Determine the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid

Ionic equilibria

pH measurements

Preparation of buffer solutions:

- Sodium acetate-acetic acid
- Ammonium chloride-ammonium hydroxide

Section B: Organic Chemistry

- Purification of organic compounds by crystallization (from water and alcohol) and distillation.
- Criteria of Purity: Determination of melting and boiling points.
- Preparations: Mechanism of various reactions involved to be discussed.

Recrystallisation, determination of melting point and calculation of quantitative yields to be done.

(a) Bromination of Phenol/Aniline

(b) Benzoylation of amines/phenols

SUGGESTED READINGS

- Advance Organic Chemistry Reaction Mechanism and Structure by Jerry March.
- Organic Chemistry by SM Mukherji, SP Singh and RP Kapoor, Vol. I, II & III, New Age International Publishers
- Organic Chemistry (Volume 1) by I. L. Finar,
- Modern Approach to Organic Chemistry By B.Sc 1st year by Sahgal.
- Modern Organic Chemistry by M.K. Jain and S.C. Sharma
- New College Chemistry Vol. I and II by M.K. Jain, S.C. Sharma and Kishor Sharma
- Fundamentals of Organic Chemistry by J.E McMurry.
- Principles of Physical Chemistry by Puri, Sharma and Pathania.
- Physical Chemistry by S.C.Khetarpal, G.S, Sharma and R.K. Kalia.
- Moderns Approach to Physical Chemistry by S. Kiran.
- A text Book of Physical Chemistry by K.K.Sharma and I.K. Sharma

12. Physical Chemistry by P.N.Kapil and S.K.Guglani.
13. Elements of Physical Chemistry by Puri, Sharma and Pathania.

For Lab

1. Experiments in Physical Chemistry by R C Dass and B Bhera.
2. Selected experimental in Physical Chemistry, Vol. I by J N Gurtu and R Kapoor.
3. Experimental Physical Chemistry by J C Ghose.
4. Experimental Physical Chemistry by B.D Khosla
5. Systematic Practical Chemistry for B.Sc 1st, 2nd and 3rd year by P.C Kamboj
6. Vogel's Text Book of Qualitative Organic analysis (revised) J. Bassett, R.C Cdenney, G H Jettery and J Mendhan, ELBS.
7. Laboratory Manual in Organic Chemistry, R K Bansal.
8. Experimental Organic Chemistry Vol. I & II, P R Singh, D S Gupta and K S Bajpai.

Chem.212 Solutions, Phase Equilibrium, Conductance Electrochemistry & Functional Group Organic Chemistry-II **4+2**

THEORY(60 Lectures)

Section A: Physical Chemistry-2 (30 Lectures) Solutions

UNIT-I: Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes.

Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction. **(8 Lectures)**

UNIT-II: Phase Equilibrium: Statement and meaning of the terms – phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system – water, CO₂ and S systems. Phase equilibria of two component system – solid-liquid equilibria, simple eutectic-Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions – compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCl-H₂O), FeCl₃-H₂O) and CuSO₄-H₂O) system. Freezing mixtures, acetone – dry ice. **(8Lectures)**

UNIT-III: Conductance: Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.

Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base). **(6 Lectures)**

UNIT-IV: Electrochemistry: Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG , ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge. pH determination using hydrogen electrode and quinhydrone electrode. Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only). **(8 Lectures)**

Section B: Organic Chemistry-3 (30 Lectures)

UNIT-V: Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Carboxylic acids and their derivatives : Carboxylic acids (aliphatic and aromatic) *Preparation:* Acidic and Alkaline hydrolysis of esters. *Reactions:* Hell – Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Upto 5 carbons):

Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion.

Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky

Reaction, Perkin condensation. **(6 Lectures)**

UNIT-VI: Amines and Diazonium Salts: Amines (Aliphatic and Aromatic): (Upto 5 carbons)

Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction.

Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO₂, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

Diazonium salts: *Preparation:* from aromatic amines.

Reactions: conversion to benzene, phenol, dyes. **(6 Lectures)**

UNIT-VII: Amino Acids, Peptides and Proteins:

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis.

Reactions of Amino acids: ester of –COOH group, acetylation of –NH₂ group, complexation with Cu²⁺ ions, ninhydrin test.

Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by degradation Edmann degradation,

N-terminal and C-terminal (thiohydantoin and with carboxypeptidase enzyme).

Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-phase synthesis. **(10 Lectures)**

UNIT-VIII: Carbohydrates: Classification, and General Properties, Glucose and Fructose (openchain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation,. Structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation. **(8 Lectures)**

PRACTICAL

Section A: Physical Chemistry

Distribution: To study the distribution of I₂ between CCl₄ and H₂O at room temperature.

Phase equilibria:

a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.

b) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.

c) Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Conductance:

I. Determination of cell constant

II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.

III. Perform the following conductometric titrations:

i) Strong acid vs. strong base

ii) Weak acid vs. strong base

Section B: Organic Chemistry

I. Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

II. Organic Synthesis:

- i) Preparation of Iodoform.
- ii) Preparation of p-bromoacetanilide from acetanilide.
- iii) Preparation of glucosazone.
- iv) Preparation of aspirin.

III. Thin Layer Chromatography

- i) Determination of R_f value and purity of organic compounds by use of thin layer chromatography.
- ii) To analyze the organic compounds by thin layer chromatography.

SUGGESTED READINGS

1. Principles of Physical Chemistry by Puri, Sharma and Pathania.
2. Physical Chemistry by S.C. Khetarpal, G.S. Sharma and R.K. Kalia.
3. Modern Approach to Physical Chemistry by S. Kiran.
4. A text Book of Physical Chemistry by K.K. Sharma and I.K. Sharma
5. Physical Chemistry by P.N. Kapil and S.K. Guglani.
6. Elements of Physical Chemistry by Puri, Sharma and Pathania.
7. Advance Organic Chemistry Reaction Mechanism and Structure by Jerry March.
8. Organic Chemistry by SM Mukherji, SP Singh and RP Kapoor, Vol. I, II & III, New Age International Publishers
9. Organic Chemistry (Volume II) by I. L. Finar,
10. Modern Approach to Organic Chemistry By B.Sc 1st year by Sahgal.
11. Modern Organic Chemistry by M.K. Jain and S.C. Sharma
12. New College Chemistry Vol. I and II by M.K. Jain, S.C. Sharma and Kishor Sharma
13. Fundamentals of Organic Chemistry by J.E McMurry.

For Lab:

1. Experiments in Physical Chemistry by R C Dass and B Bhera.
2. Selected experimental in Physical Chemistry, Vol. I by J N Gurtu and R Kapoor.
3. Experimental Physical Chemistry by J C Ghose.
4. Experimental Physical Chemistry by B.D Khosla
5. Systematic Practical Chemistry for B.Sc 1st, 2nd and 3rd year by P.C Kamboj
6. Vogel's Text Book of Qualitative Organic analysis (revised) J. Bassett, R.C Cdenney, G H Jettery and J Mendhan, ELBS.
7. Laboratory Manual in Organic Chemistry, R K Bansal.
8. Experimental Organic Chemistry Vol. I & II, P R Singh, D S Gupta and K S Bajpai.

Chem.222 Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics

4+2

THEORY (60 Lectures)

UNIT-I: Transition Elements (3d series): General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu. Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

(10 Lectures)

UNIT-II: Coordination Chemistry: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. Limitations of valence bond theory, the electrostatic crystal field splitting of d-orbitals in octahedral, tetrahedral, square planar and tetragonally distorted octahedral stereochemistries. Factors affecting the crystal-field parameters, CFSE, spectrochemical series, Origin of colour in transition metal complexes.

Explanation of colour of $[\text{Ti}(\text{H}_2\text{O})_6] \text{Cl}_3$ and $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ and lack of colour in CuSO_4 and Cu_2SO_4 in terms of d-orbital splitting **(10 Lectures)**

UNIT-III: Magneto Chemistry: Origin and types of magnetic behavior, diamagnetism, paramagnetism, ferromagnetism and antiferromagnetism, types of magnetic behaviour shown by transition elements and compounds. Gouy's method for measuring magnetic susceptibility. Applications of magnetic susceptibility measurements to first row transition metal chemistry, Qualitative idea of orbital contribution and subnormal magnetic moments. **(5 Lectures)**

UNIT-IV: Thermodynamic and Kinetic Aspect of Metal Complexes: Definition of stability, stepwise formation constants and overall formation constants, kinetics Vs thermodynamic stability, labile and inert octahedral complexes according to VBT, Labile and inert octahedral complexes according to CFT, Factors affecting the stability of complexes. **(5 Lectures)**

Section B: Physical Chemistry-3

(30 Lectures)

UNIT-V: Kinetic Theory of Gases:

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO_2 . Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only). **(8 Lectures)**

UNIT-VI : Liquids: Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only). **(6 Lectures)**

UNIT-VII: Solids: Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X-Ray diffraction by crystals, Bragg's law. Structures of NaCl , KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

(8 Lectures)

UNIT-VIII: Chemical Kinetics: The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only). **(8 Lectures)**

PRACTICAL

Section A: Inorganic Chemistry

Semi-micro qualitative analysis (using H_2S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following:

Cations : NH_4^+ , Pb^{2+} , Bi^{3+} , Cu^{2+} , Cd^{2+} , Fe^{3+} , Al^{3+} , Co^{2+} , Ni^{2+} , Mn^{2+} , Zn^{2+} , Ba^{2+} , Sr^{2+} , Ca^{2+} , K^+

Anions : CO_3^{2-} , S^{2-} , SO_3^{2-} , $\text{S}_2\text{O}_3^{2-}$, NO_2^- , CH_3COO^- , Cl^- , Br^- , I^- , NO_3^-

(Spot tests should be carried out wherever feasible)

1. Estimate the amount of nickel present in a given solution as bis(dimethylglyoximate) nickel(II) or aluminium as oximate in a given solution gravimetrically.
2. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
3. Estimation of total hardness of a given sample of water by complexometric titration.

Section B: Physical Chemistry

(I) Surface tension measurement (use of organic solvents excluded).

- a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
- b) Study of the variation of surface tension of a detergent solution with concentration.

(II) Viscosity measurement (use of organic solvents excluded).

- a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
- b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

(III) Chemical Kinetics

Study the kinetics of the following reactions.

- i) Acid hydrolysis of methyl acetate with hydrochloric acid.
- ii) Saponification of ethyl acetate.
- iii) Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate.

SUGGESTED READINGS

1. Modern Approach to Inorganic Chemistry for B.Sc 1st year by SP Jauhar.
2. Principles of Inorganic Chemistry By Puri, Sharma and Kalia.
3. Inorganic Chemistry by James E Huhee.
4. Advanced Inorganic Chemistry by F.A. Cotton and G Wilkinson. 1. Principles of Physical Chemistry by Puri, Sharma and Pathania.
5. Physical Chemistry by S.C.Khetarpal, G.S, Sharma and R.K. Kalia.
6. Moderns Approach to Physical Chemistry by S. Kiran.
7. A text Book of Physical Chemistry by K.K.Sharma and I.K. Sharma
8. Physical Chemistry by P.N.Kapil and S.K.Guglani.
9. Elements of Physical Chemistry by Puri, Sharma and Pathania.
10. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).

For Lab:

1. Vogel's Text Book of Qualitative Inorganic analysis (revised) J. Bassett, R.C. Cdenney, G. H. Jettery and J. Mendhan, ELBS.
2. Standard Methods of Chemical Analysis by W. W. Scott.
3. Experimental inorganic Chemistry by W. G. Paimer.
4. Systematic Practical Chemistry for B.Sc 1st , 2nd and 3rd year by P.C Kamboj.
5. Selected experimental in Physical Chemistry, Vol. I by J N Gurtu and R Kapoor.
6. Experimental Physical Chemistry by J C Ghose.
7. Experimental Physical Chemistry by B.D Khosla
8. Systematic Practical Chemistry for B.Sc 1st , 2nd and 3rd year by P.C Kamboj

DISCIPLINE SPECIFIC ELECTIVE COURSES

THEORY(60 Lectures)

UNIT-I: Acids and Bases: Brønsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process.

(10 Lectures)

UNIT-II: General Principles of Metallurgy: Chief modes of occurrence of metals based on standard electrode potentials, Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agents. Hydrometallurgy with reference to cyanide process for gold and silver. Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn, Au): electrolytic refining, zone refining, van Arkel-de Boer process, Parting Process, Mond's process and Kroll Process **(8 Lectures)**

UNIT-III : *s*- and *p*-Block Elements: Periodicity in *s*- and *p*-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electron gain enthalpy, electronegativity (Pauling scale).

General characteristics of *s*-block metals like density, melting and boiling points, flame colour and reducing nature.

Oxidation states of *s*- and *p*-block elements, inert-pair effect, diagonal relationships and anomalous behaviour of first member of each group. Allotropy in C, P and S.

Complex forming tendency of *s* block elements and a preliminary idea of crown ethers and cryptates, structures of basic beryllium acetate, salicylaldehyde/ acetylacetonato complexes of Group 1 metals.

Solutions of alkali metals in liquid ammonia and their properties.

Common features, such as ease of formation, solubility and stability of oxides, peroxides, superoxides, sulphates and carbonates of *s*-block metals. **(14 Lectures)**

UNIT-IV: Structure, bonding and properties (acidic/ basic nature, oxidizing/ reducing nature and hydrolysis of the following compounds and their applications in industrial and environmental chemistry wherever applicable:

Diborane and concept of multicentre bonding, hydrides of Groups 13 (EH₃), 14, 15, 16 and 17.

Oxides of N and P, Oxoacids of P, S and Cl.

Halides and oxohalides of P and S (PCl₃, PCl₅, SOCl₂ and SO₂Cl₂) Interhalogen compounds. A brief idea of pseudohalides **(14 Lectures)**

UNIT-V: Noble gases: Rationalization of inertness of noble gases, clathrates, preparation and properties of XeF₂, XeF₄ and XeF₆, bonding in these compounds using VBT and shapes of noble gas compounds using VSEPR Theory **(5 Lectures)**

UNIT-VI: Inorganic Polymers: Types of inorganic polymers and comparison with organic polymers, structural features, classification and important applications of silicates. Synthesis, structural features and applications of silicones. Borazines and cyclophosphazenes – preparation, properties and reactions. Bonding in (N₂PCl₂)₃. **(9 Lectures)**

PRACTICAL

1. Iodometric estimation of potassium dichromate and copper sulphate
2. Iodimetric estimation of antimony in tartaremetic
3. Estimation of amount of available chlorine in bleaching powder and household bleaches
4. Estimation of iodine in iodized salts.
5. Iodimetric estimation of ascorbic acid in fruit juices.

6. Estimation of dissolved oxygen in water samples.
7. Gravimetric estimation of sulphate as barium sulphate.
8. Gravimetric estimation of aluminium as oximate complex
9. Preparation of the following: potash alum, chromealum, tetraamminecopper(II)sulphate monohydrate, potassium trioxalatoferrate(III) (any two, including one double salt and one complex).

SUGGESTED READINGS

1. Concise inorganic Chemistry 4th Edn. By J.D.Lee.
2. Inorganic Chemistry by J.E.Huheey.
3. Advanced Inorganic Chemistry by Cotton And Wilkinson
4. Chemistry of Elements by Greenwood & Earnshaw.
5. Modern Approach to Inorganic Chemistry for B.Sc 1st year by SP Jauhar.
6. Principles of Inorganic Chemistry By Puri, Sharma and Kalia.
7. Dinesh's Inorganic Chemistry.

For Lab:

1. Vogel's Text Book of Qualitative Inorganic analysis (revised) J. Bassett, R.C. Cdenney, G. H. Jetter and J. Mendhan, ELBS.
2. Standard Methods of Chemical Analysis by W. W. Scott.
3. Experimental inorganic Chemistry by W. G. Paimer.

Chem.314 Quantum Chemistry, Spectroscopy & Photochemistry

4+2

THEORY (60 Lectures)

UNIT-I: Quantum Chemistry: Black-body radiation, Planck's radiation law, photoelectric effect, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect. De Broglie hypothesis, Heisenberg's uncertainty principle, Sinusoidal wave equation, Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box.

Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H₂⁺. Bonding and antibonding orbitals. Qualitative extension to H₂. Comparison of LCAO-MO and VB treatments of H₂ (only wavefunctions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH). Localised and non-localised molecular orbitals treatment of triatomic (BeH₂, H₂O) molecules. Qualitative MO theory and its application to AH₂ type molecules. (24 Lectures)

UNIT-II: Molecular Spectroscopy: Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic

transitions of polyenes using free electron model.

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules.

Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals. **(24 Lectures)**

UNIT-III: Photochemistry: Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.

(12 Lectures)

PRACTICAL

UV/Visible spectroscopy

- I. Study the 200-500 nm absorbance spectra of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule^{-1} , kJ mol^{-1} , cm^{-1} , eV).
- II. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $\text{K}_2\text{Cr}_2\text{O}_7$. III. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colourimetry

- I. Verify Lambert-Beer's law and determine the concentration of $\text{CuSO}_4/\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$ in a solution of unknown concentration
- II. Determine the concentrations of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ in a mixture.
- III. Study the kinetics of iodination of propanone in acidic medium.
- IV. Determine the amount of iron present in a sample using 1,10-phenanthroline. V. Determine the dissociation constant of an indicator (phenolphthalein).
- V. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
- VI. Analyse the given vibration-rotation spectrum of $\text{HCl}(\text{g})$

SUGGESTED READINGS

1. Fundamentals of Molecular Spectroscopy by Banwell, & McCash.
2. Introductory Quantum Chemistry by A. K. Chandra,
3. Principles of Physical Chemistry by Puri, Sharma and Pathania.
4. Physical Chemistry by S.C.Khetarpal, G.S, Sharma and R.K. Kalia.
5. Modrens Approach to Physical Chemistry by S. Kiran.
6. A text Book of Physical Chemistry by K.K.Sharma and I.K. Sharma
7. Physical Chemistry by P.N.Kapil and S.K.Guglani.
8. Elements of Physical Chemistry by Puri, Sharma and Pathania.

For Lab:

1. Experimental Physical Chemistry by B.D Khosla
2. Selected experimental in Physical Chemistry, Vol. I by J N Gurtu and R Kapoor.
3. Experimental Physical Chemistry by J C Ghose.
4. Systematic Practical Chemistry for B.Sc 1st, 2nd and 3rd year by P.C Kamboj
5. Vogel's Quantitative Chemical Analysis, by J.Mendham.

Chem.323 Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy **4+2**

THEORY (60 Lectures)

Section A: Inorganic Chemistry-4 (30 Lectures)

UNIT-I: Chemistry of 3d metals:

Oxidation states displayed by Cr, Fe, Co, Ni and Cu.

A study of the following compounds (including preparation and important properties);

Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$. **(6 Lectures)**

UNIT-II: Organometallic Compounds: Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. π -acceptor behaviour of carbon monoxide. Synergic effects (VB approach). **(12 Lectures)**

UNIT-III: Bio-Inorganic Chemistry: Essential and trace elements in biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Na^+ , K^+ , Mg^{2+} , Ca^{2+} , Role of iron in oxygen transport, Nitrogen fixation. **(12 Lectures)**

Section B: Organic Chemistry-4 (30 Lectures)

UNIT-IV: Polynuclear and heteronuclear aromatic compounds: Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene, Furan, Pyrrole, Thiophene, and Pyridine. **(6 Lectures)**

UNIT-V: Active methylene compounds: *Preparation*: Claisen ester condensation. Keto-enol tautomerism. *Reactions*: Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules having upto 6 carbon). **(6 Lectures)**

UNIT-VI: Application of Spectroscopy to Simple Organic Molecules: Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, λ_{max} & ϵ_{max} , chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating λ_{max} of conjugated dienes and α, β -unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on $>C=O$ stretching absorptions). **(18 Lectures)**

PRACTICAL

Section A: Inorganic Chemistry

- Separation of mixtures by chromatography: Measure the R_f value in each case. (Combination of two ions to be given)
 - Paper chromatographic separation of Fe^{3+} , Al^{3+} and Cr^{3+} or
 - Paper chromatographic separation of Ni^{2+} , Co^{2+} , Mn^{2+} and Zn^{2+}
- Preparation of any two of the following complexes.
 - tetraamminecarbonatocobalt (III) nitrate
 - tetraamminecopper (II) sulphate
 - potassium trioxalatoferrate (III) trihydrate

Section B: Organic Chemistry

Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

SUGGESTED READINGS

1. Modern Approach to Inorganic Chemistry for B.Sc 1st year by SP Jauhar.
2. Principles of Inorganic Chemistry By Puri, Sharma and Kalia.
3. Inorganic Chemistry by James E Huhee.
4. Advanced Inorganic Chemistry by F.A .Cotton and G Wilkinson.
5. Modern Approach to Organic Chemistry By B.Sc 1st year by Sahgal.
6. Stereo Chemistry by P.S. Kalsi.
7. Organic Chemistry by Paula Yurkanis Bruice.
8. Reaction Mechanism by O. P. Aggarwal.
9. Modern Organic Chemistry By M.K.Jain and S.C. Sharma.
10. Concise Inorganic Chemistry by J.D. Lee.
11. Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand.

For Lab

1. Vogel's Text Book of Qualitative Inorganic analysis (revised) J. Bassett, R.C. Cdenney, G. H. Jettery and J. Mendhan, ELBS.
2. Standard Methods of Chemical Analysis by W. W. Scott.
3. Experimental inorganic Chemistry by W. G. Paimer.
4. Vogel's Text Book of Qualitative Organic analysis (revised) J. Bassett, R.C Cdenney, G H Jettery and J Mendhan, ELBS.
5. Laboratory Manual in Organic Chemistry , R K Bansal.
6. Experimental Organic Chemistry Vol. I & II, P R Singh, D S Gupta and K S Bajpai.

Chem.324 Analytical Methods in Chemistry

4+2

THEORY (60 Lectures)

UNIT-I: Qualitative and quantitative aspects of analysis: Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.
(5 Lectures)

UNIT-II: Optical methods of analysis: Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument;

Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method

Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques.

Structural illustration through interpretation of data, Effect and importance of isotope substitution.

(15 Lectures)

UNIT-III: Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

Electroanalytical methods: Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pK_a values.
(20 Lectures)

UNIT-IV: Separation techniques: Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent

extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media.

Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.

Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC). Role of computers in instrumental methods of analysis.

(20 Lectures)

PRACTICAL

I. Separation Techniques

1. Chromatography:

(a) Separation of mixtures

(i) Paper chromatographic separation of Fe^{3+} , Al^{3+} , and Cr^{3+} .

(ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the R_f values.

(b) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

II. Solvent Extractions:

1. To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni- DMG complex in chloroform, and determine its concentration by spectrophotometry.

2. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

3. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.

4. Analysis of soil:

i) Determination of pH of soil.

ii) Estimation of calcium, magnesium phosphate, nitrate

III Spectrophotometry

1. Determination of pK_a values of indicator using spectrophotometry.

2. Structural characterization of compounds by infrared spectroscopy.

3. Determination of dissolved oxygen in water.

4. Determination of chemical oxygen demand (COD).

5. Determination of Biological oxygen demand (BOD).

6. Determine the composition of the ferric-salicylate/ ferric-thiocyanate complex by Job's method.

SUGGESTED READINGS

1. Vogel's Textbook of Quantitative Chemical Analysis by G.H Jeffery, , J. Mendham & R.C. Denney.

2. Basic Concepts of Analytical Chemistry. By S.M.Khopkar.

3. Principles of Instrumental Analysis, by D.A Skoog,. F.J Holler. & T.A Nieman.

4. Laboratory Hand Book of Chromatographic and applied Methods,by Mikes.

For Lab

1. Vogel's Textbook of Quantitative Chemical Analysis by G.H Jeffery, , J. Mendham & R.C. Denney.

2. Basic Concepts of Analytical Chemistry. By . S.M.Khopkar.

3. Principles of Instrumental Analysis, by D.A Skoog,. F.J Holler. & T.A Nieman.

4. Laboratory Hand Book of Chromatographic and applied Methods,by Mikes.

ABILITY ENHANCEMENT COURSES

(AEC)

Eng.111 English Communication 2+0

THEORY (30 Lectures)

UNIT-I: Introduction: Theory of Communication, Types and modes of Communication

(6 lectures)

UNIT-II: Language of Communication: Verbal and Non-verbal (Spoken and Written), Personal, Social and Business, Barriers and Strategies, Intra-personal, Inter-personal and Group communication

(6 lectures)

UNIT-III: Speaking Skills: Monologue, Dialogue, Group Discussion, Effective Communication/ Mis-Communication, Interview, Public Speech

(6 lectures)

UNIT-IV: Reading and Understanding: Close Reading, Comprehension, Summary Paraphrasing, Analysis and Interpretation, Translation (from Indian language to English and vice-versa) Literary/Knowledge, Texts

(6 lectures)

UNIT-V: Writing Skills: Documenting, Report Writing, Making notes, Letter writing

(6 lectures)

SUGGESTED READINGS:

1. *Fluency in English - Part II*, Oxford University Press, 2006.
2. *Business English*, Pearson, 2008.
3. *Language, Literature and Creativity*, Orient Blackswan, 2013.
4. *Language through Literature* (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas

Env.121 Environmental Studies 3+0

THEORY (45 Lectures)

Unit-I: **Multidisciplinary nature of environmental studies**

Definition, scope and importance; need for public awareness.

(2 lecture)

Unit-II: **Natural resources**

Renewable and non-renewable resources

- Natural resources and associated problems:
 - g) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
 - h) Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams - benefits and problems.
 - i) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
 - j) Food resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizer-pesticides problems, water logging, salinity, case studies.

- k) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
- l) Land resources: Land as resource, land degradation, man induced landslides, soil erosion and desertification.
- Role of individual in conservation of natural resources
- Equitable use of resources for sustainable life styles. **(8 lectures)**

Unit-III: **Ecosystems**

- Concept of an ecosystem
- Structures and function of an ecosystem
- Producers, consumers and decomposers
- Energy flow in ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystems:
 - e) Forest ecosystem
 - f) Grassland ecosystem
 - g) Desert ecosystem
 - h) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) **(6 lectures)**

Unit-IV: **Biodiversity and its conservation**

- Introduction- Definition: genetic, species and ecosystem diversity
- Biogeographical classification of India
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, national and local levels
- India as a mega-biodiversity nation
- Hot-spots of biodiversity
- Threats to biodiversity: Habitat loss, poaching of wild life, man-wild life conflicts
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity **(7 lectures)**

Unit-V: **Environmental pollution** Definition, causes, effects and control measures of:

- h) Air pollution
- i) Water pollution
- j) Soil pollution
- k) Marine pollution
- l) Noise pollution
- m) Thermal pollution
- n) Nuclear hazards
- Solid waste management: Causes, effects and control measures of rural, urban and industrial waste
- Fireworks hazards: Types, causes, effects on environment and human health, measures to reduce the usage of fireworks
- Pollution case studies
- Disaster management: Floods, earthquakes, cyclone and landslides **(9 lectures)**

Unit-VI: **Social issues and the environment**

- From unsustainable to sustainable developments
- Resettlement and rehabilitation of people: Its problems and concerns. Case studies
- Environmental ethics: Issues and possible solutions with special reference to role of Indian and other religions and cultures in environmental conservation
- Climate change, global warming, ozone layer depletion, acid rain, nuclear accidents and holocaust. Case studies.
- Waste land reclamation
- Environment Protection Act
- Air (Prevention and control of pollution) Act
- Water (Prevention and control of Pollution) Act

- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation (5 lectures)

Unit-VII: **Human population and the environment**

- Population growth, variation among Nations.
- Environment and human health
- Environmental movements: Chipko, silent valley and Bishnois of Rajasthan
- Role of information technology in environment and human health. Case studies. (3 lectures)

Unit VIII: **Field work**

- Visit to local area to document environmental assets – river/forest/grassland/hill/mountains
- Visit to local polluted site – urban/rural/industrial/agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems – pond, river, hill slopes etc. (5 lectures)

SUGGESTED READINGS:

1. Carson, R. 2002. *Silent Spring*. Mifflin Harcourt.
2. Gadgil, M; and Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. Of California Press.
3. Gleeson, B. And Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H.1993. *Water in crises*. Pacific Institute for studies in Dev.; Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J; Gary K.Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K.2013. Threats from Indian Himalayan Dams. *Science*, 339: 36-37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams* (pp.29-64). Zed Books.
8. McNell, Johan R. 2000. *Something New Under the Sun: An Environmental History of the Twentieth Century*.
9. Odum, E.P; Odum, H.T. and Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I. L; Gerba, C. P. & Brusseau, M. L. 2011. *Environmental and Pollution Science*. Academic Press.
11. Rao, M. N. & Datta, A. K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H; Hassenzahl, D. M. & Berg, L.R. 2012. *Environment*. 8 th. Edition. John Wiley & Sons.
13. Rosencranz, A; Divan, S., & Noble, M.L.2001. *Environmental Law and Policy in India...* Tripathy 1992.
14. Sengupta, R. 2003. *Ecology and economics: An approach to sustainable development*. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S. R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
16. . Sodhi, N.S., Gibson, L. & Raven, P. H. (eds.). 2013. *Conservation Biology: voices from the Tropics*, John Wiley & Sons.
17. Thapar, V. 1998. *Land of the Tiger: A Natural History of Indian Subcontinent*.
18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
19. Wilson, E.O. 2006. *The Creation: An appeal to save life on earth*. New York: Norton

20. World Commission on Environment and Development. 1987.. Our common Future. Oxford University Press
21. Purohit, S.S. and Rajive Rajan. 2007. Ecology, Environment and Pollution. Agro-bios (India)
22. Sharma, P.D. 2010. Ecology and Environment. Rastogi Publications, Meerut-25000 (India)
23. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner. 2. Bharucha Erach, the Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email: mapin@icenet.net (R).
24. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press. 1140p.
25. Jadhav, H. & Bhosale, V.M. 1995.Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p.
26. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol I and II, Enviro Media (R)
27. Trivedi R.K. and P.K. Goel, Introduction to air pollution, Techno-Science Publications (TB)

SKILL ENHANCEMENT COURSES

(SEC)

SEC-I:

Comp.211 Computer Applications

2+1

THEORY (15 Lectures)

UNIT-I: General introduction to computer: definition, characteristics, advantages and limitations of computer, functions of computer, computer organisation. **(5 Lectures)**

UNIT-II: Input and Output devices: Keyboard, Mouse, scanner, MICR, OCR, OMR, Microphone, Monitors (CRT, LCD, LED), Speakers, Printers (Impact and Non-impact) **(5 Lectures)**

UNIT-III: Memory Unit: Primary memory-RAM, Rom and Cache, Secondary memory devices-paper tape, magnetic tape, magnetic disk, Optical disk. **(5 Lectures)**

UNIT-IV: Hardware and Software: Hardware, Software-System Software, Application software and their types. **(4 Lectures)**

UNIT-V: Languages: machine, assembly and high level languages. **(4 Lectures)**

UNIT-VI: Number system: Decimal, Binary, Octal and Hexadecimal number systems, conversion from one number system to another, Binary addition and subtraction, complement method of subtraction (1's complement and 2's complement method) **(7 Lectures)**

PRACTICAL

Working with WINDOWS operating systems: understanding explorer, file/folder attributes, coping and moving files/folders, Understanding Word processing using MS Word, Creating, Editing, Formatting and Saving a document in MSWORD; using mail merge in MS Word, Understanding Electronic Spreadsheets using MS Excel, Creating, Editing and Saving a spreadsheet with MSEXCEL. Use of in-built functions and writing user defined expressions in MS Excel. Creating Graphs in MS Excel. Building presentations with MS PowerPoint.

SUGGESTED READINGS:

1. Fundamentals of Computers by E Balagurusamy, McGraw Hill Education.
2. Computer Fundamentals by Anita Goel, Pearson Education.
3. Introduction to Information Technology by Rajaraman V, PHI.
4. Computer Fundamentals by P. K. Sinha, BPB Publications.
5. Introduction to Computers by Peter Norton, McGraw Hill Education.
6. MS Office 2000 Complete by Sybex, Bpb Publications
7. Learning Ms Office 2010 by Bangia, Khanna Publisher
8. Learning Computer Fundamentals, MS Office and Internet & Web Technology Paperback by Dinesh Maidasani, Laxmi Publications.

SEC-II:

Stat.221 Elements of Statistics

2+1

THEORY (30 Lectures)

UNIT I: Definition, scope and limitations of statistics; presentation and summarization of statistical data; frequency distribution and its graphical representation; measures of central tendency, dispersion, skewness and kurtosis. **(15 Lectures)**

UNIT II: Definition and concept of probability; additive and multiplication law of probability (without proof). **(3 Lectures)**

UNIT III: Correlation: Types of correlation and identification through scatter diagram, computation of correlation coefficient. Linear Regression: Fitting of regression equations; Y on X and X on Y; properties of correlation and regression coefficients. **(3 Lectures)**

UNIT IV: Elements of sampling: Simple random sampling, sampling distribution, standard error; tests of significance, large sample test - SND test for means, single sample and two samples; small sample tests for mean: Student's t-test, Fisher's t-test and Paired t-test: F test. **(6 Lectures)**

UNIT V: Analysis of variance for one-way and two-way classified data. **(3 Lectures)**

PRACTICAL

Construction and graphical representation of frequency distribution; calculations of measures of central tendency, dispersion, skewness and kurtosis; correlation and regression analysis; one sample and two sample standard normal deviation tests for mean; Student's t-test, Fisher's t-test and paired t-test; F-test; analysis of variance – one way and two way classified data.

SUGGESTED READINGS

1. Fundamental of Statistics Vol. I by A.M. Goon, M.K. Gupta and B. Dasgupta
2. Fundamental of Statistics Vol. II by A.M. Goon, M.K. Gupta and B. Dasgupta
3. Statistical Methods by S.P. Gupta
4. A Text Book of Agricultural Statistics by R. Rangaswamy
5. Statistical Techniques in Agricultural and Biological Research by D. Raghavarao
6. Practical Manual in Statistics for Undergraduate Students by Manoj Bhargava and Kamlesh Singh

Comp.222 Computer Programming using C Language

2+1

THEORY (30 Lectures)

UNIT-I: Introduction: character set; constant, variables and keywords; type declaration instruction; input- output instructions; arithmetic instruction; integer and float conversion; type conversion in assignment; hierarchy of operators. **(6 Lectures)**

UNIT-II: Decision control statements: if, if-else, logical operators; hierarchy of logical operators; conditional operators. **(6 Lectures)**

UNIT-III: Loops: for loop, do-while loop; select-case statement; go to statement. **(6 Lectures)**

UNIT-IV: Arrays: one dimensional arrays; array initialization, input and output. **(6 Lectures)**

UNIT-V: Data types and string handling: integers (long and short); integers (signed and unsigned); characters (signed and unsigned); float and double, Introduction to strings and Library functions on strings. Introduction to subprograms. **(6 Lectures)**

PRACTICAL

Introduction to C workbench, writing and saving of simple C programmes, use of input, output and arithmetic instructions with C programs, Control statements in C- examples of if statement in C programs, Loops in C programs using for statement examples, building of simple programs with arrays, development of different programmes with emphasis on Physics and Mathematics.

SUGGESTED READINGS

1. Let Us C by Yashavant Kanetkar, BPB Publications.
2. The C Programming Language by Brian W. Kernighan, Pearson Education.
3. The C Programming Language (Ansi C Version) by Brian W. Kernighan and Dennis M. Ritchie, PHI.
4. C: The Complete Reference by Herbert Schildt, McGraw Hill Education

SEC-III:

Phys.313 Weather Forecasting

3+0

THEORY (45 Lectures)

UNIT I: Introduction to atmosphere: Elementary idea of atmosphere: physical structure and composition; compositional layering of the atmosphere; variation of pressure and temperature with height; air temperature; requirements to measure air temperature; temperature sensors: types; atmospheric pressure: its measurement; cyclones and anticyclones: its characteristics. **(9 Lectures)**

UNIT II: Measuring the weather: Wind; forces acting to produce wind; wind speed direction: units, its direction; measuring wind speed and direction; humidity, clouds and rainfall, radiation: absorption, emission and scattering in atmosphere; radiation laws. **(9 Lectures)**

UNIT III: Weather systems: Global wind systems; air masses and fronts: classifications; jet streams; local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes. **(9 Lectures)**

UNIT IV: Climate and Climate Change: Climate: its classification; causes of climate change; global warming and its outcomes; air pollution; aerosols, ozone depletion, acid rain, environmental issues related to climate. **(9 Lectures)**

UNIT V: Basics of weather forecasting: Weather forecasting: analysis and its historical background; need of measuring weather; types of weather forecasting; weather forecasting methods; criteria of choosing weather station; basics of choosing site and exposure; satellites observations in weather forecasting; weather maps; uncertainty and predictability; probability forecasts. **(9 Lectures)**

SUGGESTED READINGS

1. Aviation Meteorology, I.C. Joshi, 3rd edition 2014, Himalayan Books
2. The weather Observers Hand book, Stephen Burt, 2012, Cambridge University Press.
3. Meteorology, S.R. Ghadkar, 2001, Agromet Publishers, Nagpur.
4. Text Book of Agrometeorology, S.R. Ghadkar, 2005, Agromet Publishers, Nagpur.
5. Why the weather, Charls Franklin Brooks, 1924, Chpraman & Hall, London.
6. Atmosphere and Ocean, John G. Harvey, 1995, The Artemis Press.

Maths.313 Integral Calculus**3+0****THEORY:****(45 Lectures)**

UNIT I: Integration by Partial fractions, integration of rational and irrational functions. Properties of definite integrals. Reduction formulae for integrals of rational, trigonometric, exponential and logarithmic functions and of their combinations. **(25 Lectures)**

UNIT II: Areas and lengths of curves in the plane, volumes and surfaces of solids of revolution. Double and Triple integrals. **(20 Lectures)**

SUGGESTED READINGS:

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd., 2002.

Chem.315 Chemistry of Cosmetics & Perfumes**2+1****THEORY (30 Lectures)**

Unit-I: A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, sun tan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. **(15 Lectures)**

Unit-II : Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone. **(15 Lectures)**

PRACTICAL

1. Preparation of talcum powder.
2. Preparation of shampoo
3. Preparation of enamels.
4. Preparation of hair remover
5. Preparation of face cream
6. Preparation of nail polish and nail polish remover.

SUGGESTED READINGS

1. E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
2. P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
3. Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

SEC-IV:**Phys.323 Renewable Energy and Energy Harvesting****3+0****THEORY:****(45 Lectures)**

UNIT I: Fossil fuels and Alternate Sources of energy: Fossil fuels and Nuclear Energy, their

limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity. **(8 Lectures)**

UNIT II: Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. **(6 Lectures)**

UNIT III: Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. **(6 Lectures)**

UNIT IV: Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. **(6 Lectures)**

UNIT V: Geothermal Energy: Geothermal Resources, Geothermal Technologies. Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources. **(6 Lectures)**

UNIT VI: Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power. **(7 Lectures)**

UNIT VII: Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications. Carbon captured technologies, cell, batteries, power consumption Environmental issues and Renewable sources of energy, sustainability. **(6 Lectures)**

SUGGESTED READING

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).

Maths.323 Vector Calculus

3+0

THEORY (45 Lectures)

UNIT I: Scalar and vector product of three vectors. Product of four vectors. Reciprocal Vectors. Differentiation and partial differentiation of a vector function. Gradient of a scalar point function, divergence and curl of vector point function. **(25 Lectures)**

UNIT II: Vector integration: line integral, surface integral, Volume integral. Theorems of Gauss, Green and Stokes (without proof) and the problems based on these theorems. **(20 Lectures)**

SUGGESTED READINGS

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd. 2002.
3. P.C. Matthew's, *Vector Calculus*, Springer Verlag London Limited, 1998.

Chem.325 Analytical Clinical Biochemistry

2+1

THEORY (30 Lectures)

Unit-I: Introduction: Carbohydrates, proteins, lipids, enzymes and nucleic acids (18 Lectures)

Unit-II: Biochemistry of disease: A diagnostic approach by blood/ urine analysis

Blood: Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin

Urine: Collection and preservation of samples. Composition and estimation of constituents of urine (12 Lectures)

PRACTICAL

Identification and estimation of the following:

1. Carbohydrates – qualitative and quantitative.
2. Lipids – qualitative.
3. Determination of the iodine number of oil.
4. Determination of the saponification number of oil.
5. Determination of cholesterol using Liebermann- Burchard reaction.
6. Proteins – qualitative.
7. Determination of protein by the Biuret reaction.
8. Blood test
9. Urine test

SUGGESTED READINGS

1. T.G. Cooper: Tool of Biochemistry.
2. Keith Wilson and John Walker: Practical Biochemistry.
3. Alan H Gowenlock: Varley's Practical Clinical Biochemistry.
4. Thomas M. Devlin: Textbook of Biochemistry.
5. Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.
6. Talwar, G.P. & Srivastava, M. *Textbook of Biochemistry and Human Biology*, 3rd Ed. PHI Learning.
7. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry* 7th Ed., W. H. Freeman.
8. Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.

GENERAL INTEREST / HOBBY COURSES

Ort.111 Orientation 1+0(NC)

THEORY (15 Lectures)

Introduction to the university vis-à-vis college-history, functions, organizational set-up; Academic programmes, regulations bodies Academic (ICAR/UGC/VCI), Human resources, Committees on students; welfare; Interaction of fresh students with Dean, faculty members and senior students; Interaction of fresh students with the in-charges of sports, NCC and NSS programmes and Hostel Wardens; Visit to different colleges, directorates; library, health centre and Students' Welfare Organization and interaction with their heads; Familiarization with common terms (Academic year, semester, Choice Based Credit System (CBCS), courses, credit hours, grade point, advisor, tutor, counsellor, SGPA/CGPA/OCGPA etc.); Advisory/counselling system; Minimum class attendance, mass absence, credit load, make-up examination, evaluation of course work; Addition/withdrawal/repeating of course; Re-evaluation/Re-examination of answer sheets; Grading, calculation of SGPA/CGPA/OCGPA; Requirements for continuation/completion of the degree, NCC/NSS requirements, dropping from the university; Semester report, good standing; Conduct and discipline in the college with special reference to hostel rules, examination and ragging, management, Breach of discipline and punishments; Participation in extra-curricular activities; Scholarships/stipends/fellowships, Gold medals; Composition of Students' Association and its role for promoting academic atmosphere; Scope for placement (higher studies/jobs) of graduates in the world market with special reference to fellowships available, information sources and alumni placed, if any; Professional ethics and role of professional towards society.

NCC [(0+2) for First and (0+2) for Second Semester of First Year] 0+4(NC)

Introduction to: Defence services, system of NCC training, Leadership and NCC song, Foot drill, sizing, getting on parade, dismissing and falling out, saluting, marching, weapon training. Introduction and characteristics of weapons, judging distance, five discipline and five control orders, field signals, description of ground; conventional signs, general principles, First aid, Hygiene and sanitation; Camouflage and concealment, NCC annual training camp.

NCC [(0+2) for First and (0+2) for Second Semester of First Year] 0+4(NC)

Forming up in three ranks, open and close order march, dressing; Arms drill, shoulder arm, order arm, present arm, Guard of honour; Ceremonial; Weapon training-rifle bayonet, light machine gun, sten machine carbine, introduction and characteristics stripping, assembling and cleaning, loading, uploading and firing; Field craft, visual training, targets, battle craft; Section formation, section battle drill; scouts and patrols, ambush, field engineering; Map reading, grid systems, use of service protractor, prismatic compass and its use, Self-defence, precautions and training, attack and counter attacks, marching and searching, Civil defence, NCC annual training camp.

Note: One annual training camp is compulsory for award of degree.

NSS *[(0+2) for First and (0+2) for Second Semester of Second Year]* **0+4(NC)**

Orientation of NSS volunteers regarding National Service Scheme; formation of group/houses; Adoption of villages; Strategic Frame work: Communication for HIV/AIDS; Environment concerns and strategies in new millennium; Drug abuse, social policing in conflict situation; Role of youth: Disaster management through NSS; Understanding gender; Combating female foeticide; Deadly human diseases; Appointment of office bearers; visit to adopted villages and interaction with villagers to identify the needs and problems of the community; involving the community in the solutions of their problems; Campus beautification drive; Celebration of important days; Van mahotsava.

NSS *[(0+2) for First and (0+2) for Second Semester of Second Year]* **0+4(NC)**

Study of philosophy of NSS; Fundamental rights; Socio-economic structure of Indian society; Population problems; Brief of five year plan; Eradication of social evils; Awareness programmes related to HIV/AIDS; Chronic diseases, Cancer, TB etc.; Consumer acts and rights; Disaster management; Motivation of donation of blood and eyes etc.; Campus beautification; Environment enrichment and conservation; Celebration of important days; Van mahotsava; Health, Family welfare and nutrition.

Note: One NSS special camp is compulsory for award of degree.

NSS Special Camping Programme

Activities in the adopted villages

Environment enrichment and conservation

- Water Conservation
- Health, family welfare and nutrition programme
- Water conservation
- Health, family welfare and nutrition programme
- Literacy programme (adult education)
- Creating awareness for improvement of the status of women
- Assistance and guidance in poultry farming animal husbandry, care of animal health
- Self-employment programme.