Skill Development
Employability
Entrepreneurship
All the three
Skill Development and Employability
Skill Development and Entrepreneurship
Employability and Entrepreneurship

UTKAL UNIVERSITY

REGULATIONS & SYLLABUS UNDER GRADUATE PROGRAMME IN

BACHELOR OF SCIENCE

(HONOURS & PASS)- CBCS PATTERN Effective for Admission Batch: 2017-18

(Applicable to Autonomous Colleges)

REGULATIONS

1. Eligibility

1.1 Higher Secondary/+2/ Senior Secondary or any other equivalent examination passed from any Board/Council established by the Govt. of India or any State Govt. or any other equivalent examination recognized by Central Board of Secondary Education/Council of Higher Secondary Education, Govt. of Odisha/Dept of Higher Education/Dept. of Industry or any other Dept of Govt. of Odisha or Utkal University. Those joining B.Sc. Programme must have passed the above examination under the faculty of Science/Technology/Engineering/Pharmacy etc. There shall be no such restriction for joining BA/ B.Com stream.

1.2 Students ordinarily may be selected for admission through Entrance Test, Group Discussion and Personal Interview and/or a combination of these with due weighage to career to bedecided by the Autonomous College or Director, Higher Education. DDCE would admit students on first come first serve basis. The Govt. of Odisha may lay down admission process forcolleges under its control.

1.3 Admission Policy would be decided by the Academic Council of the respective Autonomous Colleges and for affiliated colleges Government will decide the admission policy.

1.4. Directorate of Distance & Continuing Education would decide its own admission policy.

2. Duration

2.1 At least three years of six semesters in toto. In case of professional courses the duration may be more as per the direction of regulatory bodies established under Law.

2.2 Odd semester is from June to December (i.e., Sem.-I, Sem.-III & Sem.-V semester). The examination shall be held normally in the month of November - December.

2.3 Even semester is from January to June (i.e., Sem.-II, Sem.-IV & Sem.-VI semester). The examination shall be held normally in the month of May - June. However the FinalSemester shall be conducted in April and result shall be published by end of May.

2.4 A student would be required to complete the course within six academic years from the date of admission.

2.5 A student may opt for fast track of completing all the six semesters in two years provided she/he has at least 2(two) years industry/organizational experience after +2. Such permission would be granted at the discretion of the Principal of the Autonomous Colleges and DDCE. This clause shall not be applicable to affiliated, non autonomous colleges.

3. Compulsory Registration in Semester-I

3.1 Registration for Semester-I is compulsory. A candidate admitted to +3 Courses but not registered for 1st semester examination, his/her admission will be automatically cancelled.

3.2 A candidate may take a blank Semester: A blank Semester has to be clubbed with next Odd or Even Semester as the case may be i.e. Sem.-II, Sem.-IV and Sem.-VI/Sem.-I, Sem.-III and Sem.-V. The Hostel policy for blank semester is to be decided by colleges as per their suitability. Hostel accommodation cannot be claimed as a right for a blank semester. (Blank semester is not to be confused as repetition due to failure).

3.3 75% attendance for non DDCE students is a requirement for being eligible to appear at

Examination Up to 15% waiver may be granted by the College Principal at discretion on Health Ground or participation in sports, cultural activities, NCC and NSS activities etc.

3.4 A student may clear backlog papers within 6 years. Improvement if any has to be completed within 4 years.

3.5 A student may register for extra credit i.e. register for additional papers under the same faculty or outside the faculty under an autonomous college or DDCE provided they are in a position to facilitate such teaching.

4. Weightage Distribution (Percentage) for Evaluation

• Theory Subjects

Mid Term Test-I	Mid Term Test-II	End Term Test	Total
10	10	80	100

• Subjects with Practical

Unit Test-I	Unit Test-II	End Term Test	Total
		A-Theory **B-Practical**	
10	10	**A**-50 **B**-30(20+10-Record)	100

• Dissertation/Project Work

Identification of problem	Review of Literature	Methodo-Logy	Findings	Analysis	Viva-Voce	Total
10	10	10	25	25	20	100

Note: For the DDCE unit tests, quizzes, presentation, seminar etc. may not be introduced immediately.

5. Grading System

5.1

Grade		Marks secured out of 100	Grade points
Outstanding	$^{J}O^{J}$	90 – 100	10
Excellent	$^{J}A+^{J}$	80 – 89	9
Very Good	$^{J}A^{J}$	70 – 79	8
Good	$^{J}B+^{J}$	60 – 69	7
Above average	B	50 – 59	6
Fair	$^{J}C^{J}$	40 – 49	5
Pass	$^{J}D^{J}$	30 – 39	4
Failed	$^{J}F^{J}$	Below 30	0

NOTE:

- A Candidate has to secure 30% or above to pass in each of the Papers.

• The candidate obtaining Grade-F is considered failed and will be required to clear theback paper(s) in the subsequent examinations within the stipulated time.

• The candidate securing Grade-B and above in Core/Honours papers in aggregate will be awarded Honours.

• The candidate securing Grade-B + and above in aggregate in first appearance will be awarded Honours with Distinction/Distinction(for pass/regular course).

• Any candidate filling the forms for appearing in back papers/improvement shall not be awarded Distinction.

5.2 A transitory letter Grade-I (carrying points 2) shall be introduced for cases where the results are incomplete. This grade shall automatically be converted into appropriate grade(s) asand when the results are complete.

5.3 A student's level of competence shall be categorized by a **GRADE POINT AVERAGE** to be specified as:
SGPA: Semester Grade Point Average CGPA: Cumulative Grade Point Average

(a) **POINT:** Integer equivalent of each letter grade.

(b) **CREDIT:** Integer signifying the relative emphasis of individual course item(s) in a semester as indicated by the Course structure and syllabus.
CREDIT POINT: (b) × (a) for each course item.
CREDIT INDEX: ∑ CREDIT POINT of course items.

GRADE POINT AVERAGE: $\dfrac{\text{CREDIT INDEX}}{\sum \text{CREDIT}}$

SEMESTER GRADE POINT AVERAGE(SGPA)= $\dfrac{\text{CREDIT INDEX for a semester}}{\sum_{\text{CREDIT}}}$.

CUMULATIVE GRADE POINT AVERAGE(CGPA)

$= \dfrac{\text{CREDIT INDEX of all previous Semester up to the 6th semester}}{\sum_{\text{CREDIT}}}$.

5.4 In addition to the points marks/ percentage would also be awarded and shall also bereflected in the Mark Sheet.

5.5 The details of grading system shall be printed on the backside of University Mark-sheet.

6. Repeat Examination

6.1 A student has to clear back papers (i.e., in the paper/papers one has failed) by appearing at subsequent semester examinations within six years from the date of admission.

6.2 A student may appear improvement (repeat) in any number of papers in the immediate subsequent examination. The higher marks shall be retained.

6.3 Improvement has to be completed with 4-yrs. from the date of admission.

7. Hard case Rule

7.1 2% of grace mark on the aggregate mark subject to maximum of 5(five) marks in single paper shall be given. This shall be applicable in each semester.

7.2 0.5(point five percent) grace mark can be given for award of B Grade in each semester provided grace mark under 7.1 has not been awarded.

8. Examination Question Pattern(Suggestive)

8.1 The end semester examination will be of three hours irrespective of marks.

8.2 **For subject without having practical** full marks are 100 per paper out of which 20 marks is allotted for Mid-Semester Examination (Internal) and 80 marks for end semester examination.
The question papers shall be divided into two parts such as Group-A & Group-B.
Group-A will carry 10 short questions of two marks each .The answer should be within two sentences.
There shall be 5 long type questions in Group$B$ with one alternative each have to be attempted and all questions shall be of equal value (12 marks $\times$5).

For subject with practical full marks are 100 per paper out of which 20 marks is al- lotted for Mid- Semester Examination, 50 is for End Semester Examination and 30 is for practical.
The question papers shall be divided into two parts such as Group-A & Group-B.
Group-A will carry 10 short questions of one mark each. The answer should be within two sentences.
There shall be 5 long-type questions with one alternative each have to be attempted for subjects having practical. The questions shall be of equal value (8 Marks $\times$5).
Practical will carry 30 marks out of which 10 will be for records.

8.3 Model answers for long questions should be between 700 – 1000 words.

9. Each Department shall have a designated Teacher in-charge of Examination to be decided by the Principal in addition to the Controller of Examinations of the College (applicable to autonomous colleges).

10. The Internal Evaluation would be the sole responsibility of Teacher offering the course.

11. Suitable modifications may be made by the Autonomous Colleges keeping in view the UGC guideline for Autonomous Colleges, University guidelines from time to time and State Govt. guidelines from time to time.

12. Broad Principles of Credit Transfer

There should be a small group to consider all cases of credit transfer. The group should consists of the following:

Chairman: Chairman P.G Council (for University affiliated colleges)/Director, DDCE for DDCE/Principals of the Autonomous College/Controller of Examinations, Utkal University.

Convener: Dy. Controller of Examinations for University affiliated colleges/Faculty mem- ber of DDCE for DDCE/Controller of Examinations of respective Autonomous colleges for Autonomous colleges.

Members: Four teachers to be nominated by the Chairman, P.G. Council/Director, DDCE/Principal of Autonomous Colleges as the case may be.

Waiver for courses covered under other colleges not withstanding differences in detailed course can be granted . Papers which one has not studied even though they are prescribed for earlier semesters can be covered by the students .

Other Broad Principles: Student transferred after Semester-I examination cannot be given position or medal under autonomous colleges. Students who have failed/remained absent/appeared for improvement shall not be eligible for University Gold medal or Rank. Students who have been granted credit waiver under credit transfer system cannot be awarded Gold medal or position.

DETAILS OF COURSES UNDER BACHELOR OF SCIENCE(HONOURS)

Course	Theory+Practical	Theory + Tutorial
I. Core Course (6 Credits) (14 Papers)	14 × 4 = 56	14 × 5 = 70
Core Course Practical / Tutorial* (14 Papers)	14 × 2 = 28	14 × 1 = 14
II. Elective Course (6 Credits) (8 Papers)		
A.1. Discipline Specific Elective (4 Papers)	4 × 4 = 16	4 × 5 = 20
A.2. Discipline Specific Elective Practical/ Tutorial* (4 Papers)	4 × 2 = 8	4 × 1 = 4
B.1. Generic Elective/Interdisciplinary (4 Papers)	4 × 4 = 16	4 × 5 = 20
B.2. Generic Elective, Practical/ Tutorials*(4 Papers)	4 × 2 = 8	4 × 1 = 4

• Optional Dissertation or Project Work in place of one Discipline Specific elective paper (6 credits) in Semester-VI.

III. Ability Enhancement Courses		
1. Ability Enhancement Compulsory Courses(AECC)		
(2 Papers of 4 credit each) Environmental Science/English/ Hindi/MIL Communication	2 × 4 = 8	2 × 4 = 8
2. Skill Enhancement Courses(SEC)		
(Min.2)(2 Papers of 4 credit each)	2 × 4 = 8	2 × 4 = 8
Total Credit	148	148

• Institute should evolve a system/policy about ECA/General Interest/Hobby/Sports NCC/NSS/related courses on its own.

• Wherever there is a practical there will be no tutorial and vice-versa.

• For Generic Elective, there shall be two subjects other than the Core subject having two papers each.

SCHEME FOR CHOICE BASED CREDIT SYSTEM BACHELOR OF SCIENCE(HONOURS)

Semester	**Core Course(**14**)**	**Ability Enhancement Compulsory Course** (AECC)(2)	**Skill Enhancement Course** (SEC)(2)	**Discipline Specific Elective** (DSE)(4)	**Generic Elective** (GE)(4)
I	C-1 C-2	Environmental Science			GE-1A
II	C-3 C-4	MIL Communication (Oriya/Hindi)			GE-2A
III	C-5 C-6 C-7		SEC-1(English Communication)		GE-1B
IV	C-8 C-9 C-10		SEC-2		GE-2B
V	C-11 C-12		DSE-1 DSE-2		
VI	C-13 C-14		DSE-3 DSE-4		

DETAILS OF COURSES UNDER BACHELOR OF SCIENCE(REGULAR/PASS)

Course	Theory+Practical	Theory + Tutorial
I. Core Course (6 Credits)		
(12 Papers)	12 × 4 = 48	12 × 5 = 60
(4 Courses from each of the 3 Disciplines of choice)		
Core Course Practical / Tutorial*		
(12 Practical/Tutorials*)	12 × 2 = 24	12 × 1 = 12
(4 Courses from each of the 3 Disciplines of choice)		
II. Elective Course (6 Credits)		
(6 Papers)	6 × 4 = 24	6 × 5 = 30
(Two papers from each discipline of choice including paper of interdisciplinary nature)		
Elective Course Practical/Tutorials*		
(6 Practical/Tutorials*)	6 × 2 = 12	6 × 1 = 6
(Two Papers from each Disciplines of choice including paper of interdisciplinary nature)		

• **Optional Dissertation/Project Work in place of one Discipline elective paper (6 credits) in Semester-VI.**

III. Ability Enhancement Courses		
1. Ability Enhancement Compulsory Courses(AECC)		
(2 Papers of 4 credit each) Environmental Science/English/ Hindi/MIL Communication	2 × 4 = 8	2 × 4 = 8
2. Skill Enhancement Courses(SEC)		
(4 Papers of 4 credit each)	4 × 4 = 16	4 × 4 = 16
Total Credit	132	132

• **Institute should evolve a system/policy about ECA/General Interest/Hobby/Sports NCC/NSS/related courses on its own.**

• **Wherever there is a practical, there will be no tutorial and vice-versa.**

SCHEME FOR CHOICE BASED CREDIT SYSTEM BACHELOR OF SCIENCE (REGULAR/ PASS)

Semester	**Core Course(**12**)**	**Ability Enhancement Compulsory Course** (AECC)(2)	**Skill Enhancement Course** (SEC)(2)	**Discipline Specific Elective** (DSE)(6)
I	DSC-1A DSC-2A DSC-3A	Environmental Science		
II	DSC-1B DSC-2B DSC-3B	MIL Communication (Oriya/Hindi)		
III	DSC-1C DSC-2C DSC-3C		SEC-1(English Communication)	
IV	DSC-1D DSC-2D DSC-3D		SEC-2	
V			SEC-3	DSE-1A DSE-2A DSE-3A
VI			SEC-4	DSE-1B DSE-2B DSE-3B

COLOUR SCHEME OF MAPPING THE SYLLABI FOR ENTREPRENEURSHIP, EMPLOYABILITY AND SKILL DEVELOPMENT

Skill Development
Employability
Entrepreneurship
All the three
Skill Development and Employability
Skill Development and Entrepreneurship
Employability and Entrepreneurship

ABILITY ENHANCEMENT COMPULSORY COURSES (AECC)
(For all Subjects)

SEMESTER-I

AECC-I: Environmental Science

Max. Marks:100 (End-Sem.:80 Marks, Mid-Sem.: 20 Marks)

UNIT-I

The Environment: The Atmosphere, Hydrosphere, Lithosphere, Biosphere, Ecology, Ecosystem, Biogeochemical Cycle (Carbon Cycle, Nitrogen Cycle).

UNIT-II

Environment Pollution: Air Pollution, Water Pollution, Soil Pollution, Noise Pollution, Thermal Pollution, Radiation Pollution, Natural Disasters and their Management.

UNIT-III

Population Ecology: Individuals, Species, Pollution, Community, Control Methods of Popula- tion, Urbanization and its effects on Society, Communicable Diseases and its Transmission, Non-Communicable Diseases.

UNIT-IV

Environmental Movements in India: Grassroot Environmental movements in India, Role of women, Environmental Movements in Odisha, State Pollution Control Board, Central Pollution Control Board.

UNIT-V

Natural Resources: Conservation of Natural Resources, Management and Conservation of Wildlife, Soil Erosion and Conservation, Environmental Laws: Water Act, 1974, Air Act, 1981, The Wildlife (Protection) Act, 1972, Environment Protection, 1986.

SEMESTER-II

AECC-II: MIL Communication (Odia/Sanskrit/Alt. Eng.)

Max. Marks:100 (End-Sem.:80 Marks, Mid-Sem.: 20 Marks)

(**Detailed syllabus for this paper is available in MIL Odia/Sanskrit/Alt. Eng Communication syllabus).**

BOTANY(HONOURS)

SEMESTER-I

C-I: MICROBIOLOGY & PHYCOLOGY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

Unit-I

Introduction to microbial world, microbial nutrition, growth and metabolism. (2 lectures)

Unit-II

Bacteria: Discovery, general characteristics, types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts), cell structure, nutritional types, reproduction-vegetative, asexual and recombina-
tion (conjugation, transformation and transduction). Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine). (5 lectures)

Unit-III

Algae:- General characteristics; Ecology and distribution; range of thallus organization; Cell struc- ture and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; and methods of reproduction, classification; criteria, system of Fritsch, and evo- lutionary classification of Lee (only upto groups); significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, R.N. Singh, T.V. Desikachary, H.D. Kumar, M.O.P. Iyengar). Role of algae in the environment, agriculture, biotechnology and industry. (6 lectures)

Unit-IV

Cyanophyta:- Ecology and occurrence, range of thallus organization, cell structure, heterocyst, reproduction. economic importance; role in biotechnology. Morphology and life-cycle of Nostoc.(5 lectures)

Chlorophyta:- General characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycles of Chlamydomonas, Volvox, Oedogonium, Coleochaete. Evolutionary significance of Prochloron. (5 lectures)

Unit-V

Charophyta:- General characteristics; occurrence, morphology, cell structure and life-cycle of Chara; evolutionary significance.(2 lectures)

Xanthophyta:- General characteristics; range of thallus organization; Occurrence, morphology and life-cycle of Vaucheria.(3 lectures)

Phaeophyta:- Characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycles of Ectocarpus and Fucus.(3 lectures)

Rhodophyta:- General characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycle of Polysiphonia.(4 lectures)

PRACTICAL

Microbiology:

1. Electron micrographs/Models of viruses T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule.
3. Gram staining.
4. Endospore staining with malachite green using the (endospores taken from soil bacteria).

Phycology:

Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), Volvox, Oedogonium,Coleochaete, Chara, Vaucheria, Ectocarpus, Fucus and Polysiphonia,Procholoron through electron micrographs, temporary preparations and permanent slides.

Suggested Readings:

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Prescott, L.M., Harley J.P., Klein D. A. (2005). Microbiology, McGraw Hill, India. 6th edition.
3. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
4. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
5. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
6. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.

C-2: BIOMOLECULES & CELL BIOLOGY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

Unit-I

Biomolecules: Types and significance of chemical bonds; Structure and properties of water; pH and buffers.(2 lectures)

Carbohydrates: Nomenclature and classification; Role of monosaccharides (glucose, fructose, sugar alcohols mannitol and sorbitol); Disaccharides (sucrose, maltose, lactose), Oligosaccharides and polysaccharides (structural-cellulose, hemicelluloses, pectin, chitin, mucilage; storage, starch, inulin) (3 lectures)

Lipids: Definition and major classes of storage and structural lipids. Storage lipids. Fatty acids

structure and functions. Essential fatty acids. Triacyl glycerols structure, functions and properties. (2 lectures)
Proteins: Structure of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, tertiary and quarternary; Isoelectric point; Protein denaturation and biological roles of proteins. (2 lectures)
Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA. (4 lectures) **Unit-II**
Bioenergenetics: Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule. (3 lectures)
Enzymes: Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism ofaction (activation energy, lock and key hypothesis, induced - fit theroy), Michaelis Menten equation, enzyme inhibition and factors affecting enzyme activity. (4 lectures)

Unit-III

The cell: Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory). (2 lectures)
Cell wall and plasma membrane: Chemistry, structure and function of Plant Cell Wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport Passive, active and facilitated transport, endocytosis and exocytosis. (3 lectures)

Unit-IV

Cell organelles: Nucleus; Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus. (3 lectures)
Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament. (2 lectures)
Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast. (2 lectures)
Endoplasmic Reticulum, Golgi Apparatus, Lysosomes (2 lectures)

Unit-V

Cell division: Eukaryotic cell cycle, different stages of mitosis and meiosis. Cell cycle, Regulation of cell cycle. (6 lectures)

PRACTICAL

1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
2. Study of plant cell structure with the help of epidermal peel mount of Onion/Rhoeo/Crinum.
3. Demonstration of the phenomenon of protoplasmic streaming in Hydrilla leaf.
4. Measurement of cell size by the technique of micrometry.
5. Counting the cells per unit volume with the help of haemocytometer. (Yeast/pollen grains).
6. Study of cell and its organelles with the help of electron micrographs.
7. Study the phenomenon of plasmolysis and deplasmolysis.
8. Study different stages of mitosis and meiosis using aceto carmine and aceto orcine method.

Suggested Readings:

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning.
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill

Livingstone.

3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
6. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
7. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Beckers World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
8. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
9. 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

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SEMESTER-II

C-3: MYCOLOGY & PHYTOPATHOLOGY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

Unit-I

Introduction to true fungi: Definition, General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification.

Chytridiomycetes: General account (5 lectures)

Zygomycota: General characteristics; Ecology; Thallus organisation; Life cycle with reference to Rhizopus. (4 lectures)

Ascomycota: General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; life cycle and classification with reference to Saccharomyces, Aspergillus, Penicillium, Alternaria and Neurospora, Peziza. (5 lectures)

Unit-II

Basidiomycota**:** General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat Puccinia (Physiological Specialization), loose and covered smut (symp- toms only), Agaricus; Bioluminescence, Fairy Rings and Mushroom Cultivation. (5 lectures)

Allied Fungi: General characterises; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies. (3 lectures)

Oomycota: General characteristic; Ecology; Life cycle and classification with reference to Phytophthora, Albugo. (4 lectures)

Unit-III

Symbiotic associations: Lichen Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction. Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance. (4 lectures)

Unit-IV

Applied Mycology: Role of fungi in biotechnology, Application of fungi in food industry (Flavour &

texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Myco-fungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology. (5 Lectures)

Unit-V

Phytopathology: Terms and concepts; General symptoms; Geographical distribution of diseases; etiology; symptomology; Host- Pathogen relationships;disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine. Bacterial diseases Citrus canker and angular leaf spot disease of Cotton.Viral diseases Tobacco Mosaic viruses, vein clearing. Fungal diseases Early blight of potato, Black stem rust of wheat, white rust of crucifers. (5 lectures)

PRACTICAL

1. Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, asocarps & basidiocarps).
2. Rhizopus: study of asexual stage from temporary mounts and sexual structures through permanent slides.
3. Aspergillus and Penicillium: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.
4. Peziza: sectioning through ascocarp.
5. Alternaria: Specimens/photographs and temporary mounts.
6. Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberryleaves; sections/ mounts of spores on wheat and permanent slides of both the hosts.
7. Agaricus: Specimens of button stage and full grown mushroom; sectioning of gills of Agaricus, fairy rings and bioluminescent mushrooms to be shown.
8. Albugo: Study of symptoms of plants infected with Albugo; asexual phase study throughsection/temporary mounts and sexual structures through permanent slides.
9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endo mycorrhiza (Photographs)
10. Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Viral diseases: TMV, Fungal diseases: Early blight of potato, and White rust of crucifers.

Suggested Readings:

1. Agrios, G.N. 1997 Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
3. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.
4. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
5. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.

C-4: ARCHEGONIATE

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

Unit-I

Introduction: Unifying features of archegoniates; Transition to land habit; Alternation of generations. (2 lectures)

Unit-II

Bryophytes: General characteristics; Adaptations to land habit; Classification; Range of thallus organization. Classification (up to family).Riccia, Marchantia, Pellia, Porella, Anthoceros, Sphagnum and Funaria; Reproduction and evolutionary trends in Riccia, Marchantia , Anthoceros and Funaria (developmental stages not included). Ecological and economic importance of bryophytes with special reference to Sphagnum. (12 lectures)

Unit-III

Pteridophytes: General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of Psilotum, Selaginella, Equisetum and Pteris.(Developmental details not to be included).Apogamy, and apospory, heterospory andseed habit, telome theory, stelar evolution. Ecological and economic importance. (10 lectures)

Unit-IV

Gymnosperms: General characteristics, classification (up to family), morphology, anatomy and reproduction of Cycas, Pinus, Ginkgo and Gnetum. (Developmental details not to be included). Ecological and economic importance. (8 lectures)

Unit-V

Fossils: Geographical time scale, fossils and fossilization process. Morphology, anatomy and affinities of Rhynia, Calamites, Lepidodendron, Lyginopteris and Cycadeoidea. (8 lectures)

PRACTICAL

1. Riccia Morphology of thallus.
2. Marchantia- Morphology of thallus, whole mount of rhizoids & Scales, vertical sectionof thallus through Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanentslides).
3. Anthoceros- Morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).
4. Pellia, Porella- Permanent slides.
5. Sphagnum- Morphology of plant, whole mount of leaf (permanent slide only).
6. Funaria- Morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus,spores (temporary slides); permanent slides showing antheridial and archegonial heads, longitudinal section of capsule and protonema.
7. Psilotum- Study of specimen, transverse section of synangium (permanent slide).
8. Selaginella- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide).

9. Equisetum- Morphology, transverse section of internode, longitudinal section ofstrobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide).

10. Pteris- Morphology, transverse section of rachis, vertical section of sporophyll, wholemount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).

11. Cycas- Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll,transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide).
12. Pinus- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male andfemale-cones), transverse section of Needle, transverse section of stem, longitudinal section of transverse section of male cone, whole mount of microsporophyll, whole mount of Microspores (temporary slides), longitudinal section of female cone, tangential longitudinal section & radial longitudinal sections stem (permanent slide).
13. Gnetum- Morphology (stem, male & female cones), transverse section of stem, verticalsection of ovule (permanent slide)

14. Botanical excursion.

Suggested Readings:

1. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.

2. Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Pub- lishers, New Delhi, India.

3. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad.

4. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.

5. Vander-Poorteri 2009 Introduction to Bryophytes. COP.

SEMESTER-III

C-5: ANATOMY OF ANGIOSPERMS

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

Unit-I

Introduction and scope of Plant Anatomy: Applications in systematics, forensics and pharmacognosy. (2 Lectures)

Tissues: Classification of tissues; Simple and complex tissues (no phylogeny); cytodifferentiationof tracheary elements and sieve elements; Pits and plasmodesmata; Wall ingrowths and transfer cells, adcrustation and incrustation,Ergastic substances. (5 Lectures)

Unit-II

Stem: Organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cytohistological zonation); Types of vascular bundles; Structure ofdicot

and monocot stem. (5 Lectures)

Leaf: Structure of dicot and monocot leaf, Kranz anatomy. (4 Lectures)

Root: Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescentcentre; Root cap; Structure of dicot and monocot root; Endodermis, exodermis and origin of lateral root. (4 Lectures)

Unit-III

Vascular Cambium: Structure, function and seasonal activity of cambium; Secondary growth in root and stem. (4 Lectures)

Wood: Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. (5 Lectures)

Periderm: Development and composition of periderm, rhytidome and lenticels. (3 Lectures)

Unit-IV

Adaptive and Protective Systems Epidermal tissue system, cuticle, epicuticular waxes, trichomes(uni- and multicellular, glandular and nonglandular, two examples of each), stomata (classification);Adcrustation and incrustation;Anatomical adaptations of xerophytes and hydrophytes. (5 Lectures)

Unit-V

Secretory System: Hydathodes, cavities, lithocysts and laticifers. (3 Lectures)

PRACTICAL

1. Study of anatomical details through permanent slides/temporary stain mounts/macerations/ museum specimens with the help of suitable examples.
2. Apical meristem of root, shoot and vascular cambium.
3. Distribution and types of parenchyma, collenchyma and sclerenchyma.
4. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres.
5. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood.
6. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.
7. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
8. Root: monocot, dicot, secondary growth.
9. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels.
10. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).
11. Adaptive Anatomy: xerophytes, hydrophytes.
12. Secretory tissues: cavities, lithocysts and laticifers.

Suggested Readings:

1. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
3. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.
4. Esau, K. (1977). Anatomy of Seed Plants. John Wiley & Sons, Inc., Delhi.

C-6: ECONOMIC BOTANY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

Unit-I

Origin of Cultivated Plants: Concept of Centres of Origin, their importance with reference to Vavilovs work. Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity. (3 Lectures)

Unit-II

Cereals : Wheat and Rice (origin, morphology, processing & uses), brief account of millets. (3 lectures)

Legumes: General account, importance to man and ecosystem. (3 Lectures)

Sugars & Starches: Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato morphology, propagation & uses. (3 lectures)

Unit-III

Spices:Listing of important spices, their family and part used, economic importance with special reference to fennel, saffron, clove and black pepper (4 Lectures)

Beverages: Tea, Coffee (morphology, processing & uses)(4 lectures) Drug-yielding plants: Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, Papaver and Cannabis. (4 Lectures)

Tobacco: Tobacco (Morphology, processing, uses and health hazards) (2Lectures)

Unit-IV

Oils & Fats: General description, classification, extraction, their uses and health implications groundnut, coconut, linseed and Brassica and Coconut (Botanical name, family & uses) (4 lectures) Essential Oils: General account, extraction methods, comparison with fatty oils & their uses. (4 Lectures)

Unit-V

Natural Rubber: Para-rubber: tapping, processing and uses. (2 Lectures)

Timber plants: General account with special reference to teak and pine. (2 Lectures)

Fibres: Classification based on the origin of fibres, Cotton and Jute (morphology, extraction and uses). (2 Lectures)

PRACTICAL

1. Cereals: Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests).
2. Legumes: Soya bean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).
3. Sugars & Starches: Sugarcane (habit sketch; cane juice- micro-chemical tests), Potato(habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, w.m. starch grains, micro-chemical tests).
4. Spices: Black pepper, Fennel and Clove (habit and sections).

5. Beverages: Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
6. Oils & Fats: Coconut- T.S. nut, Mustardplant specimen, seeds; tests for fats in crushed seeds.
7. Essential oil-yielding plants: Habit sketch ofRosa, Vetiveria, Santalum and Eucalyptus (specimens/photographs).
8. Rubber: specimen, photograph/model of tapping, samples of rubber products.
9. Drug-yielding plants: Specimens of Digitalis, Papaverand Cannabis.
10. Tobacco: specimen and products ofTobacco.
11. Woods: Tectona, Pinus: Specimen, Section of young stem.
12. Fibre-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fibre and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fibre).

Suggested Readings:

1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publish- ers, The Netherlands.
3. Chrispeels, M.J. and Sadava, D.E. (2003). Plants, Genes and Agriculture. Jones & Bartlett Publishers.

C-7: GENETICS

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

Unit-I

Mendelian genetics and its extension Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Probability and pedigree analysis; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits, Penetrance and Expressivity, Numericals; Polygenic inheritance. (16 lectures)

Unit-II

Extrachromosomal Inheritance: Chloroplast mutation: Variegation in Four oclock plant; Mitochondrial mutations in yeast; Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in Paramecium. (6 lectures)

Unit-III

Linkage, crossing over and chromosome mapping: Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numericals based on gene mapping; Sex Linkage. (12 lectures)

Unit-IV

Variation in chromosome number and structure: Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy (8 lectures)

Gene mutations: Types of mutations; Molecular basis of Mutations; Mutagens physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: CIB method. Role of Transposons in mutation.DNA repair mechanisms. (6 lectures)

Unit-V

Fine structure of gene: Classical vs molecular concepts of gene; Cis-Trans complementation test for functional allelism; Structure of Phage T4, rII Locus. (6 lectures)

Population and Evolutionary Genetics: Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation. (6 lectures)

PRACTICAL

1. Meiosis through temporary squash preparation.
2. Mendels laws through seed ratios. Laboratory exercises in probability and chi-square analysis.
3. Chromosome mapping using test cross data.
4. Pedigree analysis for dominant and recessive autosomal and sex linked traits with floral chart.
5. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
6. Blood Typing: ABO groups & Rhfactor.
7. Study of aneuploidy: Downs, Klinefelters and Turners syndromes.
8. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.

Suggested Readings:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th edition.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. Benjamin Cummings, U.S.A. 10th edition.
4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.

SEMESTER-IV

C-8: MOLECULAR BIOLOGY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

Unit-I

Nucleic acids : Carriers of genetic information: Historical perspective; DNA as the carrier of genetic information (Griffiths, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrats experiment. (4 lectures)

Unit-II

The Structures of DNA and RNA / Genetic Material: DNA Structure: Miescher to Watson and Crick-historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves; Organization of DNAProkaryotes, Viruses, Eukaryotes. RNA Structure- Organelle DNA - mitochondria and chloroplast DNA.The Nu- cleosome - Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative hete-rochromatin. (8 lectures)

The replication of DNA: Chemistry of DNA synthesis (Kornbergs discovery); General principles bidirectional, semi-conservative and semi discontinuous replication, RNA priming; Various models of DNA replication, including rolling circle, (theta) mode of replication, replication of linear ds-DNA, replication of the 5end of linear chromosome; Enzymes involved in DNA replication. (6 lectures)

Unit-III

Central dogma and genetic code: Key experiments establishing-The Central Dogma (Adaptor hy-pothesis and discovery of mRNAtemplate), Genetic code (deciphering & salient features) (2 lectures)
Mechanism of Transcription: Transcription in prokaryotes; Transcription in eukaryotes (4 lectures)
Processing and modification of RNA: Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I & group II intron splicing, alternative splicing eu-karyotic mRNA processing(5 cap, 3 polyA tail); Ribozymes, exon shuffling; RNA editing and mRNA transport. (5 lectures)

Unit-IV

Translation (Prokaryotes and eukaryotes): Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins. (6 lectures)

Unit-V

Regulation of transcription in prokaryotes and eukaryotes: Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in E.coli. Eukaryotes: tran-scription factors, heat shock proteins, steroids and peptide hormones; Gene silencing. (5 lectures)

PRACTICAL

1. Preparation of LB medium and raising E.Coli.
2. Isolation of genomic DNA from E.Coli.

3. DNA isolation and RNA estimation by orcinol method.
4. DNA estimation by diphenylamine reagent/UV Spectrophotometry.
5. Study of DNA replication mechanisms through photographs (Rolling circle, Thetareplication and semi-discontinuous replication).
6. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.
7. Photographs establishing nucleic acid as genetic material (Messelson and Stahls, Avery etal, Griffiths, Hershey & Chases and Fraenkel & Conrats experiments)
8. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.

Suggested Readings:

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th edition.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
4. Russell, P. J. (2010). iGenetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.

C-9: PLANT ECOLOGY & PHYTOGEOGRAPHY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

Unit-I

Introduction Concept of ecology, Autoecology, Synecology, system ecology, Levels of organization. Inter-relationships between the living world and the environment, the components of environmental, concept of hydrosphere and lithosphere and dynamism, homeostasis. (2 lectures)

Unit-II

Soil: Importance; Origin; Formation; Composition; Physical; Chemical and Biological components; Soil profile; Role of climate in soil development. (5 lectures)

Water: Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table. (2 lectures)

Light, temperature, wind and fire: Variations; adaptations of plants to their variation. (4 lectures)

Unit-III

Biotic interactions: 2 lectures Population ecology: Characteristics and Dynamics .Ecological Speciation 4 lectures Plant communities: Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession processes, types; climax concepts. (4 lectures)

Unit-IV

Ecological pyramids. (4 lectures)

Functional aspects of ecosystem: Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus.(5 lectures)

Unit-V

Phytogeography: Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Local Vegetation. (8 lectures)

PRACTICAL

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and luxmeter.
2. Determination of pH of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper)
3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.
4. Determination of organic matter of different soil samples by Walkley & Black rapid titration method.
5. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.
6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.
7. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each). (b) Study of biotic interactions of the following: Stem parasite (Cuscuta), Root parasite (Orobanche) Epiphytes, Predation (Insectivorous plants).
8. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).
9. Quantitative analysis of herbaceous vegetation in the college campus for frequency andcomparison with Raunkiaers frequency distribution law.
10. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.

11. Field visit to familiarise students with ecology of different sites.

Suggested Readings:

1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
3. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
4. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
5. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.

C-10: PLANT SYSTEMATICS

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

Unit-I

Plant identification, Classification, Nomenclature; Biosystematics. (2 lectures)
Identification: Field inventory; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys: Single access and Multi-access. (5 lectures)

Unit-II

Taxonomic hierarchy: Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary). (5 lectures)
Botanical nomenclature: Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids. (5 lectures)

Unit-III

Systematics-an interdisciplinary science: Evidence from palynology, cytology, phytochemistry and molecular data. (6 lectures)
Systems of classification: Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (upto series) and Engler and Prantl (upto series); Brief reference of Angiosperm Phylogeny Group (APG III) classification. (6 lectures)

Unit-IV

Biometrics, numerical taxonomy and cladistics: Characters; Variations; OTUs, character weighting and coding; cluster analysis; Phenograms, cladograms (definitions and differences). (4 lectures)

Unit-V

Phylogeny of Angiosperms: Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). origin & evolution of angiosperms; coevolution of angiosperms and animals; methods of illustrating evolutionary relationship (phylogenetic tree, cladogram). (7 lectures)

PRACTICAL

1. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according toBentham & Hookers system of classification):
   Ranunculaceae - Ranunculus, Delphinium
   Brassicaceae - Brassica, Alyssum / Iberis
   Myrtaceae - Eucalyptus, Callistemon
   Umbelliferae - Coriandrum /Anethum / Foeniculum
   Asteraceae - Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax
   Solanaceae - Solanum nigrum/Withania
   Lamiaceae - Salvia/Ocimum
   Euphorbiaceae - Euphorbia hirta/E.milii, Jatropha
   Liliaceae - Asphodelus/Lilium/Allium
   Poaceae - Triticum/Hordeum/Avena
2. Field visit (local) Subject to grant of funds from the university.
3. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book)

Suggested Readings:

1. Singh, G. (2012). Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
2. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
4. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi.
5. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York.

SEMESTER-V

C-11: REPRODUCTIVE BIOLOGY OF ANGIOSPERMS

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

Unit-I

Introduction: History (contributions of G.B. Amici, W. Hofmeister, E. Strasburger, S.G. Nawaschin, P. Maheshwari, B.M. Johri, W.A. Jensen, J. Heslop-Harrison) and scope. (2 lectures)

Unit-II

Anther: Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance. (2 lectures)

Pollen biology: Microgametogenesis; Pollen wall structure, MGU (male germ unit) structure, NPC system; Palynology and scope (a brief account); Pollen wall proteins; Pollen viability, storage and germination; Abnormal features: Pseudomonads, polyads, massulae, pollinia. (5 lectures)

Unit-III

Ovule: Structure; Types; Special structures: endothelium, obturator, aril, caruncle and hypostase; Female gametophyte megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of Polygonum type); Organization and ultrastructure of mature embryo sac. (5 lectures)

Endosperm: Types, development, structure and functions.(3 lectures)

Embryo: Six types of embryogeny; General pattern of development of dicot and monocot embryo; Suspensor: structure and functions; Embryoendosperm relationship; Nutrition of embryo; Unusual features; Embryo development in Paeonia. (6 lectures)

Unit-IV

Pollination and fertilization: Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization. (4 lectures)

Self incompatibility: Basic concepts (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome selfincompatibility: mixed pollination, bud pollination, stub pollination; Intraovarian and in vitro pollination; Modification of stigma surface, parasexual hybridization;Cybrids, in vitro fertilization. (5 lectures)

Unit-V

Seed: Structure, importance and dispersal mechanisms (3 lectures)

Polyembryony and apomixes: Introduction; Classification; Causes and applications. (4 lectures)

Germline transformation: Pollen grain and ovules through pollen tube pathway method/ Agrobacterium/ electrofusion/floral dip/biolistic. (4 lectures)

PRACTICAL

1. Anther: Wall and its ontogeny; Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bicelled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation.

2. Pollen grains: Fresh and acetolyzed showing ornamentation and aperture, psuedomonads, polyads, pollinia (slides/photographs,fresh material), ultrastructure of pollen wall(micrograph); Pollen viability: Tetrazolium test.germination: Calculation of percentage germination in different media using hanging drop method.

3. Ovule: Types-anatropous, orthotropous, amphitropous/campylotropous, circinotropous, unitegmic,

bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs).

4. Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature egg apparatus.
5. Intra-ovarian pollination; Test tube pollination through photographs.
6. Endosperm: Dissections of developing seeds for endosperm with free-nuclear haustoria.
7. Embryogenesis: Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages; Study of suspensor through electron micrographs.

Suggested Readings:

1. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
2. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
3. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
4. Johri, B.M. l (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands.

C-12: PLANT PHYSIOLOGY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

Unit-I

Plant water relationship: Water Potential and its components, water absorption by roots, aquaporins, pathway of water movement, symplast, apoplast, transmembrane pathways, root pressure, guttation. Ascent of sap cohesion-tension theory. Transpiration and factors affecting transpiration,antitranspirants, mechanism of stomatal movement. (6 lectures)

Translocation in the phloem:Experimental evidence in support of phloem as the site of sugar translocation. PressureFlow Model; Phloem loading and unloading; Sourcesink relationship. (5 lectures)

Unit-II

Mineral nutrition: Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements, chelating agents. (5 lectures)

Unit-III

Nutrient Uptake: Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems,proton ATPase pump and ion flux, uniport, co-transport, symport, antiport. (5 lectures)

Unit-IV

Plant growth regulators: Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene.Brassinosteroids and Jasmonic acid. (10 lectures)

Unit-V

Physiology of flowering: Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy. (4 lectures)

Phytochrome: Discovery, chemical nature, role of phytochrome in photomorphogenesis, lowenergy responses (LER) and high irradiance responses (HIR), mode of action. (5 lectures)

PRACTICAL

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Determination of water potential of given tissue (potato tuber) by weight method.
3. Study of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf.
4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte.
5. To calculate the area of an open stoma and percentage of leaf area open through stomatain a mesophyte and xerophyte (both surfaces).
6. To study the phenomenon of seed germination (effect of light).
7. To study the induction of amylase activity in germinating barley grains.

Demonstration experiments:

(a) To demonstrate suction due to transpiration. (b) Fruit ripening/Rooting from cuttings (Demonstration). (c) Bolting experiment/Avena coleptile bioassay (demonstration).

Suggested Readings:

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., Mller, I.M. and Murphy, A (2015). Plant Physiology and Development.Sinauer Associates Inc. USA. 6th edition.
3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.

SEMESTER-VI

C-13: PLANT METABOLISM

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

Unit-I

Concept of metabolism: Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric ,covalent modulation and Isozymes). (5 lectures) Carbohydrate metabolism: Synthesis and catabolism of sucrose and starch. (1 lectures)

Unit-II

Carbon assimilation: Historical background, photosynthetic pigments, role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO_2 reduction, photorespiration, C4 pathways; Crassulacean acid metabolism; Factors affecting CO2 reduction. (10 lectures)

Unit-III

Carbon Oxidation: Glycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phos- phate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, NADH shuttle; TCA cycle,amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, cyanideresistant respiration, factors affecting respiration. (6 lectures)

ATP-Synthesis: Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photophosphorylation), ATP synthase, Boyers conformational model, Rackers experiment, Jagendorfs experiment; role of uncouplers. (4 lectures)

Unit-IV

Lipid metabolism: Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α oxidation. (5 lectures)

Unit-V

Nitrogen metabolism: Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and transamination. (5 lectures)

Mechanisms of signal transduction: Calcium, phospholipids, cGMP, NO. (4 lectures)

PRACTICAL

1. Chemical separation of photosynthetic pigments.
2. Experimental demonstration of Hills reaction.
3. To study the effect of light intensity on the rate of photosynthesis.
4. Effect of carbon dioxide on the rate of photosynthesis.
5. To compare the rate of respiration in different parts of a plant.
6. To demonstrate activity of Nitrate Reductase in germinationg leaves of different plant sources.
7. To study the activity of lipases in germinating oilseeds and demonstrate mobilization of lipids during germination.
8. Demonstration of fluorescence by isolated chlorophyll pigments.
9. Demonstration of absorption spectrum of photosynthetic pigments.

Suggested Readings:

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., Mller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.

C-14: PLANT BIO-TECHNOLOGY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

Unit-I

Plant Tissue Culture: Historical perspective; Aseptic tissue culture techniques, Composition of media; Nutrient and hormone requirements (role of vitamins and hormones). (3 lectures)

Unit-II

Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm Conservation). (7 lectures)

Unit-III

Recombinant DNA technology-I: Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC and briefly PAC, MAC, HAC). Gene Cloning (Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR-mediated gene cloning). (10 lectures) **Unit-IV**

Recombinant DNA technology-II: Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; Probes-oligonucleotide, heterologous, PCR; Methods of gene transfer- Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics selectable marker and reporter genes (Luciferase, GUS, GFP). (10 lectures)

Unit-V

Applications of Biotechnology: Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Su- perbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Gentically Engineered ProductsHuman Growth Hormone; Humulin; Biosafety concerns. (10 lectures)

PRACTICAL

1. (a) Preparation of MS medium.
   (b) Demonstration of in vitro sterilization and inoculation methods using leaf and nodal ex-plants of tobacco, Datura, Brassica etc.
2. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
3. Isolation of protoplasts.
4. Construction of restriction map of circular and linear DNA from the data provided.

5. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
6. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs.
7. Isolation of plasmid DNA.
8. Restriction digestion and gel electrophoresis of plasmid DNA.

Suggested Readings:

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publica- tion House Pvt. Ltd., New Delhi. 5th edition.
4. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
5. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.
6. Chawla, H.S. (2010). Introduction to Plant Biotechnology.Oxford & IBH Publishing Co.Pvt. Ltd., New Delhi.
7. Singh, B. D. (2010) Biotechnology: Expanding Horizon. Kalyani Publishers. New Delhi.

DISCIPLINE SPECIFIC ELECTIVE COURSES

DSE-1A: ANALYTICAL TECHNIQUES IN PLANT SCIENCES

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

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. (10 lectures)
UNIT-II: Cell fractionation: Centrifugation: Differential and density gradient centrifugation, su- crose density gradient, CsCl2gradient, analytical centrifugation, ultracentrifugation, marker enzymes. (5 lectures)
UNIT-III: Radioisotopes: Use in biological research, auto-radiography, pulse chase experiment. (3 lectures)
Spectrophotometry: Principle and its application in biological research. 3 lectures Chromatography: Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography. (6 lectures)
UNIT-IV: 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 (5 lectures)
UNIT-V: Biostatistics: Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit. (8 lectures)

PRACTICAL

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR 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 Lowrys methods.

8. To separate proteins using PAGE.
9. To separation 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).
12. Estimation of plant pigments.

Suggested Readings:

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Pub- lishing 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 ed

DSE-1B: BIO-INFORMATICS

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

UNIT-I: Introduction to Bioinformatics: Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics. (3 Lectures)
Databases in Bioinformatics: Introduction, Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System. (4 Lectures)
UNIT-II: Biological Sequence Databases: National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database, Gene Expression Database. EMBL Nucleotide Sequence Database (EMBL-Bank): Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools. DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at DDBJ. Protein Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR. Swiss-Prot: Introduction and Salient Features. (15 Lectures)
UNIT-III: Sequence Alignments: Introduction, Concept of Alignment, Multiple Sequence Align- ment (MSA), MSA by CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM). (8 Lectures)
UNIT-IV: Molecular Phylogeny: Methods of Phylogeny, Software for Phylogenetic Analyses, Con- sistency of Molecular Phylogenetic Prediction. (5 Lectures)
UNIT-V: Applications of Bioinformatics: Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement. (5 Lectures)

PRACTICAL

1. Nucleic acid and protein databases.
2. Sequence retrieval from databases.

3. Sequence alignment.
4. Sequence homology and Gene annotation.
5. Construction of phylogenetic tree.

Suggested Readings:

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics-II Edition. Benjamin Cummings.

DSE-2A: PLANT BREEDING

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

UNIT-I: Plant Breeding: Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding. (6 lectures)

UNIT-II; Methods of crop improvement: Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants Procedure, advantages and limitations. (15 lectures)

UNIT-III: Quantitative inheritance: Concept, mechanism, examples of inheritance of Kernel colour in wheat, Skin colour in human beings.Monogenic vs polygenic Inheritance. (6 lectures)

UNIT-IV: Inbreeding depression and heterosis: History, genetic basis of inbreeding depression and heterosis; Applications. (6 lectures)

UNIT-V: Crop improvement and breeding: Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement. (7 lectures)

PRACTICAL

Practical related to theory.

Suggested Readings:

1. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7thedition.
2. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford IBH. 2ndedition.
3. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishers.

DSE-2B: NATURAL RESOURCE MANAGEMENT

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

UNIT-I: Natural resources: Definition and types. 2 lectures Sustainable utilization: Concept, approaches (economic, ecological and socio-cultural). (5 lectures)

UNIT-II: Land: Utilization (agricultural, pastoral, horticultural, silvicultural); Soil degradation and management. (5 lectures)
Water: Fresh water (rivers, lakes, groundwater, aquifers, watershed); Marine; Estuarine; Wetlands; Threats and management strategies. (4 lectures)

UNIT-III: Biological Resources: Biodiversity-definition and types; Significance; Threats; Management strategies; Bioprospecting; IPR; CBD; National Biodiversity Action Plan). (8 lectures) Forests: Definition, Cover and its significance (with special reference to India); Major and minor forest products; Depletion; Management. (4 lectures)

UNIT-IV: Energy: Renewable and non-renewable sources of energy 4 lectures Contemporary practices in resource management: EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint. (6 lectures)

UNIT-V: Resource Accounting; Waste management. National and international efforts in resource management and conservation (4 lectures)

PRACTICAL

1. Estimation of solid waste generated by a domestic system (biodegradable and nonbiodegradable) and its impact on land degradation.
2. Collection of data on forest cover of specific area.
3. Measurement of dominance of woody species by DBH (diameter at breast height) method.
4. Calculation and analysis of ecological footprint.
5. Ecological modeling.

Suggested Readings:

1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

DSE-2C: BIO-STATISTICS

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

UNIT-I: Biostatistics - definition - statistical methods - basic principles. Variables - measurements, functions, limitations and uses of statistics. (8 lectures)

Unit-II: Collection of data primary and secondary - types and methods of data collection procedures - merits and demerits. Classification - tabulation and presentation of data sampling methods. (8 lectures)

Unit-III: Measures of central tendency - mean, median, mode, geometric mean - merits & demerits. Measures of dispersion - range, standard deviation, mean deviation, quartile deviation - merits and demerits; Co- efficient of variations. (10 lectures)

Unit-IV: Correlation - types and methods of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression. (8 lectures)

Unit-V: Statistical inference - hypothesis - simple hypothesis - student 't' test - chi square test. (6 lectures)

PRACTICAL

1. Calculation of mean, standard deviation and standard error
2. Calculation of correlation coefficient values and finding out the probability
3. Calculation of F value and finding out the probability value for the Fvalue.

Suggested Readings:

1. Biostatistic, Danniel, W.W., 1987.New York, John Wiley Sons.
2. An introduction to Biostatistics, 3rd edition, Sundarrao, P.S.S and Richards, J. Christian Medical College, Vellore
3. Statistical Analysis of epidemiological data, Selvin, S., 1991. New York University Press.
4. Statistics for Biology, Boston, Bishop, O.N. Houghton, Mifflin.
5. The Principles of scientific research, Freedman, P. New York, Pergamon Press.
6. Statistics for Biologists, Campbell, R.C., 1998.Cambridge University Press.

DSE-3A: STRESS BIOLOGY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

UNIT-I: Defining plant stress: Acclimation and adaptation. (2 lectures)

UNIT-II: Environmental factors: Water stress; Salinity stress, High light stress; Temperature stress; Hypersensitive reaction; Pathogenesis related (PR) proteins; Systemic acquired resistance; Mediation of insect and disease resistance by jasmonates. (12 lectures)

UNIT-III: Stress sensing mechanisms in plants: Role of nitric oxide. Calcium modulation, Phospholipid signaling (12 lectures)

UNIT-IV: Developmental and physiological mechanisms that protect plants against environmental stress: Adaptation in plants; Changes in root: shoot ratio; Aerenchyna development; Osmoticadjustment; Compatible solute production. (10 lectures)

UNIT-V: Reactive oxygen speciesProduction and scavenging mechanisms.(4 lectures)

PRACTICAL

1. Quantitative estimation of peroxidase activity in the seedlings in the absence and presence of salt stress.
2. Superoxide activity in seedlings in the absence and presence of salt stress.
3. Assay of Ascorbate
4. Assay of peroxidase.

5. Assay of superoxide dismutase activity.
6. Quantitative estimation and analysis of catalase.

Suggested Readings:

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., Mller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.

DSE-3B: HORTICULTURAL PRACTICES & POST-HARVEST TECHNOLOGY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

UNIT-I: Introduction: Scope and importance, Branches of horticulture; Role in rural economy and employment generation; Importance in food and nutritional security; Urban horticulture and ecotourism. (2 lectures)
Ornamental plants: Types, classification (annuals, perennials, climbers and trees); Identification and salient features of some ornamental plants [rose, marigold, gladiolus, carnations, orchids, poppies, gerberas, tuberose, sages, cacti and succulents (opuntia, agave and spurges)] Ornamental flowering trees (Indian laburnum, gulmohar, Jacaranda, Lagerstroemia, fishtail and areca palms, semul, Coral tree). (3 lectures)

UNIT-II: Fruit and vegetable crops:Production, origin and distribution; Description of plants and their economic products; Management and marketing of vegetable and fruit crops; Identification of some fruits and vegetable varieties (citrus, banana, mango, chillies and cucurbits). (4 lectures) Horticultural techniques: Application of manure, fertilizers, nutrients and PGRs; Weed control; Biofertilizers, biopesticides; Irrigation methods (drip irrigation, surface irrigation, furrow and border irrigation); Hydroponics; Propagation Methods: asexual (grafting, cutting, layering, budding), sexual (seed propagation), Scope and limitations. (6 lectures)

UNIT-III: Landscaping and garden design : Planning and layout (parks and avenues); gardening traditions - Ancient Indian, European, Mughal and Japanese Gardens; Urban forestry; policies and practices. (4 lectures)
Floriculture: Cut flowers, bonsai, commerce (market demand and supply); Importance of flower shows and exhibitions. (4 lectures)

UNIT-IV: Post-harvest technology: Importance of post harvest technology in horticultural crops; Evaluation of quality traits; Harvesting and handling of fruits, vegetables and cut flowers; Principles, methods of preservation and processing; Methods of minimizing loses during storage and transportation; Food irradiation - advantages and disadvantages; food safety. (6 lectures)
Disease control and management : Field and post-harvest diseases; Identification of deficiency symptoms; remedial measures and nutritional management practices; Crop sanitation; IPM strategies (genetic, biological and chemical methods for pest control); Quarantine practices; Identification of common diseases and pests of ornamentals, fruits and vegetable crops. (5 lectures)

UNIT-V: Horticultural crops - conservation and management: Documentation and conservation of germplasm; Role of micropropagation and tissue culture techniques; Varieties and cultivars of various horticultural crops; IPR issues; National, international and professional societies and sources of information on horticulture. (6 lectures)

Field Trip: Field visits to gardens, standing crop sites, nurseries, vegetable gardens and horticultural fields at IARI or other suitable locations.

PRACTICAL

Practical related to theory.

Suggested Readings:

1. Singh, D. & Manivannan, S. (2009). Genetic Resources of Horticultural Crops. Ridhi International, Delhi, India.
2. Swaminathan, M.S. and Kochhar, S.L. (2007). Groves of Beauty and Plenty: An Atlas of Major Flowering Trees in India. Macmillan Publishers, India.
3. NIIR Board (2005). Cultivation of Fruits, Vegetables and Floriculture. National Institute of Industrial Research Board, Delhi.
4. Kader, A.A. (2002). Post-Harvest Technology of Horticultural Crops. UCANR Publications, USA.
5. Capon, B. (2010). Botany for Gardeners. 3rd Edition. Timber Press, Portland, Oregon.

DSE-3C: RESEARCH METHODOLOGY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

UNIT-I: Basic concepts of research :Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs emperical).Research methods vs methodology.Literature-review and its consolidation; Library research; field research; laboratory research. (6 lectures) 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. (8 lectures)

UNIT-II: Data collection and documentation of observations: Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissuespecimens and application of scale bars. The art of field photography. (4 lectures)
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. (4 lectures)

UNIT-III: 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, noncoagulant fixatives; tissue dehydration using graded solvent series; Paraffin and plastic infiltration; Preparation of thin and ultrathin sections. (4 lectures)

UNIT-IV: 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. (8 lectures)

UNIT-V: The art of scientific writing and its presentation : Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Power point presentation. Poster pre-

sentation. Scientific writing and ethics, Introduction to copyright-academicmisconduct/plagiarism. (6 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.

DSE-3D: INDUSTRIAL & ENVIRONMENTAL MICROBIOLOGY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

UNIT-I: Scope of microbes in industry and environment: (2 lectures)

Bioreactors/Fermenters and fermentation processes: Solid-state and liquid-state (stationary and submerged) fermentations; Batch and continuous fermentations. Components of a typical bioreactor, Types of bioreactors laboratory, pilot scale and production fermenters; Constantly stirred tank fermenter, tower fermenter, fixed bed and fluidized bed bioreactors and airlift fermenter. A visit to any educational institute/ industry to see an industrial fermenter, and other downstream processing operations. (8 lectures)

UNIT-II: Microbial production of industrial products: Microorganisms involved, media, fermentation conditions, downstream processing and uses; Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying; Hands on microbial fermentations for the production and estimation (qualitative and quantitative) of Enzyme: amylase or lipase activity, Organic acid (citric acid or glutamic acid), alcohol (Ethanol) and antibiotic (Penicillin) (8 lectures)
Microbial enzymes of industrial interest and enzyme immobilization: Microorganisms for industrial applications and hands on screening microorganisms for casein hydrolysis; starch hydrolysis; cellulose hydrolysis. Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase). (6 lectures)

UNIT-III: Microbes and quality of environment: Distribution of microbes in air; Isolation of microorganisms from soil, air and water. (4 lectures)

UNIT-IV: Microbial flora of water: Water pollution, role of microbes in sewage and domestic waste

water treatment systems. Determination of BOD, COD, TDS and TOC of water samples; Microorganisms as indicators of water quality, check coliform and fecal coliform in water samples. (6 lectures)

UNIT-V: Microbes in agriculture and remediation of contaminated soils: Biological fixation; Mycorrhizae; Bioremediation of contaminated soils. Isolation of root nodulating bacteria, arbuscular mycorrhizal colonization in plant roots. (6 lectures)

PRACTICAL

1. Principles and functioning of instruments in microbiology laboratory
2. Hands on sterilization techniques and preparation of culture media.

Suggested Readings:

1. Pelzar, M.J. Jr., Chen E.C. S., Krieg, N.R. (2010). Microbiology: An application based approach. Tata McGraw Hill Education Pvt. Ltd., Delhi.
2. Tortora, G.J., Funke, B.R., Case. C.L. (2007). Microbiology. Pearson Benjamin Cummings, San Francisco, U.S.A. 9th edition.

GENERIC ELECTIVE COURSES

GE-1A: BIODIVERSITY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

UNIT-I: Microbes : Viruses Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria Discovery, General characteristics and cell structure; Reproduction vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance. (8 lectures)

UNIT-II: Algae: General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and lifecycles of the following: Nos- toc, Chlamydomonas, Oedogonium, Vaucheria, Fucus, Polysiphonia. Economic importance of algae. (10 lectures)
Fungi : Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition , nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of Rhizopus (Zygomycota) Penicillium, Alternaria (Ascomycota), Puccinia, Agaricus (Basidiomycota); Symbiotic Associations-Lichens: (6 lectures)

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

Bryophytes : General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of Marchantia and Funaria.(Developmental details not to be included).Ecology and economic importance of bryophytes with special mention of Sphagnum. (6 lectures)

UNIT-IV: Pteridophytes : General characteristics, classification, Early land plants (Cooksonia and

Rhynia). Classification (up to family), morphology, anatomy and reproduction of Selaginella, Equisetum and Pteris.(Developmental details not to be included).Heterospory and seed habit, stellar evolution. Ecological and economical importance of Pteridophytes. (5 lectures)

UNIT-V: 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. EMs/Models of viruses T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining.
4. Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), Oedogonium, Vaucheria, Fucus* and Polysiphonia through temporary preparations and permanent slides. (*: Fucus - Specimen and permanent slides)
5. Rhizopus and Penicillium: Asexual stage from temporary mounts and sexual structuresthrough permanent slides.
6. Alternaria: Specimens/photographs and tease mounts.
7. Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberryleaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
8. Agaricus: Specimens of button stage and full grown mushroom; Sectioning of gills of Agaricus.
9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
10. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
11. Marchantia- morphology of thallus, w.m. rhizoids and scales, v.s. thallus throughgemmacup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
12. Funaria- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores(temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
13. 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).
14. 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).
15. 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).
16. 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).
17. 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 Ben- jamin 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.H., 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.

GE-1B: PLANT ECOLOGY & TAXONOMY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

UNIT-I: Introduction: (2 lectures)
Ecological factors : Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes (6 lectures)
Plant communities : Characters; Ecotone and edge effect; Succession; Processes and types (3 lectures)

UNIT-II: Ecosystem : Structure; Biotic and abiotic components, energy flow trophic organisa- tion; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous (6 lectures)

Phytogeography : Principle biogeographical zones; Endemism (2 lectures)

UNIT-III: Introduction to plant taxonomy: Identification, Classification, Nomenclature. (2 lec- tures)
Identification : Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access (3 lectures)

UNIT-IV: Taxonomic evidences from palynology, cytology, phytochemistry and molecular Data: (4 lectures)

Taxonomic hierarchy: Ranks, categories and taxonomic groups 2 lectures Biometrics, numerical taxonomy and cladistics: Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences). (5 lectures)

UNIT-V: Botanical nomenclature: Principles and rules (ICN); ranks and names; binominal sys- tem, typification, author citation, valid publication, rejection of names, principle of priority and its limitations. (4 lectures)
Classification: Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series). (5 lectures)

PRACTICAL

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and luxmeter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each). (b)Study of biotic interactions of the following: Stem parasite (Cuscuta), Root parasite (Orobanche), Epiphytes, Predation (Insectivorous plants).
5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaers frequency distribution law
7. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hookers system of classification):Brassicaceae - Brassica,Alyssum / Iberis; Asteraceae -Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax; Solanaceae -Solanum nigrum, Withania; Lamiaceae -Salvia, Ocimum; Liliaceae - Asphodelus / Lilium / Allium.
8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

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.

GE-2: ECONOMIC PLANT ANATOMY & EMBRYOLOGY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

UNIT-I: Introduction: (2 lectures)
Meristematic and permanent tissues: Root and shoot apical meristems; Simple and complex tissues (5 lectures)

Organs: Structure of dicot and monocot root stem and leaf. (3 lectures)

UNIT-II: Secondary Growth: Vascular cambium structure and function, seasonal activity. Sec- ondary growth in root and stem, Wood (heartwood and sapwood) (6 lectures)(
Adaptive and protective systems: Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes. (5 lectures)

UNIT-III: Structural organization of flower: Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs,organization and ultrastructure of mature embryo sac. (5 lectures) Pollination and fertilization: Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms. (6 lectures)

UNIT-IV: Embryo and endosperm: Endosperm types, structure and functions; Dicot and monocot embryo; Embryo endosperm relationship (5 lectures)

UNIT-V: Apomixis and polyembryony: Definition, types and Practical applications. (5 lectures)

PRACTICAL

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides).
4. Root: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (Nerium leaf); Hydrophyte (Hydrilla stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
9. Female gametophyte: Polygonum (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Pho-tographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.

13. Calculation of percentage of germinated pollen in a given medium.

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.

GE-4A: PLANT PHYSIOLOGY & METABOLISM

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

UNIT-I: Plant-water relations: Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation. (4 lectures)
Mineral nutrition: Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps. (4 lectures)
Translocation in phloem.: Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading (4 lectures)

UNIT-II: Photosynthesis: Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photo- system I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration. (8 lectures)

UNIT-III: Respiration : Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway. (4 lectures)

UNIT-IV: Enzymes: Structure and properties; Mechanism of enzyme catalysis and enzyme inhi- bition. (3 lectures)
Nitrogen metabolism : Biological nitrogen fixation; Nitrate and ammonia assimilation. (3 lectures)

UNIT-V: Plant growth regulators :Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene. (5 lectures)

Plant response to light and temperature: Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization. (5 lectures)

PRACTICAL

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration byexcised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O_2 evolution in photosynthesis.

7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

Demonstration experiments (any four): (a) Bolting.
(b) Effect of auxins on rooting.
(c) Suction due to transpiration.
(d) R.Q. (e) Respiration in roots.

Suggested Readings:

1. Taiz, L., Zeiger, E., Mller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th 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.

GE-4B: BOTANY & PLANT BIO-TECHNOLOGY
(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30 Lectures: 60 (40
Theory + 20 Practical classes)

UNIT-I: Origin of Cultivated Plants: Concept of centres of origin, their importance with reference to Vavilovs work. (3lectures)

UNIT-II: Cereals: Wheat -Origin, morphology, uses 3 lectures Legumes: General account with special reference to Gram and soybean (4 lectures)

UNIT-III: Spices: General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses) (4 lectures)
Beverages: Tea (morphology, processing, uses) (3 lectures)

UNIT-IV: Oils and Fats: General description with special reference to groundnut 3 lectures Fibre Yielding Plants: General description with special reference to Cotton (Botanical name, family, part used,morphology and uses) (3 lectures)

UNIT-V: Introduction to biotechnology (2 lectures)
Plant tissue culture: Micropropagation; haploid production through androgenesis andgynogenesis; brief account of embryo and endosperm culture with their applications, Gene cloning by recombinant DNA technology, transgenic plants. (6 lectures)
Molecular Techniques: 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.Molecular diagnosis of human disease, Human gene Therapy. (9lectures)

PRACTICAL

1. Study of economically important plants: Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests

2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

Suggested Readings:

1. Kochhar, S.L. (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, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

GE-V: ENVIRONMENTAL BIO-TECHNOLOGY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100

THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

UNIT-I: Environment - basic concepts and issues, global environmental problems ozone depletion, UV-B, greenhouse effect and acid rain due to anthropogenic activities, their impact and biotechno- logical approaches for management. (4 lectures)
An overview of atmosphere, hydrosphere, lithosphere and anthrosphere - environmental problems. Environmental pollution - types of pollution, sources of pollution, measurement of pollution, Bio-concentration, bio/geomagnification. (4 lectures)

UNIT-II: Microbiology of waste water treatment, aerobic process - activated sludge, oxidation ponds, trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Anaerobic process - anaerobic digestion, anaerobic filters, up-flow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, tannery, sugar and antibiotic industries. (6 lectures)

UNIT-III: Xenobiotic compounds - organic (chlorinated hydrocarbons, substituted simple aro- matic compounds, poly-aromatic hydrocarbons, pesticides, surfactants) and inorganic (metals, ra-dionuclides, phosphates, nitrates). Bio-remediation of xenobiotics in environment - ecological con-sideration, decay behavior and degradative plasmids, molecular techniques in bio-remediation. (6 lectures)
Role of immobilized cells/enzymes in treatment of toxic compounds. Bio-pesticides, bio-reactors, bio-leaching, bio-mining, bio-sensors, bio-techniques for air pollution abatement and odour control. (4 lectures)

UNIT-IV: Sustainable Development: Economics and Environment: Economic growth, Gross Na-tional Productivity and the quality of life, Tragedy of Commons, Economics of Pollution control, Cost-benefit and cost effectiveness analysis, WTO and Environment, Corporate Social Responsibility, Environmental awareness and Education; Environmental Ethics. (6 lectures)

UNIT-V: International Legislations, Policies for Environmental Protection: Stockholm Conference (1972) and its declaration, WCED (1983) and Brundtland Report (1987), Rio Earth Summit-UNCED (1992) and its declaration, Montreal Protocol - 1987, Basel Convention (1989), Kyoto Protocol- 1997, Ramsar Convention 1971. (3 lectures)
National Legislations, Policies for Pollution Management: Salient features of Wild life protection act

1972, Water Pollution (Prevention and Control) Act- 1974, Forest conservation act 1980, Air Pollution (Prevention and Control) Act-1981, National Environmental Policy-2006, Central and State Pollution Control Boards: Constitution and power. (3 lectures)
Public Participation for Environmental Protection: Environmental movement and peoples participation with special references to Gandhamardan, Chilika and Narmada Bachao Andolan, Chipko and Silent valley Movement; Women and Environmental Protection, Role of NGO in bringing environmental awareness and education in the society. (4lectures)

PRACTICAL

1. Water/Soil analysis-DO, salinity, pH, chloride, total hardness, alkalinity, acidity, nitrate, calcium, Magnesium and phosphorus.
2. Gravimetric analysis-Total solid, dissolved solid, suspended solid in an effluent
3. Microbial assessment of air (open plate and air sample) and water.

Suggested Readings:

1. Waste water engineering-treatment, disposal and reuse, Metcalf and Eddy Inc., Tata McGraw Hill, New Delhi.
2. Environmental Chemistry, AK. De, Wiley Eastern Ltd, New Delhi.
3. Introduction to Bio-deterioration, D.Allsopp and K.J. Seal, ELBS / Edward Arnold.
4. Bioremidation, Baaker, KH and Herson D.S., 1994. Mc.GrawHill Inc, NewYork.
5. Industrial and Environmental Biotechnology - Nuzhat Ahmed, Fouad M. Qureshi and Obaid Y. Khan, 2006. Horizon Press.
6. Environmental Molecular Biology, Paul. A, Rochelle, 2001.Horizon Press.
7. Environmental Protection and Laws by Jadhav and Bhosale, V.M.Himalaya publ. House 13. Biodiversity Assessment and Conservation by PC Trivedi, Agrobios publ.

SKILL ENHANCEMENT COURSES (SEC)

SEC-I: BIO-FERTILIZERS

(Credits-2: Lectures: 30)

THEORY (Each class 1 hr.)-Marks: 50.

Unit-I: General account about the microbes used as biofertilizer Rhizobium isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis. (4 lectures)

Unit-II: Azospirillum: isolation and mass multiplication carrier based inoculant, associative effect of different microorganisms.Azotobacter: classification, characteristics crop response to Azotobacter inoculum, maintenance and mass multiplication. (8 lectures)

Unit-III: Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation. (4 lectures)

Unit-IV: Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield colonization of VAM isolation and inoculum production of VAM, and its influence on growth and yield of crop plants. (8 lectures)

Unit-V: Organic farming Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes bio-compost making methods, types and method of vermicomposting field Application. (6 lectures)

Suggested Readings:

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay, Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic, Farming Akta Prakashan, Nadiad

SEC-II: HERBAL TECHNOLOGY

(Credits-2: Lectures: 30)

THEORY (Each class 1 hr.)-Marks: 50.

Unit-I: Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants. (6 lectures)

Unit-II: Pharmacognosy - systematic position m edicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka. (6 lectures)

Unit-III: Phytochemistry - active principles and methods of their testing - identification and utiliza- tion of the medicinal herbs; Catharanthus roseus (cardiotonic), Withania somnifera (drugs acting on nervous system), Clerodendron phlomoides (anti-rheumatic) and Centella asiatica (memory booster). (6 lectures)

Unit-IV: Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds) (8 lectures)

Unit-V: Medicinal plant banks micro propagation of important species (Withania somnifera, neem and tulsi- Herbal foods-future of pharmacognosy) (4 lectures)

Suggested Readings:

1. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R, New Delhi.
2. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book Distributors.
3. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
4. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994. Oxford IBH publishing Co.
5. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
6. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.

7. Pharmacognosy, Dr.C.K.Kokate et al. 1999. Nirali Prakashan.

SEC-III: NURSERY & GARDENING

(Credits-2: Lectures: 30)

THEORY (Each class 1 hr.)-Marks: 50.

Unit-I: Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants. (4 lectures)

Unit-II: Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion Seed production technology - seed testing and certification. (6 lectures)

Unit-III: Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants green house - mist chamber, shed root, shade house and glass house. (6 lectures)

Unit-IV: Gardening: definition, objectives and scope - different types of gardening landscape and home gardening - parks and its components - plant materials and design computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting. (8 lectures)

Unit-V: Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, ladys finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures. (6 lectures)

Suggested Readings:

1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co.,New Delhi.
2. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
6. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.

SEC-IV: FLORICULTURE

(Credits-2: Lectures: 30)

THEORY (Each class 1 hr.)-Marks: 50.

Unit-I: Introduction: History of gardening; Importance and scope of floriculture and landscape gardening. (2 lectures)

Unit-II: Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators. (8 lectures)

Unit-III: Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai. (4 lectures)

Unit-IV: Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds,

Shrubbery, Borders, Water garden. Some Famous gardens of India (4 lectures)
Landscaping Places of Public Importance: Landscaping highways and Educational institutions. (4 lectures)

Unit-V: Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold,Rose, Lilium, Orchids). (6 lectures)

Diseases and Pests of Ornamental Plants. (2 lectures)

Suggested Readings:

Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

SEC-V: MEDICAL BOTANY

(Credits-2: Lectures: 30)

THEORY (Each class 1 hr.)-Marks: 50.

Unit-I: History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences; Definitionand Scope-Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments. (5 lectures)

Unit-II: Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations. (5 lectures)

Unit-III: 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, Ethno medicinal plant Gardens. (6 lectures)
Unit-IV: 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. (6 lectures)

Unit-V: Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany. Folk medicines of ethnobotany, ethno medicine, ethno ecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases. (8 lectures)

Suggested Readings:

1. Trivedi P C, 2006. Medicinal Plants: Ethno botanical Approach, Agro-bios, India.
2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd Edn. Agro- bios, India.

SEC-VI: PLANT DIVERSITY & HUMAN WELFARE

(Credits-2: Lectures: 30)

THEORY (Each class 1 hr.)-Marks: 50.

Unit-I: Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agro-bio-diversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity:Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes. (6 lectures)

Unit-II: Loss of Bio-diversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agro-bio-diversity, Projected scenario for biodiversity loss, (6 lectures)

Unit-III: Management of Plant Bio-diversity: Organizations associated with bio-diversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Bio-diversity legislation and conservations, Bio-diversity information management and communication. (6 lectures)

Unit-IV: Conservation of Bio-diversity: Conservation of genetic diversity, species diversity and ecosystem diversity, In situ and ex situ conservation, Social approaches to conservation, Bio-diversity awareness programmes, Sustainable development. (6 lectures)

Unit-V: Role of plants in relation to Human Welfare: (a) Importance of forestry their utilization and commercial aspects (b) Avenue trees. (c) Ornamental plants of India. (d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses. (6 lectures)

Suggested Readings:

Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi

SEC-VII: ETHNOBOTANY

(Credits-2: Lectures: 30)

THEORY (Each class 1 hr.)-Marks: 50.

Unit-I: 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) Azadiractha indica. (b) Ocimum sanctum. (c) Vitex negundo. (d) Gloriosa superba e) Tribulus terrestris. (f) Pongamia pinnata. (g) Cassia auriculata. (h) Indigofera tinctoria. Role of ethnob- otany in modern medicine with special example Rauvolfia sepentina, Trichopus zeylanicus, Artemisia, Withania. (8 lectures)

Unit-IV: Role of ethnic groups in conservation of plant genetic resources.Endangered taxa and forest management (participatory forest management). (4 lectures)

Unit-V: 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. (6 lectures)

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, Lucknow, India.

5. S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.

6. Colton C.M. 1997. Ethnobotany Principles and applications. John Wiley and sons Chichester

7. Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India.Botanical Survey of India. Howrah.

8. Rajiv K. Sinha Ethnobotany The Renaissance of Traditional Herbal Medicine INA SHREE Publishers, Jaipur-1996

9. Faulks, P.J. 1958.An introduction to Ethnobotany, Moredale pub. Ltd.

SEC-VIII: MUSHROOM CULTURE TECHNOLOGY

(Credits-2: Lectures: 30)

THEORY (Each class 1 hr.)-Marks: 50.

Unit-I: Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms.Types of edible mushrooms available in India - Volvariella volvacea, Pleurotus citrinopileatus, Agaricus bisporus. (5 lectures)

Unit-II: Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. (6 Lectures)

Unit-III: Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production. (6 lectures)

Unit-IV: Storage and nutrition : Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in saltsolutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins. (8 lectures)

Unit-V: Food Preparation: Types of foods prepared from mushroom.Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value. (5 lectures)

Suggested Readings:

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.

2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.

3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.

4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

SEC-IX: INTELLECTUAL PROPERTY RIGHTS

(Credits-2: Lectures: 30)

THEORY (Each class 1 hr.)-Marks: 50.

Unit-I: Introduction to intellectual property right (IPR) : Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples.IPR and WTO (TRIPS, WIPO). (2 lectures)

Patents: Objectives, Rights, Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents. Infringement. (3 Lectures)

Copyrights: Introduction, Works protected under copyright law, Rights, Transfer of Copyright, Infringement. (3 Lectures)

Unit-II: Trademarks: Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name. (3 Lectures)

Geographical Indications : Objectives, Justification, International Position, Multilateral Treaties, National Level, Indian Position. (3 Lectures)

Unit-III: Protection of Traditional Knowledge : Objective, Concept of Traditional Knowledge, Holders, Issues concerning, Bio-Prospecting and Bio-Piracy, Alternative ways, Protectability, needfor a Sui-Generis regime, Traditional Knowledge on the International Arena, at WTO, at National level, Traditional Knowledge Digital Library. (4Lectures)

Unit-IV: Protection of Plant Varieties : Plant Varieties Protection-Objectives, Justification, International Position, Plant varieties protection in India. Rights of farmers, Breeders and Researchers.National gene bank, Benefit sharing. Protection of Plant Varieties and Farmers Rights Act, 2001. (2 Lectures)

Unit-V: Industrial Designs: Objectives, Rights, Assignments, Infringements, Defences of Design Infringement (2 Lectures)

CHEMISTRY(HONOURS)

SEMESTER-I

C-1: INORGANIC CHEMISTRY-I

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100 THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

Unit-I: Atomic structure

Bohrs theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenbergs Uncertainty Principle and its significance, Schrdingers wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Paulis Exclusion Principle, Hunds rule of maximum multiplicity, Aufbaus principle and its limitations. (14 Lectures)

Unit-II: Periodicity of elements

Periodicity of elements Periodicity of Elements: s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s & p-block. (a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. (b) Atomic radii (van der Waals) (c) Ionic and crystal radii. (d) Cova- lent radii (octahedral and tetrahedral) (e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. (f) Electron gain enthalpy, trends of electron gain enthalpy. (g) Electronegativity, Paulings/ Mullikens electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sandersons electron density ratio. (16 Lectures)

Unit-III: Chemical bonding-I

Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Land equation with derivation. Madelung constant, Born-Haber cycle and its application, Solvation energy. (ii) Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability. Fajans rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference. (16 Lectures)

Unit-IV: Chemical Bonding-II

(i) Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators. (ii) Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions,

induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process. (10 Lectures)
Oxidation-reduction Redox equations, standard electrode potential and its application to inorganic reactions. Principles involved in some volumetric analyses (iron, copper and manganese). (4 Lectures)

Reference Books:

- Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
- Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970.

Atkins, P.W. & Paula, J. Physical Chemistry, Oxford Press, 2006.

- Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.

PRACTICAL: C-1 LAB.

(A) Titrimetric Analysis:

(i) Calibration and use of apparatus. (ii) Preparation of solutions of different Molarity/Normality of titrants.

(B) Acid-Base Titrations:

(i) Estimation of carbonate and hydroxide present together in mixture. (ii) Estimation of carbonate and bicarbonate present together in a mixture. (iii) Estimation of free alkali present in different soaps/detergents.

(C) Oxidation-Reduction Titrimetry:

(i) Estimation of Fe(II) and oxalic acid using standardized KMnO4 solution. (ii) Estimation of oxalic acid and sodium oxalate in a given mixture. (iii) Estimation of Fe(II) with K2Cr2O7 using internal (diphenylamine, anthranilic acid) and external indicator.

Reference text:

Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.

C-2: PHYSICALCHEMISTRY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

Unit-I: Gaseous state

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and averagekinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure for different gases. Causes of deviation from ideal behaviour. van der Waals

equation of state, its derivation and application in explaining real gas behaviour. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states. (18 Lectures)

Unit-II: Liquid state

(i) Qualitative treatment of the structure of the liquid state; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water. (6 Lectures)

Ionic equilibria- I

(ii) 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; dissociation constants of mono- and diprotic acids. (6 Lectures)

Unit- III: Solid state

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Braggs law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals. (16 Lectures)

Unit-IV: Ionic equilibria - II

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Solubility and solubility product of sparingly soluble salts applications of solubility product principle. Qualitative treatment of acid base titration curves(calculation of pH at various stages). Theory of acidbase indicators; selection of indicators and their limitations. Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants. (14 Lectures)

Reference Books:

- Atkins, P. W. & Paula, J. de Atkins Physical Chemistry Ed., Oxford University Press (2006).
- Ball, D. W. Physical Chemistry Thomson Press, India (2007).
- Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
- Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
- Principles of Physical Chemistry, Puri, Sharma, Pathania, Vishal Pub. Co.

PRACTICAL: C-2 LAB.

Surface tension measurements.

(a) Determine the surface tension by (i) drop number (ii) drop weight method.

(b) Study the variation of surface tension of detergent solutions with concentration.

Viscosity measurement using Ostwalds viscometer.

(a) Determination of viscosity of aqueous solutions of (i) polymer, (ii) ethanol, and (iii) sugar at room temperature.

(b) Study the variation of viscosity of sucrose solution with the concentration of solute.

pH metry.

(a) Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.

(b) Preparation of buffer solutions of different pH (i) Sodium acetate-acetic acid, (ii) Ammonium chloride-ammonium hydroxide.

(c) pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.

(d) Determination of dissociation constant of a weak acid.

Reference Books:

• Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).

• Garland, C. W., Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill, New York (2003).

• Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co., New York (2003).

SEMESTER-II

C-3: ORGANIC CHEMISTRY I

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

Unit-I: BASICS OF ORGANIC CHEMISTRY

Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of carbocations, carbanions, free radicals and carbenes. Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

CARBON-CARBON SIGMA BONDS

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity. (12 Lectures)

Unit-II: STEREOCHEMISTRY

Fischer Projection, Newmann and Sawhorse Projection formulae; Geometrical isomerism: cistrans and, syn-anti isomerism E/Z notations with C.I.P rules. Optical Isomerism: Optical Activity, Spe- cific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with one and two chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations. (18 Lectures)

Unit-III: CHEMISTRY OF ALIPHATIC HYDROCARBONS

A. Carbon-Carbon pi bonds:

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroborationoxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation(oxidation). 1,2- and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene. Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes. **B. Cycloalkanes and Conformational Analysis**

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes (ethane and n-butane): Relative stability with energy diagrams. Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms. (18 Lectures)

Unit-IV: AROMATIC HYDROCARBONS

Aromaticity: Hckels rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Crafts alkylation/acylation with their mechanism. Directing effects of the groups. (12 Lectures)

Reference Books:

• Morrison, R. N. & Boyd, R. N.Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

• Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (PearsonEduca- tion).

• Finar, I. L. Organic Chemistry (Volume 2): Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

• Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.

• Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International, 2005.

PRACTICAL: C-3 LAB.

1. Checking the calibration of the thermometer.
2. Purification of organic compounds by crystallization using the following solvents: • Water
   • Alcohol
   •Alcohol-Water
3. Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus).
4. Effect of impurities on the melting point mixed melting point of two unknown organic compounds.
5. Determination of boiling point of liquid compounds. (boiling point lower than and morethan 100C by distillation and capillary method)

6. **Chromatography**
   - Separation of a mixture of two amino acids by ascending and horizontal paper chromatography.
   - Separation of a mixture of two sugars by ascending paper chromatography.
   - Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC).

Reference Books:

- Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
- Furniss, B.S., Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).

C-4: PHYSICALCHEMISTRY-II

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

Unit-I: Chemical thermodynamics

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics. First law: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions. Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoffs equations) and pressure on enthalpy of reactions. (14 Lectures)

Unit-II: Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes. Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. Free Energy Functions: Gibbsand Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell 17 relations; thermodynamic equation of state. (14 Lectures)

Unit-III: Systems of variable composition

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases. Chemical equilibrium, Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient (vant Hoffs reaction). Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium

constants K_p, $K_c and K_x$. Le Chatelier principle (quantitative treatment) and its applications. (18 Lectures)

Unit-IV: Solutions and Colligative Properties

Dilute solutions; lowering of vapour pressure, Raoults and Henrys Laws and their applications. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution. (14 Lectures)

Reference Books:

- Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press (2011).
- Castellan, G. W. Physical Chemistry 4th Ed., Narosa (2004).
- Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
- McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi (2004).
- Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. Commonly Asked Questions in Thermodynamics. CRC Press: NY (2011).
- Levine, I .N. Physical Chemistry 6th Ed., Tata Mc Graw Hill (2010).
- Metz, C.R. 2000 solved problems in chemistry, Schaum Series (2006).

PRACTICAL: C-4 LAB.

THERMOCHEMISTRY

(a) Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).

(b) Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

(c) Calculation of the enthalpy of ionization of ethanoic acid.

(d) Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.

(e) Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.

(f) Determination of enthalpy of hydration of copper sulphate.

(g) Study of the solubility of benzoic acid in water and determination of H.

Reference Books;

- Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
- Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi (2001).

SEMESTER-III

C-5: INORGANIC CHEMISTRY-II

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100 THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

UNIT-I: General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic process, Parting process, van Arkel-de Boer process and Monds process, Zone refining. (8 Lectures)

Acids and Bases

Brnsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle. (8 Lectures)

UNIT-II: Chemistry of s and p Block Elements-I

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements. Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate. (14 Lectures)

UNIT-III: Chemistry of s and p Block Elements-II

Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes. Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens. (14 Lectures)

UNIT-IV: Noble Gases

Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF_2, $XeF_4 and XeF_6$; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF_2). Molecular shapes of noble gas compounds (VSEPR theory). (8 Lectures)

Inorganic Polymers:

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates. (8 Lectures)

Reference Books:

- Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
- Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. Concepts & Models of Inorganic Chemistry 3rd Ed., John Wiley Sons, N.Y. 1994.
- Greenwood, N.N. & Earnshaw. Chemistry of the Elements, Butterworth-Heinemann. 1997.

- Cotton, F.A. & Wilkinson, G. Advanced Inorganic Chemistry, Wiley, VCH, 1999.
- Miessler, G. L. & Donald, A. Tarr. Inorganic Chemistry 4th Ed., Pearson, 2010.
- Shriver & Atkins, Inorganic Chemistry 5th Ed.

PRACTICAL: C-5 LAB.

(A) Iodo / Iodimetric Titrations

(i) Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically).

(ii) Estimation of available chlorine in bleaching powder iodometrically.

(B) Inorganic preparations

(i) Cuprous chloride, Cu_2Cl_2.

(ii) Preparation of manganese(III) phosphate, $MnPO_4.H_2O$.

(iii) Preparation of aluminium potassium sulphate $K_2SO_4.Al_2(SO_4)_2.24H_2O$ (Potash alum).

Reference Books:

- Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS. 1978

C-6: ORGANIC CHEMISTRY-II

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

UNIT-I: Chemistry of Halogenated Hydrocarbons

Alkyl halides: Methods of preparation, nucleophilic substitution reactions SN1, SN2 and SNi mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination. Aryl halides: Preparation, including preparation from diazonium salts, nucleophilic aromatic substitution; SNAr, Benzyne mechanism. Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions. Organometallic compounds of Mg and Li Use in synthesis of organic compounds. (16 Lectures)

UNIT-II: Alcohols, Phenols, Ethers and Epoxides

Alcohols: preparation, properties and relative reactivity of 1, 2, 3 alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement; Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, ReimerTiemann and KolbesSchmidt Reactions, Fries and Claisen rearrangements with mechanism; Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH4 (16 Lectures)

UNIT-III: Carbonyl Compounds

Structure, reactivity and preparation: Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Perkin, Cannizzaro and Wittig reaction, Beckmann rearrangements, haloform reaction and Baeyer Villiger oxidation, - substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, LiAlH4, NaBH4, MPV.; Addition reactions of unsaturated carbonyl compounds: Michael addition. Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate. (14 Lectures)

UNIT-IV: Carboxylic Acids and their Derivatives

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicar-

boxylic acids, hydroxy acids and unsaturated acids: succinic, lactic, malic, tartaric, citric, maleic and fumaric acids; Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic sustitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement. (10 Lectures)

Sulphur containing compounds

Preparation and reactions of thiols, thioethers. (4 Lectures)

Reference Books:

• Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

• Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc.

PRACTICAL: C-6 LAB.

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.
2. Organic preparations:

(i) Acetylation of one of the following compounds: amines (aniline, o-, m-, p-toluidines and o-,m-, p-anisidine) and phenols (-naphthol, vanillin, salicylic acid) by any one method:

(a) Using conventional method.

(b) Using green approach.

(ii) Benzolyation of one of the following amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and one of the following phenols (-naphthol, resorcinol, p-cresol) by Schotten-Baumannreaction.

(iii) Bromination of any one of the following:

(a) Acetanilide by conventional methods.

(b) Acetanilide using green approach (Bromate-bromide method).

(iv) Nitration of any one of the following:

(a) Acetanilide/nitrobenzene by conventional method.

(b) Salicylic acid by green approach (using ceric ammonium nitrate).

The above derivatives should be prepared using 0.5-1gm. of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point and TLC. **Reference Books:**

• Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).

• Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).

• Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

• Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

C-7: PHYSICAL CHEMISTRY-III

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100 THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes))

UNIT-I: Phase Equilibria-I

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule fornonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications

(H_2O and sulphur system). Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions (Pb-Ag system, desilverisation of lead) (14 Lectures)

UNIT-II: Phase Equilibria-II

Three component systems, water-chloroform-acetic acid system, triangular plots. Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and non-ideal), azeotropes, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications. (14 Lectures)

UNIT-III: Chemical Kinetics

Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of orders, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions. Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, qualitative treatment of the theory of absolute reaction rates. (18 Lectures)

UNIT-IV: Catalysis

Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis. (8 Lectures)

Surface chemistry

Physical adsorption, chemisorption, adsorption isotherms (Langmuir, Freundlich and Gibbs isotherms), nature of adsorbed state. (6 Lectures)

Reference Books:

- Peter Atkins & Julio De Paula, Physical Chemistry 9th Ed., Oxford University Press (2010).
- Castellan, G. W. Physical Chemistry, 4th Ed., Narosa (2004).
- McQuarrie, D. A. & Simon, J. D., Molecular Thermodynamics, Viva Books Pvt. Ltd.: New Delhi (2004).
- Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
- Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S.
- Commonly Asked Questions in Thermodynamics. CRC Press: NY (2011).
- Zundhal, S.S. Chemistry concepts and applications Cengage India (2011).
- Ball, D. W. Physical Chemistry Cengage India (2012).
- Mortimer, R. G. Physical Chemistry 3rd Ed., Elsevier: NOIDA, UP (2009).
- Levine, I. N. Physical Chemistry 6th Ed., Tata McGraw-Hill (2011).
- Metz, C. R. Physical Chemistry 2nd Ed., Tata McGraw-Hill (2009).

PRACTICAL: C-7 LAB.

I. Distribution of acetic/ benzoic acid between water and cyclohexane.

II. Study the equilibrium of at least one of the following reactions by the distribu- tion method:

$I_2(aq) + I^- \longrightarrow I_3^-(aq)$

$Cu_2 + (aq) + nNH_3 \longrightarrow Cu(NH_3)n.$

III. Study the kinetics of the following reactions.

(1) Integrated rate method:

a. Acid hydrolysis of methyl acetate with hydrochloric acid.

b. Saponification of ethyl acetate.

(2) Compare the strengths of HCl and H2SO4 by studying kinetics of hydrolysis of methyl acetate.

Adsorption

Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

Reference Books:

• Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

• Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).

• Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

SEMESTER- IV

C-8: INORGANIC CHEMISTRY-III

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100 THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

UNIT-I: Coordination Chemistry

Werners theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of CFSE weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq in octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry, Jahn-Teller theorem, square planar geometry. Qualitative aspect of ligand field and MO Theory. IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, Labile and inert complexes. (20 Lectures)

UNIT-II: Transition Elements-I

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & Bsworth diagrams). Difference between the first, second and third transition series. (12 Lectures)

UNIT-III: Transition Elements-II

Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy).(12 Lectures)

UNIT-IV: Lanthanoids and Actinoids

Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only). General features of actinoids, separation of Np, Pm, Am from U. (6 Lectures)

Bioinorganic Chemistry

Metal ions present in biological systems, classification of elements according to their action in biological system. Na/K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine. Iron and its application in bio-systems, Haemoglobin; Storage and transfer of iron. (10 Lectures)

Reference Books:

- Purcell, K.F & Kotz, J.C. Inorganic Chemistry W.B. Saunders Co, 1977.
- Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
- Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.
- Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry. Wiley-VCH, 1999.
- Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967.
- Greenwood, N.N. & Earnshaw A., Chemistry of the Elements, Butterworth-Heinemann, 1997.

PRACTICAL: C-8 LAB.

Gravimetric Analysis:

i. Estimation of nickel(II) using Dimethylglyoxime (DMG). ii
Estimation of copper as CuSCN.

iii. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.

iv. Estimation of Al(III) by precipitating with oxine and weighing as Al(oxine)3 (aluminium oxinate).

Chromatography of metal ions

Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:

i. Ni(II) and Co(II)

ii. Fe(III) and Al(III)

Reference Book:

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

C-9: ORGANIC CHEMISTRY-III

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100 THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

UNIT-I: Nitrogen Containing Functional Groups

Preparation and important reactions of nitro and compounds, nitriles. Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmanns exhaustive methylation, Hofmann-elimination reaction; Distinction between 1, 2 and 3 amines with Hinsberg reagent and nitrous acid. (14 Lectures)

UNIT-II: Diazonium Salts

Preparation and their synthetic applications.

Polynuclear Hydrocarbons

Reactions of naphthalene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene. Polynuclear hydrocarbons. (12 Lectures)

UNIT-III: Heterocyclic Compounds

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan,

Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine. Fischer indole synthesis and Madelung synthesis, structure of quinoline and isoquinoline. Derivatives of furan: Furfural and furoic acid (preparation only). (18 Lectures)

UNIT-IV: Alkaloids

Natural occurrence, General structural features, Isolation and their physiological action Hoffmanns exhaustive methylation, Emdes modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine. (8 Lectures) Terpenes Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral, Neral and -terpineol. (8 Lectures)

Reference Books:

• Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
• Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (PearsonEduca- tion).
• Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Prod- ucts), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
• Acheson, R.M. Introduction to the Chemistry of Heterocyclic compounds, John Welly & Sons (1976).
• Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc.
• Kalsi, P. S. Textbook of Organic Chemistry 1st Ed., New Age International (P) Ltd. Pub.
• Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press.
• Singh, J.; Ali, S.M. & Singh, J. Natural Product Chemistry, Prajati Parakashan (2010).

PRACTICAL: C-9 LAB.

1. Detection of extra elements (N, X, S).
2. Functional group test for nitro, amine and amide groups.
3. Qualitative analysis of unknown organic compounds containing simple functional groups (alco- hols, carboxylic acids, phenols and carbonyl compounds).

Reference Books:

• Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
• Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).
• Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
• Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

C-10: PHYSICAL CHEMISTRY-IV

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100

THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

UNIT-I: Conductance-I

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hckel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Waldens rules. (12 Lectures)

UNIT-II: Conductance-II

Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts. (16 Lectures)

UNIT-III: Electrochemistry-I

Quantitative aspects of Faradays laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half- cells. Application of EMF measurements in determining free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass electrodes. (18 Lectures)

UNIT-IV: Electrochemistry-II

Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation). Electrical properties of atoms and molecules Basic ideas of electrostatics, Electrostatics of dielectric media. Clausius-Mosotti equation and Lorenz-Laurentz equation (no derivation), Dipole moment and molecular polarizabilities and their measurements. (14 Lectures)

Reference Books:

- Atkins, P.W & Paula, J.D. Physical Chemistry, 9th Ed., Oxford University Press (2011).
- Castellan, G. W. Physical Chemistry 4th Ed., Narosa (2004).
- Mortimer, R. G. Physical Chemistry 3rd Ed., Elsevier: NOIDA, UP (2009).
- Barrow, G. M., Physical Chemistry 5th Ed., Tata McGraw Hill: New Delhi (2006).
- Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
- Rogers, D. W. Concise Physical Chemistry Wiley (2010).
- Silbey, R. J.; Alberty, R. A. & Bawendi, M. G. Physical Chemistry 4th Ed., John Wiley & Sons, Inc. (2005).

PRACTICAL: C-10 LAB.

Conductometry

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

iii. Strong acid vs. weak base

Potentiometry

I. Perform the following potentiometric titrations:

i. Strong acid vs. strong base

ii. Weak acid vs. strong base

iii. Dibasic acid vs. strong base

Reference Books:

• Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

• Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).

• Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

SEMESTER- V

C-11: ORGANICCHEMISTRY-IV

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

UNIT-I: Nucleic Acids

Components of nucleic acids, Nucleosides and nucleotides; Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides. (9 Lectures) **Enzymes** Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as example), 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, uncompetitive and non-competitive inhibition including allosteric inhibition). (8 Lectures)

UNIT-II: Amino Acids, Peptides and Proteins

Amino acids, peptides and their classification. -Amino acids - Synthesis, ionic properties and reactions. Zwitterions, pKa values, isoelectric point and electrophoresis. Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis

of peptides using N-protecting, C-protecting and C-activating groups -Solid-phase synthesis (16 Lectures)

UNIT-III: Lipids

Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenntion of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity. (8 Lectures) **Concept of Energy in Biosystems**

Cells obtain energy by the oxidation of foodstuff (organic molecules). Introduction to metabolism (catabolism and anabolism). Overview of catabolic pathways of fat and protein. Interrelationship in the metabolic pathways of protein, fat and carbohydrate. Caloric value of food, standard caloric content of food types. (7 Lectures)

UNIT-IV: Pharmaceutical Compounds: Structure and Importance

Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine). (12 Lectures)

Reference Books:

- Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry. VIth Edition. W.H. Freeman and Co.
- Nelson, D.L., Cox, M.M. and Lehninger, A.L. (2009) Principles of Biochemistry. IV Edition. W.H. Freeman and Co.
- Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harpers Illustrated Biochem- istry. XXVIII edition. Lange Medical Books/ McGraw-Hill.

PRACTICAL: C-11 LAB.

1. Preparations of the following compounds:

i. Aspirine, ii. Phenacetin, iii. Milk of magnesia, iv. Aluminium hydroxide gel, v. Divol.

2. Saponification value of an oil or a fat.
3. Determination of Iodine number of an oil/ fat.

Reference Books:

- Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
- Arthur, I. Vogel, Quantitative Organic Analysis, Pearson.

C-12: PHYSICALCHEMISTRY-V

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

UNIT-I: Quantum Chemistry

Postulates of quantum mechanics, quantum mechanical operators, Schrdinger equation and its application to free particle and particle-in-a-box (rigorous treatment), quantization of energy levels,

zero-point energy and Heisenberg Uncertainty principle; wave functions, probability distribution functions, nodal properties. Extension to three dimensional boxes, separation of variables, degeneracy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrdinger equation and discussion of solution and wave functions. Vibrational energy of diatomic molecules and zero-point energy. Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component. Rigid rotator model of rotation of diatomic molecule. Schrdinger equation, transformation to spherical polar coordinates. Separation of variables (Preliminary treatment). Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrdinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. (18 Lectures)

UNIT-II: Chemical Bonding

Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H^+. 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. 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. (12 Lectures)

UNIT-III: Molecular Spectroscopy-I

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.

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. (16 Lectures)

UNIT-IV: Molecular Spectroscopy-II

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation. (6 Lectures) **Photochemistry**

Characteristics of electromagnetic radiation, Lambert-Beers 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. (8 Lectures)

Reference Books:

- Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-

Hill: New Delhi (2006).
• Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill (2001).
• House, J. E. Fundamentals of Quantum Chemistry 2nd Ed. Elsevier: USA (2004).
• Lowe, J. P. & Peterson, K. Quantum Chemistry, Academic Press (2005).
• Kakkar, R. Atomic & Molecular Spectroscopy, Cambridge University Press (2015).

PRACTICAL: C-12 LAB.

Colourimetry

1. Determine the concentration of HCl against 0.1 N NaOH spectrophotometrically. 2. To find the strength of given ferric ammonium sulfate solution of (0.05 M) by using EDTAspectrophotometrically. 3. To find out the strength of CuSO4 solution by titrating with EDTA spectrophotometrically.
4. To determine the concentration of Cu(II) and Fe(III) solution photometrically by titrating with EDTA.

Reference Books:

• Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
• Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
• Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).
• Experimental Physical Chemistry by J. N. Gurtu, R. Kapoor.

SEMESTER- VI

C-13: INORGANICCHEMISTRY-IV

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100 THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

UNIT-I: Organometallic Compounds-I

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. -acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding. Zeises salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls. (14 Lectures)

UNIT-II: Organometallic Compounds-II

Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium

(dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler Natta Catalyst). Species present in ether solution of Grignard reagent and their structures. Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation), structure and aromaticity, comparison of aromaticity and reactivity with that of benzene. (14 Lectures)

UNIT-III: Theoretical Principles in Qualitative Analysis (H_2S Scheme)

Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II. (10 Lectures)

Catalysis by Organometallic Compounds

Study of the following industrial processes and their mechanism:

1. Alkene hydrogenation (Wilkinsons Catalyst).
2. Hydroformylation (Co salts).
3. Wacker Process.
4. Synthetic gasoline (Fischer Tropsch reaction). (8 Lectures)

UNIT-IV: Reaction Kinetics and Mechanism

Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans-effect and its applications, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes. Thermodynamic and kinetic stability, Kinetics of octahedral substitution (classification of metal ions based on water exchange rate), General mechanism of substitution in octahedral complexes (D, I, Id, Ia). (14 Lectures)

Reference Books:

- Vogel, A.I. Qualitative Inorganic Analysis, Longman, 1972.
- Svehla, G. Vogel's Qualitative Inorganic Analysis, 7th Edition, Prentice Hall, 1996-03-07.
- Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reac- tivity 4th Ed., Harper Collins 1993, Pearson,2006.
- Sharpe, A.G. Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005.
- Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, 3rd Ed., John Wiley and Sons, NY, 1994.
- Greenwood, N.N. & Earnshaw, A. Chemistry of the Elements, Elsevier 2nd Ed, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).
- Lee, J.D. Concise Inorganic Chemistry 5th Ed., John Wiley and sons 2008.
- Powell, P. Principles of Organometallic Chemistry, Chapman and Hall, 1988.
- Shriver, D.D. & P. Atkins, Inorganic Chemistry 2nd Ed., Oxford University Press, 1994.
- Basolo, F. & Person, R. Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution 2nd Ed., John Wiley & Sons Inc; NY.
- Purcell, K.F. & Kotz, J.C., Inorganic Chemistry, W.B. Saunders Co. 1977.
- Miessler, G. L. & Donald, A. Tarr, Inorganic Chemistry 4th Ed., Pearson, 2010.
- Collman, James P. et al. Principles and Applications of Organotransition Metal Chemistry. Mill Valley, CA: University Science Books, 1987.

• Crabtree, Robert H. The Organometallic Chemistry of the Transition Metals, New York, NY: John Wiley, 2000.
• Spessard, Gary O., & Gary L. Miessler. Organometallic Chemistry. Upper Saddle River, NJ: Prentice-Hall, 1996.
• Mehrotra R.C. and Singh, A. Organometallic Chemistry, New Age International Publishers, 2nd Edn, 2000.

PRACTICAL: C-13 LAB.

Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:
$CO^{2-}, NO_2^-, S^-, SO_3^-, S_2O^{2-}, CH_3COO^-, F^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^-, C_2O^{2-}, PO^{3-}, NH^+,$
$K^+, Pb^+, Cu^+, Cd^+, Bi^+, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, , Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+},$
Ca^{2+}, Mg^{2+}. Mixtures should preferably contain one interfering anion, **or** insoluble component ($BaSO_4$, $SrSO_4$, $PbSO_4$, $CaF_2 or Al_2O_3$) **or** combination of anions e.g. CO^{2-} and SO^{2-}, NO_2- and NO_3-, Cl^- and Br^-, Cl^- and I^-, Br^- and I^-, NO_3^- and Br^-, NO_3^- and I^-. Spot tests should be done whenever possible.

Reference Books:

• Vogels Qualitative Inorganic Analysis, Revised by G.Svehla.
• Marr & Rockett Inorganic Preparations.

C-14: ORGANIC CHEMISTRY-IV

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL
(Each class 2 hrs.): Marks-30
Lectures: 60 (40 Theory + 20 Practical classes)

UNIT-I: Organic Spectroscopy-I

UV Spectroscopy: Types of electronic transitions, max, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward rules for calculation of max for the following systems: the unsaturated aldehydes: ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (alde- hydes, ketones and dienes); distinction between cis and trans isomers.

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis. (18 Lectures)

UNIT-II: Organic Spectroscopy-II

NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin-spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics; Interpretation of NMR spectra of simple compounds. Mass Spectroscopy-Basic principle, Fragmentation pattern, Instrumentation, Determination of m/e ratio. Application of Mass Spectroscopy on CH4, C2H6, n-butane and neo-pentane. Applications of IR, UV and NMR for identification of simple organic molecules. (12 Lectures)

UNIT-III: Carbohydrates

Occurrence, classification and their biological importance. Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation; Disaccharides Structure elucidation of maltose. Polysaccharides Elementary treatment of starch, cellulose. (8 Lectures) **Dyes** Classification, colour and constitution; Mordant and Vat dyes; Chemistry of dyeing. Synthesis and applications of: Azo dyes Methyl orange and Congo red (mechanism of Diazo Coupling); Triphenyl methane dyes - Malachite Green, and crystal violet; Phthalein dyes Phenolphthalein and Fluorescein; Natural dyes Alizarin and Indigo; Edible dyes with examples. (8 Lectures)

UNIT-IV: Polymers

Introduction and classification including di-block, tri-block and amphiphilic polymers; Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polydispersity Index. Polymerisation reactions -Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene); Fabrics natural and synthetic (acrylic, polyamido, polyester); Rubbers natural and synthetic: Buna-S and Neoprene; Vulcanization; Polymer additives; Biodegradable and conducting polymers with examples. (14 Lectures)

Reference Books:

- Kalsi, P. S. Textbook of Organic Chemistry 1st Ed., New Age International (P) Ltd. Pub.
- Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Billmeyer, F. W. Textbook of Polymer Science, John Wiley & Sons, Inc.
- Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. Polymer Science, New Age International (P) Ltd.

Pub.

• Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

• Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc.

• Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press.

• Singh, J.; Ali, S.M. & Singh, J. Natural Product Chemistry, Pragati Prakashan (2010).

• Kemp, W. Organic Spectroscopy, Palgrave.

PRACTICAL: C-14 LAB.

1. Extraction of caffeine from tea leaves.
2. Preparation of sodium polyacrylate.
3. Preparation of urea formaldehyde.
4. Analysis of Carbohydrate: aldoses and ketoses, reducing and non-reducing sugars.
5. Qualitative analysis of unknown organic compounds containing mono-functional groups (carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bifunctional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols etc.

Reference Books:

• Vogel, A.I. Quantitative Organic Analysis, Part 3, Pearson (2012).

• Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).

• Furniss, B.S., Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).

• Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

• Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

DISCIPLINE SPECIFIC ELECTIVE(DSE)

SEMESTER-V

DSE-1: POLYMER CHEMISTRY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100 THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

UNIT-I: Introduction and history of polymeric materials:
Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers. (4 Lectures)

Functionality and its importance:
Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems. (8 Lectures)

UNIT-II: Kinetics of Polymerization:
Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques. (8 lectures)

Crystallization and crystallinity:
Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point. (4 Lectures)

Nature and structure of polymers-Structure property relationships. (2 Lectures)

UNIT-III: Determination of molecular weight of polymers
(Mn, Mw, etc.) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index. (8 Lectures)

Glass transition temperature (Tg) and determination of Tg

WLF equation, Factors affecting glass transition temperature (Tg). (8 Lectures)

UNIT-IV: Polymer Solution
Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions. (8 Lectures)

Properties of Polymers
(Physical, thermal & mechanical properties). Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) poly(vinyl acetate), polyacrylamide, fluoro polymers (Teflon), polyamides (nylon- 6 and nylon 6,6). Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers (polysiloxane), Polycarbonates, Conducting Polymers, (polyacetylene, polyaniline). (10 Lectures)

Reference Books:

- Seymours Polymer Chemistry, Marcel Dekker, Inc.

- G. Odian: Principles of Polymerization, John Wiley.
- F.W. Billmeyer: Text Book of Polymer Science, John Wiley.
- P. Ghosh: Polymer Science & Technology, Tata Mcgraw-Hill.
- R.W. Lenz: Organic Chemistry of Synthetic High Polymers.

PRACTICAL: DSE-1 LAB.

Polymer synthesis

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).

(a) Purification of monomer.

(b) Polymerization using benzoyl peroxide (BPO) / 2,2-azo-bis-isobutylonitrile (AIBN).

2. Preparation of nylon 66/6.

3. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein.

(a) Preparation of IPC.

(b) Purification of IPC.

(c) Interfacial polymerization.

4. Redox polymerization of acrylamide.
5. Precipitation polymerization of acrylonitrile.
6. Preparation of urea-formaldehyde resin.
7. Preparations of novalac resin/resold resin.
8. Microscale Emulsion Polymerization of poly(methylacrylate).

Polymer characterization

1. Determination of molecular weight by viscometry:

(a) Polyacrylamide-aq. $NaNO_2$ solution

(b) (Poly vinyl proplylidine (PVP) in water

2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of head-to-head monomer linkages in the polymer.
3. Determination of molecular wt. by end group analysis: Polyethylene glycol (PEG) (OH group).
4. Determination of hydroxyl number of a polymer using colorimetric method.

Polymer analysis

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
2. Instrumental Techniques
3. IR studies of polymers

*at least 5 experiments to be carried out.

Reference Books:

- Malcohm P. Stevens, Polymer Chemistry: An Introduction, 3rd Ed.
- Harry R. Allcock, Frederick W. Lampe and James E. Mark, Contemporary Polymer Chemistry, 3rd ed. Prentice-Hall (2003).
- Fred W. Billmeyer, Textbook of Polymer Science, 3rd ed. Wiley-Interscience (1984).
- Joel R. Fried, Polymer Science and Technology, 2nd ed. Prentice-Hall (2003).
- Petr Munk and Tejraj M. Aminabhavi, Introduction to Macromolecular Science, 2nd ed. John

Wiley & Sons (2002).
- L.H. Sperling, Introduction to Physical Polymer Science, 4th ed. John Wiley & Sons (2005).
- Malcolm P. Stevens, Polymer Chemistry: An Introduction, 3rd ed. Oxford University Press (2005).
- Seymour/ Carrahers Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).

DSE-2: GREEN CHEMISTRY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

UNIT-I: Introduction to Green Chemistry
What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry. (4 Lectures)

Principles of Green Chemistry and Designing a Chemical synthesis-I
Twelve principles of Green Chemistry with their explanations and examples with special emphasis on: Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products, Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions. Prevention/ minimization of hazardous/ toxic products reducing toxicity. risk = (function) hazard exposure; waste or pollution prevention hierarchy. Green solvents supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents. (12 Lectures)

UNIT-II: Principles of Green Chemistry and Designing a Chemical synthesis-II

Explanation of principles with special emphasis on: Energy requirements for reactions alternative sources of energy: use of microwaves and ultrasonic energy. Selection of starting materials; avoidance of unnecessary derivatization careful use of blocking/protecting groups. Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis. Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD What you dont have cannot harm you, greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation. Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. (14 Lectures)

UNIT-III: Examples of Green Synthesis/ Reactions and some real world cases-I Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alter- native to Strecker synthesis) Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in or- ganic solvents: Diels-Alder reaction and Decarboxylation reaction. Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine). Surfactants for carbon dioxide replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments. Designing of Environmentally safe marine antifoulant. (14 Lectures)

UNIT-IV: Examples of Green Synthesis/ Reactions and some real world cases-II Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments. An effi- cient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn. Healthier Fats and oil by Green Chemistry: Enzymatic Inter esterification for production of

no Trans-Fats and Oils Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting (6 Lectures)

Future Trends in Green Chemistry

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co crystal controlled solid state synthesis (C2S3); Green chemistry in sustainable development. (10 Lectures)

Reference Books:

• V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, • Anamalaya Publishers (2005).

• P.T. Anastas & J.K. Warner: Oxford Green Chemistry- Theory and Practical, University Press (1998).

• A.S. Matlack: Introduction to Green Chemistry, Marcel Dekker (2001).

• M.C. Cann & M.E. Connely: Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).

• M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, American Chemical Society, Washington (2002).

PRACTICAL: DSE-2

1. Safer starting materials.

• The Vitamin C clock reaction using Vitamin C tablets, tincture of iodine, hydrogen peroxide and liquid laundry starch.

• Effect of concentration on clock reaction.

• Preparation and characterization of nanoparticles (Ag, Au) using plant extract.

2. Using renewable resources

• Preparation of biodiesel from vegetable oil.

3. Avoiding waste

• Principle of atom economy.

• Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.

• Preparation of propene by two methods can be studied.

(I) Triethylamine ion + OH^- $\xrightarrow{H_2SO_4/O}$ propene + trimethylpropene + water

(II) 1-propanol $\longrightarrow$ propene + water

• The other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy. 4. Use of enzymes ascatalysts

• Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide

5. Alternative Green solvents

Diels Alder reaction in water

• Reaction between furan and maleic acid in water and at room temperature rather than in benzene and reflux.

• Extraction of D-limonene from orange peel using liquid CO_2 prepared form dry ice.

• Mechanochemical solvent free synthesis of azomethines

4. Alternative sources of energy

• Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of Cu(II).

• Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

Reference Books:

• Anastas, P.T & Warner, J.C. Green Chemistry: Theory and Practice, Oxford University Press (1998).

• Kirchoff, M. & Ryan, M.A. Greener approaches to undergraduate chemistry experiment. American Chemical Society, Washington DC (2002).

• Ryan, M.A. Introduction to Green Chemistry, Tinnesand; (Ed), American Chemical Society, Washington DC (2002).

• Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. Green Chemistry Experiment: A monograph International Publishing House Pvt Ltd. New Delhi. Bangalore CISBN 978-93-81141-55-7 (2013).

• Cann, M.C. & Connelly, M. E. Real world cases in Green Chemistry, American Chemical Society (2008).

• Cann, M. C. & Thomas, P. Real world cases in Green Chemistry, American Chemical Society (2008).

DSE-3: INDUSTRIAL CHEMICALS AND ENVIRONMENT

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100 THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

UNIT-I: Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, sulphur dioxide. Inorganic Chemicals: Manufacture, application and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, potassium dichromate and potassium permanganate. (10 Lectures)

Industrial Metallurgy

Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology. (4 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 SO_2, CO_2, CO, NO_x, $and H_2S$and control procedures. Effects of air pollution on living organisms and vegetation. Greenhouse effect and global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and halogens, removal of sulphur from coal. (14 Lectures)

UNIT-III: 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, sec-

ondary and tertiary treatment). Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, fertilizer. Sludge disposal. Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, ion exchange). Water quality parameters for waste water, industrial water and domesticwater. (16 Lectures)

UNIT-IV: Energy & Environment

Sources of energy: Coal, petrol and natural gas. Nuclear fusion/fission, solar energy, hydrogen, geothermal, tidal and hydel. Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management. (10 Lectures)

Biocatalysis: Introduction to biocatalysis: Importance in green chemistry and chemical industry. (6 Lectures)

Reference Books:

- E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
- R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
- A. Kent: Riegels Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
- S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.
- De, Environmental Chemistry: New Age International Pvt., Ltd, New Delhi.
- S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.
- S.E. Manahan, Environmental Chemistry, CRC Press (2005).
- G.T. Miller, Environmental Science 11th edition. Brooks/ Cole (2006).
- Mishra, Environmental Studies. Selective and Scientific Books, New Delhi (2005).

PRACTICAL: DSE-3

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 ($AgNO_3$ and potassium chromate).
6. Estimation of total alkalinity of water samples (CO^{2-}, HCO^{-}) using double titration method.
7. Measurement of dissolved CO_2. 8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.

Reference Books:

- E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
- R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
- A. Kent: Riegels Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
- S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.
- De, Environmental Chemistry: New Age International Pvt., Ltd, New Delhi.
- S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.

DSE-4: DISSERTATION/PROJECT WORK

Marks:100

SKILL ENHANCEMENT COURSES (SEC)

SEMESTER- III

SEC-I: PESTICIDE CHEMISTRY

(Credits: 02)- Max. Marks: 50

30 Lectures(Each Lecture 1 hr.)

General introduction to pesticides (natural and synthetic), benefits and adverse effects, chang- ing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Practical

- To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.
- Preparation of simple organophosphates, phosphonates and thiophosphates.

Reference Book:

- R. Cremlyn: Pesticides, John Wiley.

SEMESTER- IV

SEC-II: FUEL CHEMISTRY

(Credits: 02)- Max. Marks: 50

30 Lectures(Each Lecture 1 hr.)

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value Coal: Uses of coal (fuel and non-fuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gascomposition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

large Reference Books:

- E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
- P.C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
- B.K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut.

GENERIC ELECTIVE(GE)

B. Sc.(Hons.) Students other than Chemistry Honours will opt four Chemistry GE Papers.

SEMESTER-I

GE-I: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

SECTION A: INORGANIC CHEMISTRY-1 (30 Periods)

Unit-I: bf Atomic Structure

Review of: Bohrs theory and its limitations, dual behaviour of matter and radiation, de-Broglies relation, Heisenberg Uncertainty principle. Hydrogen atom spectra.

What is Quantum mechanics ? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ_2, Schrdinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Significance of quantum numbers, orbital angular momentum and quantum numbers ml and ms. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations. (14 Lectures)

Unit-II: Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Land equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajans 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.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules (N_2, O_2) and and heteronuclear diatomic molecules (CO, NO). 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: Hckels rule. (8 Lectures)

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). D and L; cis-trans nomenclature; CIP Rules: R/S (for one chiral carbon atoms) and E/Z Nomenclature (for up to two C=C systems). (10 Lectures)

Unit- IV: 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, Kolbes synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.
Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeffs rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoffs and anti-Markownikoffs addition), Hydration, Ozonolysis,Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC_2 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 $KMnO_4$, ozonolysis. (12 Lectures)

Reference Books:

- J. D. Lee: A new Concise Inorganic Chemistry, E L. B. S.
- F. A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.
- Douglas, McDaniel and Alexader: Concepts and Models in Inorganic Chemistry, John Wiley.
- T. W. Graham Solomon: Organic Chemistry, John Wiley and Sons.
- Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
- E. L. Eliel: Stereochemistry of Carbon Compounds, Tata McGraw Hill. I. L. Finar: Organic Chem- istry (Vol. I & II), E. L. B. S.
- R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
- Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.

PRACTICAL: GE-I LAB.

Section A: Inorganic Chemistry-Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohrs salt by titrating with $KMnO_4$.

4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

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 Rf value in each case (combination of two compounds to be given).

(a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.

(b) Identify and separate the sugars present in the given mixture by paper chromatography.

large Reference Books:

- Vogels Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
- Vogels Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition.
- Textbook of Practical Organic Chemistry, A.I. Vogel , Prentice Hall, 5th edition.
- Practical Organic Chemistry, F. G. Mann. & B. C. Saunders, Orient Longman, 1960.

SEMESTER-II

GE-II: CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY-I

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

Section A: Physical Chemistry-1 (30 Lectures) Unit-I:
Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperatureKirchhoffs equation. Statement of Third Law of thermodynamics (10 Lectures)

Chemical Equilibrium:

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between G and Go, Le Chateliers principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases. (8 Lectures)

Unit- II: 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- III:

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Aromatic hydrocarbons: Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Crafts reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (up to 4 carbons on benzene). (8 Lectures)

Alkyl and Aryl Halides

Alkyl Halides (Up to 5 Carbons) Types of Nucleophilic Substitution (SN_1, SN_2 and SN_i) reac- tions. Preparation: from alkenes and alcohols.

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

Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): 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 $NaNH_2/NH_3$). (8 Lectures)

Unit- IV: Alcohols, Phenols and Ethers (Upto 5 Carbons)

Alcohols: Preparation: Preparation of 1, 2 and 3 alcohols: using Grignard reagent, Esterhydroly- sis, Reduction of aldehydes and 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 case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. ReimerTiemann Reaction, Gattermann-Koch Reaction,

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

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

Preparation: from acid chlorides and from nitriles.

Reactions Reaction with HCN, ROH, $NaHSO_3$, $NH_2 - G$ derivatives. Iodoform test. Aldol Condensation, Cannizzaros reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. (14 Lectures)

Reference Books:

- T. W. Graham Solomons: Organic Chemistry, John Wiley and Sons.
- Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
- I.L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
- R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
- Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.

- G. M. Barrow: Physical Chemistry Tata McGraw-Hill(2007).
- G. W. Castellan: Physical Chemistry 4th Edn. Narosa (2004).
- C. Kotz, P. M. Treichel & J. R. Townsend: General Chemistry Cengage Lening India Pvt. Ltd., New Delhi (2009).
- H. Mahan: University Chemistry 3rd Ed. Narosa (1998).
- R. H. Petrucci: General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).

PRACTICAL: GE-II LAB.

Section A: Physical Chemistry Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO3, NH4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of H. **Ionic equilibria**

pH measurements a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

b) Preparation of buffer solutions:

(i) Sodium acetate-acetic acid.

(ii) Ammonium chloride-ammonium hydroxide.

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. 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.

(c) Oxime and 2,4 dinitrophenylhydrazone of aldehyde/ketone.

Reference Books:

- A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
- F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960).
- B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

SEMESTER-III

GE-III: CHEMISTRY OF S- AND P-BLOCK ELEMENTS, STATES OF MATTER & CHEMICAL KINETICS

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100

THEORY (Each class 1 hr.): Marks-70

PRACTICAL (Each class 2 hrs.): Marks-30

Lectures: 60 (40 Theory + 20 Practical classes)

UNIT-I: General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Hydrometallurgy, Methods of purification of metals (Al, Pb, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, Parting process, van Arkel-de Boer process and Monds process. (4 Lectures)

s- and p-Block Elements

Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling & Mulliken scales). Allotropy in C, S, and P. Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group. (11 Lectures)

UNIT-II: Compounds of s- and p-Block Elements

Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of p- block elements. Concept of multicentre bonding (diborane).

Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry.

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

Oxoacids of P, S and Cl.

Halides and oxohalides: PCl_3, PCl_5, $SOCl_2$. (15 Lectures)

Section B: Physical Chemistry-3 (30 Lectures) UNIT-III:

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. Maxwell Boltzmann distributionlaws 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). (10 Lectures)

Liquids

Surface tension and its determination using stalagmometer. Viscosity of a liquid anddetermination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only). (5 Lectures)

UNIT-IV: 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. XRay diffraction by crystals, Braggs law. Structures of NaCl, and CsCl (qualitative treatment only). Defects in crystals. (7 Lectures)

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). Halflife 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)

Reference Books:

- G. M. Barrow: Physical Chemistry Tata McGraw-Hill(2007).
- G. W. Castellan: Physical Chemistry 4th Edn. Narosa (2004).
- C. Kotz, P. M. Treichel & J. R. Townsend: General Chemistry Cengage Lening India Pvt. Ltd., New Delhi (2009).
- H. Mahan: University Chemistry 3rd Ed. Narosa (1998).
- R. H. Petrucci: General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
- D. Lee: A New Concise Inorganic Chemistry, E.L.B.S.
- F.A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.
- F. Shriver and P. W. Atkins: Inorganic Chemistry, Oxford University Press.
- Gary Wulfsberg: Inorganic Chemistry, Viva Books Pvt. Ltd.

PRACTICAL: GE-III LAB.

Section A: Inorganic Chemistry

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

Cations : NH^{4+}, Pb^{2+}, Ag^{+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sn^{2+}, Fe^{3+}, Al^{3+}, Co, Cr^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^{+}

Anions: CO_3^{2}, $S*2$, SO_3^{2}, NO_3, Cl, Br, I, NO, SO_3^{2-}, PO_4^{3-}, F_4^{-} (Spot tests should be carried out wherever feasible)

Section B: Physical Chemistry Chemical Kinetics

Study the kinetics of the following reactions.

3. Initial rate method: Iodide-persulphate reaction.
4. Integrated rate method:

a) Acid hydrolysis of methyl acetate with hydrochloric acid.

b) Saponification of ethyl acetate.

c) Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate.

Reference Books:

- A.I. Vogel, Qualitative Inorganic Analysis, Prentice Hall, 7th Edn
- A.I. Vogel, Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

SEMESTER- IV

GE:IV ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IRSPECTROSCOPY

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100 THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

Section A: Inorganic Chemistry-4 (30 Lectures) UNIT-I:Chemistry of 3d metals

Oxidation states displayed by Cr, Fe, Co, Ni and Co. A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$. (6 Lectures)

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-II: 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)

Section B: Organic Chemistry-4 (30 Lectures)

UNIT-III: Polynuclear and heteronuclear aromatic compounds

Properties of the following compounds with reference to electrophilic and nucleophilicsubstitution: Naphthalene, Anthracene, Furan, Pyrrole, Thiophene, and Pyridine. (6 Lectures)

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-IV: Application of Spectroscopy to Simple Organic Molecules

Applications of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, λ_{max} and s_{max}, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating l 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)

Reference Books:

- James E. Huheey, Ellen Keiter & Richard Keiter: Inorganic Chemistry: Principles of Structure and

Reactivity, Pearson Publication.

- G.L. Miessler & Donald A. Tarr: Inorganic Chemistry, PearsonPublication.
- J.D. Lee: A New Concise Inorganic Chemistry, E.L.B.S.
- F.A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley & Sons.
- I.L. Finar: Organic Chemistry (Vol. I & II), E.L.B.S.
- John R. Dyer: Applications of Absorption Spectroscopy of Organic Compounds, • Prentice Hall.
- R.M. Silverstein, G.C. Bassler & T.C. Morrill: Spectroscopic Identification of Organic Compounds, John Wiley & Sons.
- R.T. Morrison & R.N. Boyd: Organic Chemistry, Prentice Hall.
- Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
- Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.

PRACTICAL: GE-IV LAB.

Section A: Inorganic Chemistry

1. Separation of mixtures by chromatography: Measure the Rf 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+} andZn^{2+}

Section B: Organic Chemistry

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

Reference Books:

- A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- A.I. Vogel: Textbook of Practical Organic Chemistry, Prentice Hall, 5th Edn.
- F. G. Mann & B. C. Saunders: Practical Organic Chemistry, Orient Longman (1960).

SEMESTER- IV (CBZ Students)

GE:IV- MOLECULES OF LIFE

(Credits-6: Theory-4, Practical-2)-Max. Marks: 100
THEORY (Each class 1 hr.): Marks-70 PRACTICAL (Each class 2 hrs.): Marks-30 Lectures: 60 (40 Theory + 20 Practical classes)

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 disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation. (12 Periods)

UNIT-II Amino Acids, Peptides and Proteins

Classification of Amino Acids, Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and Cterminal amino acid (by 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. (12 Periods)

UNIT-III: Enzymes and correlation with drug action

Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action(Including stereospecifity) , Enzyme inhibitors and their importance, phenomenon of inhibition(Competitive and Non competitive inhibition including allosteric inhibtion). Drug action-receptor theory. Structure activity relationships of drug molecules, binding role of OH group, $-NH_2$ group, double bond and aromatic ring, (10 Periods)

Nucleic Acids

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. (8 Periods)

UNIT-IV: Lipids

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). (8 Periods) **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 Carbohydrate- Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates. (10 Lectures)

Recommended Texts:

- Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Educa- tion).
- Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Educa- tion).
- Nelson, D. L. & Cox, M. M. Lehningers Principles of Biochemistry 7th Ed., W. H. Freeman.
- Berg, J. M., Tymoczko, J. L. & Stryer, L. Biochemistry 7th Ed., W. H. Freeman.

PRACTICAL: GE-IV(CBZ) LAB.

1. Separation of amino acids by paper chromatography.

2. To determine the concentration of glycine solution by formylation method.
3. Study of titration curve of glycine.
4. Action of salivary amylase on starch.
5. Effect of temperature on the action of salivary amylase on starch.
6. To determine the saponification value of an oil/fat.
7. To determine the iodine value of an oil/fat.
8. Differentiate between a reducing/ nonreducing sugar.
9. Extraction of DNA from onion/cauliflower.
10. To synthesise aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC.

Recommended Texts:

- Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. Vogels Textbook of Practical Organic Chemistry, ELBS.
- Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.

COMPUTER SCIENCE(HONOURS)

SEMESTER-I

C:1-PROGRAMMING USING C
(Credit:6, Theory:4, Practical: 2)

UNIT- I

Introduction to Programming Language, Introduction to C Programming , Character Set, C Tokens, Keywords & Identifiers, Constants, Variables, Data Types, Variables , Storage Classes, Operators (Arithmetic, Relational, Logical , Assignment, Increment & Decrement, Conditional , Bitwise), Expressions , Input and Output Operations.

UNIT- II

Decision Making and Branching: Simple IF Statement, IF.. ELSE Statement, Nesting IF. ELSE Statement, ELSE IF Ladder, Switch Statement, Operator, GOTO Statement. Decision Making and Looping: The WHILE Statement, The DO Statement, The FOR Statement, Jumps in LOOPS. Arrays, Character Arrays and Strings.

UNIT- III

User-defined Functions: Need, Elements & Definition, Function Calls, Function Definition, Cate- gory of Functions, Recursion. Structures and Unions: Defining, Declaring, Accessing, Initialization Structure, Arrays of Structures, Arrays within Structures, Structures and Functions, Unions.

UNIT- IV

Pointers: Accessing the Address of a Variable, Declaring Pointer Variables, Initializations of Pointer Variable, Accessing a Variable through its Pointer, Chain of Pointers, Pointer Expressions, Pointer Increments and Scale Factor, Pointers and Arrays,, Pointers and Character Strings, Array of Pointers, Pointers as Function Arguments, Functions Returning Pointers, Pointers to Functions, Pointers to Structures, Troubles with Pointers.

UNIT- V

File Management in C: Defining and Opening a File, Closing a File, Input/ Output Operations on Files, Error Handling During I/O Operations, Random Access to Files, Command Line Arguments, Dynamic Memory Allocation.

Recommended Books:

1. E. Balaguruswamy, Programming in ANSI C,4/e, (TMH).
2. Paul Deitel, Harvey Deitel, C: How to Program, 8/e, Prentice Hall.
3. J. R. Hanly, Problem Solving & Program Design in C, 7/e, Pearson.
4. B. Kernighan & D.M. Ritche, The C Programming Language, 2/e PHI.

C: 2-COMPUTER ORGANIZATION

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Character Codes, Decimal System, Binary System, Decimal to Binary Conversion, Hexadecimal Notation, Boolean Algebra, Basic Logic Functions: Electronic Logic Gates, Synthesis of Logic Functions, Minimization of Logic Expressions, Minimization using Karnaugh Maps, Synthesis with NAND and NOR Gates.

UNIT-II

Flip-Flops, Gated Latches, Master-Slave Flip-Flops, Edge-Triggering, T Flip-Flops, JK Flip-Flops. Registers and Shift Registers, Counters, Decoders, Multiplexers, Programmable Logic Devices (PLDs), Programmable Array Logic (PAL), Complex Programmable Logic Devices (CPLDs), Field-Programmable Gate Array (FPGA), Sequential Circuits, Timing Diagrams, The Finite State Machine Model, Syn- thesis of Finite State Machines.

UNIT-III

Basic Structure of Computers: Computer Types, Functional Units, Input Unit, Memory Unit, Arithmetic and Logic Unit, Output Unit, Control Unit, Basic Operational Concepts, Bus Structures, Software. Machine Instructions and Programs: Numbers, Arithmetic Operations, and Characters: Number Representation, Addition of Positive Numbers, Addition and Subtraction of Signed Numbers, Overflow of Integer Arithmetic, Characters, Memory Locations and Addresses, Byte Address ability, Word Alignment, Accessing Numbers, Characters, and Character Strings, Memory Operations, Instructions and Instruction Sequencing, Register Transfer Notation, Basic Instruction Types, Instruction Execution and Straight-Line Sequencing, Branching, Condition Codes, Generating Memory Addresses, Addressing Modes, Implementation of Variables and Constants, Indirection and Pointers, Indexing and Arrays, Relative Addressing.

UNIT-IV

THE ARM EXAMPLE: Registers, Memory Access, and Data Transfer, Register Structure, Mem- ory Access Instructions and Addressing Modes, Register Move Instructions, Arithmetic and Logic Instructions: Arithmetic Instructions, Logic Instructions, Branch Instructions, Setting Condition Codes, Assembly Language, Psedo-Instructions, I/O Operations, Subroutines, Vector Dot Product Program, Byte-Sorting Program, Linked-List Insertion and Deletion Subroutines. Basic Input-Output Operations, Stacks and Queues, Subroutines. PowerPC Example: Basic PowerPC Processor Organization, Load and Store Instructions, Arithmetic and Logic Instructions, Flow Control Instructions, Compare Instructions, Logic Instructions, Subroutines.

UNIT-V

Memory System: Semiconductor RAM Memories, Internal Organization of Memory Chips, Static Memories, Asynchronous DRAMS, Synchronous DRAMS, Structure of Large Memories, Memory System Considerations, RAMBUS Memory. Read-Only Memories: ROM, PROM, EPROM, EEP- ROM, Flash Memory, Speed, Size, and Cost of Memory. Secondary Storage: Magnetic Hard Disks, Optical Disks, Magnetic Tape Systems.

Recommended Books:

1. Carl Hamacher, Z. Vranesic, S. Zaky: Computer Organization, 5/e (TMH)
2. William Stallings: Computer Organization and Architecture (Design for Performance), 9/e
3. S. Brown, & Z. Vranesic, Fundamentals of Digital Logic Design with VHDL, 2/e, McGraw-Hill
4. J. P. Uyemura, A First Course in Digital System Design, An Integrated Approach, Cengage Learning.

GE:1-PROBABILITY AND STATISTICS

Credits;4

UNIT-I

Probability and Probability Distribution: Events and the Sample Space, Calculating Probabilities using Simple events, Useful counting rules, Probability rules: Addition rule, Conditional probability and multiplication rule, Bayes rule.

UNIT-II

Probability Distributions: Random Variable, Discrete random variable, Mean and Standard deviation of discrete random variable, Discrete Probability Distributions: Binomial, Poisson and Hypergeometric probability distribution, Continuous Probability distribution: Normal distribution.

UNIT-III

Sampling Distribution: sampling plans and experimental designs, Sampling distribution of a statistic, Central Limit theorem, Sampling distribution of the Sample mean and Proportion. Large Sample Estimation: Point estimation, Interval estimation, Confidence interval of population mean, Population proportion, difference between two population means, difference between two population proportions.

UNIT-IV

Large Sample Tests of Hypothesis: Test of a Population mean, Test of difference of two population means, Test of hypothesis for a binomial proportion, Test of hypothesis for the difference between two binomial proportions. Inference from Small Samples: Students t Distribution, Small Sample inferences concerning a population mean and difference between two population means, Inferences concerning a population variance and difference between two population variances.

UNIT-V

Analysis of Variance: One-way classification, Two-way classification. Linear regression andCorrelation: Method of least squares, Analysis of variance for linear regression, Testing the usefulness of the linear regression model, Estimation and Prediction using the fitted line. Carl Pearsons coefficient of Correlation, Test of hypothesis concerning the Correlation coefficient.

Recommended Books: 1. William Mendenhall, Robert J. Beaver, Barbara M. Beaver, Probability and Statistics 14/e, CENGAGE Learning. 2. W. W. Hines, D.C. Montgomery, D.M. Goldsman, & C.M. Borror, Probability & Statistics inEngineering".

C: 3-PROGRAMMING USING C++

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Principles of Object-Oriented Programming: Object-Oriented Programming (OOP) Paradigm, Basic Concepts of OOP, Benefits of OOP, Object Oriented Languages, Applications of OOP. Beginning with C++: Applications of C++, C++ statements, Example with Class, Structure of C++ Program, Creating the Source File, Compiling and Linking. Tokens, Expressions and Control Structures: Tokens, Keywords, Identifiers & Constants, Basic Data Types, User-Defined Data Types, Derived Data Types, Symbolic Constants, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Operators in C++, Scope Resolution Operator, Member Deferencing Operators, Memory Management Operators, Manipulators, Type Cast Operators, Expressions and

their Types, Special Assignment Expressions, Implicit Conversions, Operator Overloading, Operator Precedence, Control Structures.

UNIT- II

Functions in C++: The Main Function, Function Prototyping, Call By Reference, Return by Ref- erence, Inline Functions, Default Arguments, Const. Arguments, Function Overloading, Friend & Virtual Functions, Math. Library Functions. Classes and Objects: Specifying a Class, Defining Member Functions, Making an outside Function Inline, Nested Member Functions, Private Member Functions, Arrays within a Class, Memory Allocation for Objects, Static Data Members, Static Mem- ber Functions, Arrays of Objects, Objects as Function Arguments, Friendly Functions, Returning Objects, Cons. Member Functions, Pointer to Members, Local Classes.

UNIT- III

Constructors & Destructors: Constructors, Parameterized Constructors, Multiple Constructors in a Class, Constructors with Default Arguments, Dynamic Initialization of Objects, Copy Construc- tor, Dynamic Constructors, Constructing Two-Dimensional Arrays, Const. Objects, Destructors. Operator Overloading and Type Conversions: Defining Operator Overloading, Overloading Unary Operators, Overloading Binary Operators, Overloading Binary Operators using Friends, Manipulation of Strings using Operators, Rules for Overloading Operators, Type Conversions.

UNIT- IV

Inheritance : Defining Derived Classes, Single Inheritance, Making a Private Member Inheritance, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance, Virtual Base Classes, Abstract Classes, Constructors in Derived Classes, Member Classes, Nesting of Classes. Pointers, Virtual Functions and Polymorphism: Pointers, Pointers to Objects, this Pointer, Pointers to Derived Classes, Virtual Functions, Pure Virtual Functions.

UNIT- V

Managing Console I/O Operations: C++ Streams, C++ Stream Classes, Unformatted I/OOpera- tions, Formatted Console I/O Operations, Managing Output with Manipulators. Files: Classes for File Stream Operations, Opening and Closing a File, Detecting end-of-file, File Modes, File Pointers and their Manipulations, Sequential Input and Output Operations, Updating a File: Random Access, Error Handling During File Operations, Command-line Arguments.

Recommended Books:

1. E. Balgurusamy, Object Oriented Programming with C++ :, 4/e (TMH).
2. Paul Deitel, Harvey Deitel, ”C++: How to Program”,9/e. Prentice Hall.
3. J. Farrell, Object-Oriented Programming, Cengage Learning.
4. BjarneStroustroup, ”Programming – Principles and Practice using C++”, 2/e,Addison-Wesley 2014.

C: 4-DATA STRUCTURES

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Introduction and Overview: Definitions, Concept of Data Structures, Overview of Data Structures, Implementation of Data Structures. Arrays: Terminology, One-Dimensional Array, Multi-Dimensional Arrays, Pointer Arrays.

UNIT-II

Linked Lists: Single Linked List, Circular Linked List, Double Linked List, Circular Double Linked List, Application of Linked Lists, Memory Representation, Boundary Tag System, De-allocation Strategy, Buddy System, Compaction.

UNIT-III

Stacks: Definition, Representation of Stack (Array, Linked List), Operations on Stacks, Applications of Stack (Evaluation of Arithmetic Expressions, Code Generation, Implementation of Recursion, Factorial Calculation, Quick Sort, Tower of Hanoi, Activation Record Management).

UNITIV

Queues: Definition, Representation of Queues (Array, Linked List), Circular Queue, Deque, Priority Queue, Application of Queues (Simulation, CPU Scheduling in Multiprogramming Environment, Round Robin Algorithm).

UNITV

Tree: Binary Trees, Properties of Binary Tree, Linear Representation of Binary a Binary Tree, Linked Representation of a Binary Tree, Physical Implementation of Binary Tree in Memory, Operations on Binary Tree (Insertion, Deletion, Traversal, Merging of two Binary Trees), Types of Binary Trees (Expression Tree, Binary Search Tree, Heap Tree, Threaded Binary Trees, Height Balanced Binary Tree, Weighted Binary Tree, Decision Trees).

Recommended Books:

1. D. Samanta, Classic Data Structures:, 2/e (PHI).
2. D.S Malik, Data Structure using C++, 2/e, Cengage Learning, 2010.
3. Adam Drozdek, ”Data Structures and algorithm in C++”, 3/e, Cengage Learning, 2012.
4. Robert L. Kruse, ”Data Structures and Program Design in C++”, Pearson.

GE: 2-NUMERICAL TECHNIQUES

Credits;4

UNIT-I

Introduction: Numbers and their accuracy, Chopping and Rounding off, Errors: Absolute and Relative errors, Floating point representations of numbers, Loss of significance. Solution of Algebraic and Transcendental Equations: Bisection Method, Newton-Raphson Method, Secant Method, Method of false position, Rate of convergence and comparison of iterative methods.

UNIT-II

Interpolation and Numerical Differentiation: Polynomial Interpolation, Interpolating polynomial: Lagrange form, Newton form, Nested form, Divided difference Interpolation, Inverse Interpolation, Errors in polynomial Interpolation. First derivative and second derivative via Taylor Series, Richardson Extrapolation.

UNIT-III

Numerical Integration: Trapezoidal Rule, Composite Trapezoidal rule, Simpsons 1/3 rule, Simpsons 3/8 rule, Gaussian Quadrature formulae (1-point, 2-point, 3-point)

UNIT-IV

Solution of System of Linear Equations: Gaussian Elimination method and Pivoting, LU factorization method, ill Conditioning, Iterative Methods: Jacobi iterative method, Gauss Seidel iterative method. Eigen Values and Eigen Vectors: Eigen value properties, Computation Eigen values by Power method.

UNIT-V

Solution of Ordinary Differential Equations: Taylor Series method, Runge-Kutta method of order 2 and order 4, Predictor-Corrector method: Adams-Bashforth-Moultan method. Smoothing of Data and the Method of Least Squares: Linear and non-linear least square method.

Recommended Books:

1. E. Ward Cheney and David R. Kincaid ,Numerical Methods and Applications CENGAGE Learn- ing India Private Ltd., New Delhi.
2. S.R.K. Iyengar, R.K. Jain, & M.K. Jain, Numerical Methods for Scientific & Engineering Computation, 6/e, New Age Int. Pub.
3. S.S. Sastry, Introductory Methods of Numerical Analysis, 5/e, EEE
4. Steven C. Chapra, Applied Numerical Methods with MATLAB, 2/e, McGraw-Hill.

SEMESTER-III

C: 5-OPERATING SYSTEMS

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Operating System, Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Distributed Systems, Special Purpose Systems, Computing Environments, Open-Source Operating Systems. Operating System Services, User Operating System Interface, System Calls, Types of System Calls, System Programs, Operating-System Design and Implementation, Operating System Structure, Virtual Machines, Operating System Debugging, Operating System Generations. System Boot.

UNIT-II

Process: Process Concept, Process Scheduling, Operations on Processes, Inter-Process Communication, Examples of IPC Systems, Communication in Client-Server Systems. Multithreaded Programming: Multithreading Models, Thread Libraries, Threading Issues, Operating-System Examples.

UNIT-III

Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Thread Scheduling. Multiple Process Scheduling. Synchronization: The Critical Section Problem, Petersons Solution, Synchronization Hardware, Semaphores, Classical Problems of Synchronization, Monitors, Synchronization Examples, Atomic Transactions.

UNIT-IV

Deadlocks: System Model, Deadlock Characterization, Methods of Handling Deadlocks, Deadlock Prevention, Deadlock avoidance, Deadlock Detection, Recovery from Deadlock. Memory Management Strategies: Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation, Example: The Intel Pentium.

UNIT-V

Virtual-Memory Management: Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files, Allocating Kernel Memory. File System: File Concept, Access Methods, Directory and Disk Structure, File-System Mounting, File Sharing, Protection.

Recommended Books:

1. A Silberschatz, P.B. Galvin, G. Gagne, Operating Systems Concepts, 8/e, John Wiley Publica- tions 2008.
2. A.S. Tanenbaum, Modern Operating Systems, 3/e, Pearson Education 2007.
3. W. Stallings, Operating Systems, Internals & Design Principles, 5/e, Prentice Hall of India. 2008.
4. G. Nutt, Operating Systems: A Modern Perspective, 2/e, Pearson Education 1997.

C: 6-DATABASE MANAGEMENT SYSTEM

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Databases and Database Users, Database System Concepts and Architecture, Data Modelling using the Entity-Relationship (ER) Model, The Enhanced Entity-Relationship (EER) Model.

UNIT-II

Relational Model: The Relational Data Model and Relational Database Constraints, The Relational Algebra and Relational Calculus.

UNIT-III

Relational Database Design by ER- and EER-to-Relational Mapping, SQL-99: Schema Definition, Constraints, Queries, and Views, Introduction to SQL Programming Techniques.

UNIT-IV

Functional Dependencies and Normalization for Relational Databases, Relational Database Algorithms and Further Dependencies, Practical Database Design Methodology and use of UML Diagrams.

UNIT-V

Disk Storage, Basic File Structures, and Hashing, Indexing Structures for Files, Algorithms for Query Processing and Optimization, Physical Database Design and Tuning.

Recommended Books:

1. R. Elmasri, S.B. Navathe, Fundamentals of Database Systems, 6/e, Pearson Education, 2010.
2. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts 6/e, McGraw Hill, 2010.
3. R. Ramakrishanan, J. Gehrke, Database Management Systems, McGraw-Hill.
4. C. Coronel, S. Morris, & P. Rob, Database Principles (Fundamentals of Design, Implementation, and Management), 9/e, Cengage Learning.

C: 7-DISCRETE STRUCTURES

(Credit:6, Theory:4, Practical: 2)

UNIT-I Logic and Proofs: Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Normal Forms, Proof Methods and Strategy, Mathematical Induction, Strong Induction and Well-Ordering, Recursive Definitions and Structural Induction, Recursive Algorithms.

UNIT-II

Basic Structures: Sets, Set Operations, Functions, Recursive Functions, Sequences and Summations. Relations: Relations and their Properties, n-ary Relations and their Applications, Representing Relations, Closures of Relations, Equivalence Relations, Partial Ordering. Boolean.

UNIT-III

Algebra: Boolean Functions, Representing Boolean Functions, Logic Gates, Minimization of Circuits. Algebraic Structures & Coding Theory: The Structure of Algebras, Semi-groups, Monoids and Groups, Homomorphism, Normal Subgroups, and Congruence Relations, Rings, Integral Domains and Fields, Quotient and Product Algebras, Coding Theory. Polynomial Rings and Polynomial Codes.

UNIT-IV

Counting: Basics of Counting, The Pigeonhole Principle, Permutations and Combinations, Binomial Coefficients, Generalized Permutations and Combinations, Generating Permutations and Combinations. Advanced Counting Techniques, Applications of Inclusion-Exclusion, Discrete probability, Conditional probability, Bayes Theorem.

UNIT-V

Graphs: Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Havel-Hakimi Theorem, Representing Graphs and Graph Isomorphism, Connectivity, Cut-Sets, Euler and Hamiltonian Paths, Shortest-Path Problem, Planar Graphs, Graph Coloring, Network Flows.

Recommended Books:

1. Kenneth H Rosen, Discrete Mathematics & Its Applications, McGraw-Hill. 7/e.
2. J. L. Hein, Discrete Structures, Logic, and Computability, 3rd Edition, Jones and Bartlett Publishers, 2009
3. C.L. Liu , D.P. Mahopatra, Elements of Discrete mathematics, 2nd Edition , Tata McGraw Hill, 1985
4. M. O. Albertson and J. P. Hutchinson, Discrete Mathematics with Algorithms , John wiley Publication, 1988

GE:3-ELECTRICITY & MAGNETISM

(Credit: 06, Theory:04, Practical:02)

UNIT-I

Electric Field and Electric Potential: Electric field: Electric field lines. Electric flux. Gauss Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conser- vative nature of Electrostatic Field. Electrostatic Potential. Laplaces and Poisson, equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole.

UNIT-II

Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet, and (2) Sphere.

UNIT-III

Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarization Charges. Elec- trical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss Law in dielectrics.

UNIT-IV

Magnetic Field: Magnetic force between current elements and definition of Magnetic FieldB. Biot-Savarts Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic

Dipole and its Dipole Moment (Analogy with Electric Dipole). Amperes Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.

UNIT-V

Magnetic Properties of Matter: Magnetization vector (M). Magnetic Intensity(H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis. Electromagnetic Induction: Faradays Law. Lenzs Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwells Equations. Charge Conservation and Displacement current. Electrical Circuits: AC Circuits: Kirchhoffs laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit. Network theorems: Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits.

Recommended Books:

1. S. Mahajan & Choudhury, Electricity, Magnetism & Electromagnetic Theory, 2012, Tata McGraw Hill
2. Edward M. Purcell,Electricity and Magnetism, 1986 McGraw-Hill Education
3. M.N.O. Sadiku, Elements of Electromagnetics, 2010, Oxford University Press.
4. J.H.Fewkes & J.Yarwood , Electricity and Magnetism,. Vol. I, 1991, Oxford Univ. Press

SEMESTER-IV

C: 8-JAVA PROGRAMMING

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Introduction to Java: Java Architecture and Features, Understanding the semantic and syntax differences between C++ and Java, Compiling and Executing a Java Program, Variables, Constants, Keywords Data Types, Operators (Arithmetic, Logical and Bitwise) and Expressions, Comments, Doing Basic Program Output, Decision Making Constructs (conditional statements and loops)and Nesting, Java Methods (Defining, Scope, Passing and Returning Arguments, Type Conversion and Type and Checking, Built-in Java Class Methods).

UNIT-II

Arrays, Strings and I/O: Creating & Using Arrays (One Dimension and Multi-dimensional), Referencing Arrays Dynamically, Java Strings: The Java String class, Creating & Using String Objects, Manipulating Strings, String Immutability & Equality, Passing Strings To & From Methods, String Buffer Classes. Simple I/O using System.out and the Scanner class, Byte and Character streams, Reading/Writing from console and files. Object-Oriented Programming Overview: Principles of Object-Oriented Programming, Defining & Using Classes, Controlling Access to Class Members, Class Constructors, Method Overloading, Class Variables & Methods, Objects as parameters, final classes, Object class, Garbage Collection.

UNIT-III

Inheritance, Interfaces, Packages, Enumerations, Autoboxing and Metadata: Inheritance: (Single Level and Multilevel, Method Overriding, Dynamic Method Dispatch, Abstract Classes), Interfaces and Packages, Extending interfaces and packages, Package and Class Visibility, Using Standard Java Packages (util, lang, io, net), Wrapper Classes, Autoboxing/Unboxing, Enumerations and Metadata.

UNIT-IV

Exception Handling, Threading, Networking and Database Connectivity: Exception types, uncaught exceptions, throw, built-in exceptions, Creating your own exceptions; Multi-threading: The Thread class and Runnable interface, creating single and multiple threads, Thread prioritization, synchronization and communication, suspending/resuming threads. Using java.net package, Overview of TCP/IP and Datagram programming. Accessing and manipulating databases using JDBC.

UNIT-V

Applets and Event Handling: Java Applets: Introduction to Applets, Writing Java Applets, Working with Graphics, Incorporating Images & Sounds. Event Handling Mechanisms, Listener Interfaces, Adapter and Inner Classes. The design and Implementation of GUIs using the AWT controls, Swing components of Java Foundation Classes such as labels, buttons, text fields, layout managers, menus, events and listeners; Graphic objects for drawing figures such as lines, rectangles, ovals, using different fonts. Overview of servlets.

Recommended Books:

1. E. Balagurusamy, Programming with Java, 4/e, TMH
2. Bruce Eckel, ”Thinking Java”, 8/e, Pearson India, 2010.
3. John R. Hubbard, ”Programming with JAVA”, Schaum’s Series, 2/e, 2004.
4. Cay S. Horstmann, GaryCornell, ”Core Java 2 Volume 1 ,9/e,Printice Hall.2012.

C: 9-COMPUTER NETWORK

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Introduction: Data Communications, Networks, The Internet, Protocols and Standards. Network Models: Layered Tasks, The OSI Model, Layers in the OSI Model, TCP/ IP Protocol Suite, Ad- dressing.

UNIT-II

Data and Signals: Analog and Digital, Periodic Analog Signals, Digital Signals, Transmission Impairment, Data Rate Limits, Performance. Digital Transmission: Digital-To-Digital Conversion, Analog-To-Digital Conversion, Transmission Modes. Analog Transmission: Digital-To-Analog Conversion, Analog-To-Analog Conversion.

UNIT-III

Multiplexing and Spreading: Multiplexing, Spread Spectrum. Transmission Media: Guided Media, Unguided Media (Wireless). Switching: Circuit Switched, Datagrams, Virtual Circuit Networks, Structure of a Switch. Telephone Network, Dial-Up MODEMS, Digital Subscriber Line (DSL), Cable TV Networks, Cable TV for Data Transfer.

UNIT-IV

Error Detection and Correction: Introduction, Block Coding, Linear Block Codes, Cyclic Codes,

Checksum. Data Link Control: Framing, Flow and Error Control, Protocols, Noiseless Channels, Noisy Channels, HDLC, Point-To-Point Protocol. Multiple Access: Random Access, Controlled Access, Channelization. Wired LANs: IEEE Standards, Standard Ethernet, Changes in the Standard, Fast Ethernet, Gigabit Ethernet: Wireless LANs: IEEE 802.11, Bluetooth.

UNIT-V

Connecting LANs: Connecting Devices, Backbone Networks, Virtual LANs. Wireless LANs: Cellular Telephony, Satellite Networks. SONET: Architecture, SONET Layers, SONET Frames, STS Multiplexing, SONET Networks, Virtual Tributaries. Virtual-Circuit Networks. Frame Relay, ATM, ATM LANs,

Recommended Books:

1. B. A. Forouzan, Data Communications and Networking, 4/e, THM ,2007
2. A. S. Tanenbaum, & David J. Wetherall, Computer Networks, 5/e, Pearson

C: 10-COMPUTER GRAPHICS

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Computer Graphics: A Survey of Computer graphics, Overview of Graphics System: Video Display Devices, Raster-Scan Systems, Input Devices, Hard-Copy Devices, Graphics Software, Introduction to OpenGL. Graphics Output Primitives: Point and Lines, Algorithms for line, circle & ellipse generation, Filled-Area Primitives. Attributes of Graphics Primitives: Point, line, curve attributes, fill area attributes, fill methods for areas with irregular boundaries, Antialiasing.

UNIT-II

Geometric Transformations (both 2-D & 3-D): Basic Geometric Transformations, Matrix Representation and Homogeneous Coordinates, Composite Transformations, Inverse Transformations, Other Transformations (Reflection, shear), Transformation between coordinate systems, Affine Transformations. Two Dimensional Viewing: Viewing pipeline, Clipping Window, Normalization & Viewport coordinate Transformations, Clipping Algorithms: Point clipping, Line clipping and Polygon clip- ping. Three Dimensional Viewing: 3-dimensional Viewing Concepts, Viewing pipeline, Projection Transformations (Orthogonal, Oblique parallel, Perspective), Clipping Algorithms.

UNIT-III

Three Dimensional Object Representations: Curved Surfaces, Quadratic Surfaces, Spline Representations, Bezier Spline Curves and Surfaces, B-Spline Curves and Surfaces, Octrees, BSP Trees, Fractal Geometry Methods, Gamma correction.

UNIT-IV

Visible Surface Detection Methods: Classification of Visible-Surface Detection Algorithms, Back-Face Detection, Depth-Buffer method, A-Buffer Method, Scan line and Depth Sorting, Area subdivision Method, Ray Casting Method.

UNIT-V

Illumination Models: Basic Illumination Models, Displaying light Intensities, Halftone Patterns and Dithering techniques, Polygon-Rendering Methods (Gouroud Shading, Phong Shading), Ray-Tracing Methods (Basic Ray-Tracing Algorithm, Ray-Surface Intersection Calculations). Computer Animation, Hierarchical Modeling (introductory idea only).

Recommended Books:

1. Donald Hearn & M. Pauline Baker, Computer Graphics with OpenGL, Pearson Education.
2. A.V. Dan, F.H. Jones, J.D. Foley, S.K. Feiner, Computer Graphics Principles & Practices in C, 2/e, Pearson.
3. D. F. Rogers, Procedural Elements for Computer Graphics, McGraw Hill.
4. D. F. Rogers, & J. A. Adams, Mathematical Elements for Computer Graphics, 2/e, McGraw Hill.

SEC: II-ANDROID PROGRAMMING

(Credit:02)

UNIT-I

Introduction: History of Android, Introduction to Android Operating Systems, Android Development Tools, Android Architecture. Overview of object oriented programming using Java: OOPs Concepts: Inheritance, Polymorphism, Interfaces, Abstract class, Threads, Overloading and Overriding, Java Virtual Machine.

UNIT-II

Development Tools: Installing and using Eclipse with ADT plug-in, Installing Virtual machine for Android sandwich/Jelly bean (Emulator), configuring the installed tools, creating a androidproject , Hello Word, run on emulator, Deploy it on USB-connected Android device.

UNIT-III

User Interface Architecture: Application context, intents, Activity life cycle, multiple screen sizes.

UNIT-IV

User Interface Design: Form widgets, Text Fields, Layouts, Button control, toggle buttons, Spinners (Combo boxes), Images, Menu, Dialog.

UNIT-V

Database: Understanding of SQLite database, connecting with the database.

Recommended Books:

1. James C. Sheusi, Android application Development for Java Programmers, Cengage Learning, 2013.
2. M. Burton, & D. Felker, Android Application Development for Dummies, 2/e, Wiley India.

GE:IV-ELECTRONICS

(Credit: 06, Theory:04, Practical:02)

UNIT-I

Semiconductor Diodes: P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current. Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. Current Flow Mechanism in Forward and Reverse Biased Diode.

UNIT-II

Two-terminal Devices and their Applications: (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter (2) Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode

and (3) Solar Cell. Bipolar Junction Transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cutoff and Saturation Regions.

UNIT-III

Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers.

UNIT-IV

Coupled Amplifier: Two stage RC-coupled amplifier and its frequency response. Feedback in Amplifiers: Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators. Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground.

UNIT-V

Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator. Conversion: Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation)

Recommended Books:

1. J. Millman and C.C. Halkias , Integrated Electronics, 1991, Tata Mc-Graw Hill.
2. J.D. Ryder , Electronics: Fundamentals and Applications , 2004, Prentice Hall.
3. B. G. Streetman & S. K. Banerjee, Solid State Electronic Devices, 6/e ,2009, PHI Learning.
4. S. Salivahanan & N. S. Kumar, Electronic Devices & Circuits, 3/e, 2012, Tata Mc-Graw Hill.
5. R. A. Gayakwad, OP-Amps and Linear Integrated Circuit, 4/e, 2000, Prentice Hall.

SEMESTER-V

C: 11-INTERNET TECHNOLOGY

(Credit: 06, Theory:04, Practical:02)

UNIT-I

Java: Use of Objects, Array and Array List class

UNIT-II

JavaScript: Data types, operators, functions, control structures, events and event handling.

UNIT-III

JDBC: JDBC Fundamentals, Establishing Connectivity and working with connection interface, Work- ing with statements, Creating and Executing SQL Statements, Working with Result Set Objects. **UNIT-IV**

JSP: Introduction to Java Server Pages, HTTP and Servlet Basics, The Problem with Servlets, The

Anatomy of a JSP Page, JSP Processing, JSP Application Design with MVC, Setting Up the JSP Environment, Implicit JSP Objects, Conditional Processing, Displaying Values, Using an expression to Set an Attribute, Declaring Variables and Methods, Error Handling and Debugging, Sharing Data Between JSP Pages, Requests, and Users, Database Access.

UNIT-V

Java Beans: Java Beans Fundamentals, JAR files, Introspection, Developing a simple Bean, Connecting to DB

Recommended Books:

1. Ivan Bayross, Web Enabled Commercial Application Development Using HTML, DHTML, Javascript, Perl CGI , BPB Publications, 2009.
2. Cay Horstmann, BIG Java, Wiley Publication , 3/e, 2009.
3. Herbert Schildt , Java 7, The Complete Reference, , 8/e, 2009.
4. Jim Keogh ,The Complete Reference J2EE, TMH, , 2002.

C: 12-SOFTWARE ENGINEERING

(Credit: 06, Theory:04, Practical:02)

UNIT-I

Professional Software Development, Software Engineering Ethics, Software Processes, Software Process Models, Process Activities, Coping with Change, The Rational Unified Process, Agile Software Development, Agile Methods, Plan-Driven and Agile Development, Extreme Programming, Agile Project Management, Scaling Agile Methods.

UNIT-II

Requirements Engineering, Functional and Non-Functional Requirements, The Software Requirements Document, Requirements Specification, Requirements Engineering Processes, Requirements Elicitation and Analysis, Requirements Validation, Requirements Management, System Modelling, Context Models, Interaction Models, Structural Models, Behavioural Models, Model-Driven, Engineering, Architectural Design, Architectural Design Decisions, Architectural Views, Architectural Patterns, Application Architectures.

UNIT-III

Design and Implementation: Object-Oriented Design using the UML, Design Patterns, Implementation Issues, Open Source Development, Software Testing: Development Testing, Test-Driven Development, Release Testing, User Testing, Software Evolution: Evolution Processes, Program Evolution Dynamics, Software Maintenance, Legacy System Management, Dependability and Security.

UNIT-IV

Socio-technical Systems: Complex Systems, Systems Engineering, System Procurement, System Development, System Operation. Dependability and Security: Dependability Properties, Availability and Reliability, Safety, Security. Dependability and Security Specification: Risk-Driven Require- ments, Specification, Safety Specification, Reliability Specification, Security, Specification, Formal Specification.

UNIT-V

Dependability Engineering: Redundancy and Diversity, Dependable Processes, Dependable Systems Architectures, Dependable Programming. Security Engineering: Security Risk Management,Design

for Security, System Survivability. Dependability and Security Assurance: Static Analysis, Reliability Testing, Security Testing, Process Assurance, Safety and Dependability Cases.

Recommended Books:

1. I. Sommerville, Software Engineering, 9/e, Addison Wesley.
2. R. Mall, Fundamentals of Software Engineering, 3/e, PHI.
3. R.S. Pressman, Software Engineering, A Practitioners Approach, 7/e, McGraw-Hill, 2009.
4. K.K. Aggarwal and Y. Singh, Software Engineering,2/e, New Age International Publishers, 2008.

DSE:1-Information Security (Credit: 06, Theory:04, Practical:02)

UNIT-I

Introduction: Security, Attacks, Computer Criminals, Security Services, Security Mechanisms. Cryptography: Substitution ciphers, Transpositions Cipher, Confusion, diffusion, Symmetric, Asymmetric Encryption. DES Modes of DES, Uses of Encryption, Hash function, key exchange, Digital Signa- tures, Digital Certificates.

UNIT-II

Program Security: Secure programs, Non malicious Program errors, Malicious codes virus, Trap doors, Salami attacks, Covert channels, Control against program.

UNIT-III

Threats: Protection in OS: Memory and Address Protection, Access control, File Protection, User Authentication. Database Security: Requirements, Reliability, Integrity, Sensitive data, Inference, Multilevel Security.

UNIT-IV

Security in Networks: Threats in Networks, Security Controls, firewalls, Intrusion detection systems, Secure e-mails.

UNIT-V

Administrating Security: Security Planning, Risk Analysis, Organisational Security Policy, Physical Security. Ethical issues in Security: Protecting Programs and data. Information and law.

Recommended Books:

1. C. P. Pfleeger, S. L. Pfleeger; Security in Computing, PHI, 2006.
2. W. Stallings; Network Security Essentials: Applications and Standards, 4/E, 2010.

DSE: 2-MICROPROCESSOR

(Credit: 06, Theory:04, Practical:02)

UNIT-I

An Introduction to Processor Design: Processor architecture and organization, Abstraction in hardware design, MU0 - a simple processor, Instruction set design ,Processor design trade-offs ,The Reduced Instruction Set Computer, Design for low power consumption .The ARM Architecture: The Acorn RISC Machine ,Architectural inheritance, The ARM programmer's model, ARM development tools.

UNIT-II ARM Assembly Language Programming: Data processing instructions, Data transfer instructions, Control flow instructions, Writing simple assembly language programs. ARM Organization and Implementation: Pipeline, Types, 3-stage pipeline ARM organization , 5-stage pipeline

ARM organization, ARM instruction execution, ARM implementation, The ARM coprocessor interface.

UNIT-III The ARM Instruction Set: Introduction, Exceptions, Conditional execution , Branch and Branch with Link (B, BL),Branch, Branch with Link and exchange (BX, BLX) , SoftwareInterrupt (SWI) ,Data processing instructions, Multiply instructions, Single word and unsigned byte data transfer instructions , Half-word and signed byte data transfer instructions, Multiple register transfer instructions , Status register to general register transfer instructions ,General register to status register transfer instructions , Coprocessor instructions. Coprocessor data operations, Coprocessor data transfers, Coprocessor register transfers, Breakpoint instruction (BRK - architecture v5T only), Unused instruction space, Memory faults, ARM architecture variants.

UNIT-IV

Architectural Support for High-Level Languages: Abstraction in software design, Data types, Floating-point data types, The ARM floating-point architecture, Expressions, Conditional statements, Loops , Functions and procedures , Use of memory, Run-time environment , Examples and exercises.

UNIT-V

Thumb Instruction Set: The Thumb bit in the CPSR, The Thumb programmer's model ,Thumb branch instructions, Thumb software interrupt instruction , Thumb data processing instructions , Thumb single register data transfer instructions, Thumb multiple register data transfer instructions, Thumb breakpoint instruction, Thumb implementation ,Thumb applications . Architectural Support for System Development: The ARM memory interface, The Advanced Microcontroller Bus Archi- tecture (AMBA),The ARM reference peripheral specification, Hardware system prototyping tools, The ARMulator.

Recommended Books:

Steve Furber :ARM System-On-Chip Architecture.

SEMESTER-VI

C: 13-ARTIFICIAL INTELLIGENCE
(Credit: 06, Theory:04, Practical:02)

UNIT-I

Intelligent Agents, Solving problems by searching, Uninformed search strategies (BFS, DFS, DLS, IDS, BD and Uniform cost search), Informed search and exploration (Greedy Best first, A* and its variations) Constraint satisfaction Problems, Adversarial search (Alpha-beta pruning).

UNIT-II

Knowledge and reasoning, logical agent (Wumpus world), Propositional logic, First order logic, Inference in first order logic (Forward chaining, backward chaining, Resolution), Knowledge representation.

UNIT-III

Planning, Partial-Order planning, Planning Graphs, Planning and acting in the real world, Uncertain knowledge and reasoning.

UNIT-IV

Learning from Observations, Decision trees, Neural network (Multilayer), Reinforcement Learning.

UNIT-V

NLP, Communication, A formal grammar for a fragment of English, Syntactic analysis (chat parsing), semantic Interpretation, Ambiguity of grammar, Machine Translation.

Recommended Books:

1. Stuart Russell and Peter Norvig, ARTIFICIAL INTELLIGENCE A MODERN APPROACH, 2/e, PHI.
2. D.W. Patterson, Introduction to A.I and Expert Systems, PHI, 2007.

3. Rich & Knight, Artificial Intelligence, 2/e, Tata McGraw Hill, 1991.

C:14-DESIGN AND ANALYSIS OF ALGORITHMS

(Credit: 06, Theory:04, Practical:02)

UNIT-I

Analysis and Design of Algorithm (Case study insertion sort and merge sort) Asymptotic Analysis, Divide and Conquer, Recurence Relations, Strassens Matix Multiplication.

UNIT-II

Sorting: Quick sort, heap sort, Counting sort, lower bound for sorting, Randomized quicksort, Order Statistics.

UNIT-III

Amotized Analysis (Aggregate analysis, Accounting analysis, Potential analysis), 2-3-4 tree Advanced Data structure: Fibonacci heap, Red black tree, hashing, data structure on disjoint set, Sciccinet Data Structure.

UNIT-IV

Dynamic Programming: Matrix Chain multiplication, LCS, TSP, Branch and Bound. Greedy Algo- ithm: MST: Krushkal , Prims, Dijkstra Algorithm, Huffman Coding, Maxflow matching, Computa- tional geometry: Convex Hall, 0-1-knaplock, fractional knapsack, Back tracking (4-Queen Prob.) **UNIT-V**

Complexity Class: P. PSPACE, NP, NP-Hard, NP Complete, Satisfiability, Cheque, Vertex Cover, Independent set, Exact cover, Graph Coloring, Hamiltonian, Cycle Matching. Approximation Algorithm: Vertex Cove, TSP, Indepentent Set, Sum of subset.

Recommended Books:

1. T.H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein Introduction to Algorithms, PHI, 3/e, 2009.
2. Sarabasse & A.V. Gelder Computer Algorithm, Introduction to Design and Analysis, Pearson 3/e, 1999.
3. E. Horowitz, S. Sahni, & S. Rajasekaran, Fundamentals of Computer Algorithms, 2/e, University Press.
4. A.V. Aho, J.E. Hopcroft, & J.D. Ullman, The Design and Analysis of Computer Algorithm, Pearson.

DSE:3-CLOUD COMPUTING

(Credit: 06, Theory:04, Practical:02)

Unit - I

Overview of Computing Paradigm: Recent trends in Computing: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. Introduction to Cloud Com- puting: Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Benefits and limitations of Cloud Computing.

UNIT-II

Cloud Computing Architecture: Comparison with traditional computing architecture (client/server), Services provided at various levels, Service Models- Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), How Cloud Computing Works, Deployment, Models- Public cloud, Private cloud, Hybrid cloud, Community cloud, Case study of NISTarchitecture.

UNIT-III

Case Studies: Case Study of Service, Model using Google App Engine, Microsoft Azure, Amazon EC2, Eucalyptus.

UNIT-IV

Service Management in Cloud Computing, Service Level Agreements (SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of Scaling.

UNIT-V

Cloud Security: Infrastructure Security- Network level security, Host level security, Applicationlevel security, Data security and Storage- Data privacy and security Issues, Jurisdictional issues raised by Data location, Authentication in Cloud Computing.

Recommended Books:

1. Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2010.
2. Rajkumar Buyya, James Broberg, Andrzej, M. Goscinski, Cloud Computing Principles & Paradigms, Wiley-2011.
3. Nikos Antonopoulos, Lee Gillam, Cloud Computing: Principles, Systems and Applications, Springer, 2012.
4. Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley-India, 2010.
5. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach ,Mc- Graw Hills, 2010.
6. Dimitris N. Chorafas, Cloud Computing Strategies ,CRC Press, 2010.

DSE:4-PROJECT WORK(Credit: 06)

ELECTRONICS

CC 1: Basic Circuit Theory and Network Analysis (Credits: Theory-04, Practicals-02)

Theory Lectures 60

Unit- 1 (13 Lectures)

Basic Circuit Concepts: Voltage and Current Sources, Resistors: Fixed and Variable resistors, Construction and Characteristics, Color coding of resistors, resistors in series and parallel. Inductors: Fixed and Variable inductors, Self and mutual inductance, Faraday's law and Lenz's law of electromagnetic induction, Energy stored in an inductor, Inductance in series and parallel, Testing of resistance and inductance using multimeter. Capacitors: Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, Air, Paper, Mica, Teflon, Ceramic, Plastic and Electrolytic capacitor, Construction and application, capacitors in series and parallel, factors governing the value of capacitors, testing of capacitors using multimeter.

Unit- 2 (13 Lectures)

Circuit Analysis: Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Star-Delta Conversion. **DC Transient Analysis:** RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant, RL and RC Circuits With Sources, DC Response of Series RLC Circuits.

Unit-3 (18 Lectures)

AC Circuit Analysis: Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance, Power in AC Circuits: Instantaneous Power, Average Power, Reactive Power, Power Factor. Sinusoidal Circuit Analysis for RL, RC and RLC Circuits. Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth. Passive Filters: Low Pass, High Pass, Band Pass and Band Stop.

Unit-4 (16 Lectures)

Network Theorems: Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem. AC circuit analysis using Network theorems. Two Port Networks: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters.

Suggested books:

1. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004) 2. Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw-Hill.(2005) 3. Robert L. Boylestad,

Essentials of Circuit Analysis, Pearson Education (2004) 4. W. H. Hayt, J. E. Kemmerly, S.
M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill(2005) 5. Alexander and M. Sadiku, Fundamentals of Electric Circuits, McGraw Hill (2008)

Basic Circuit Theory and Network Analysis Lab (Hardware and Circuit Simulation Software) 60 Lectures

1. Familiarization with a) Resistance in series, parallel and series – Parallel. b) Capacitors & Inductors in series & Parallel. c) Multimeter – Checking of components. d) Voltage sources in series, parallel and series – Parallel e) Voltage and Current dividers

2. Measurement of Amplitude, Frequency & Phase difference using CRO. 3. Verification of Kirchoff's Law. 4. Verification of Norton's theorem. 5. Verification of Thevenin's Theorem. 6. Verification of Superposition Theorem. 7. Verification of the Maximum Power Transfer Theorem. 8. RC Circuits: Time Constant, Differentiator, Integrator. 9. Designing of a Low Pass RC Filter and study of its Frequency Response. 10. Designing of a High Pass RC Filter and study of its Frequency Response. 11. Study of the Frequency Response of a Series LCR Circuit and determination of its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.

CC 2: Mathematics Foundation for Electronics (Credits: Theory-04, Practicals-02)

Theory Lectures 60

Unit-1 (16 Lectures)

Ordinary Differential Equations: First Order Ordinary Differential Equations, Basic Concepts, Separable Ordinary Differential Equations, Exact Ordinary Differential Equations, Linear Ordinary Differential Equations. Second Order homogeneous and non-homogeneous Differential Equations. **Series solution of differential equations and special functions:** Power series method, Legendre Polynomials, Frobenius Method, Bessel's equations and Bessel's functions of first and second kind. Error functions and gamma function.

Unit-2 (14 Lectures)

Matrices: Introduction to Matrices, System of Linear Algebraic Equations, Gaussian Elimination Method, Gauss-Seidel Method, LU decomposition, Solution of Linear System by LU decomposition. Eigen Values and Eigen Vectors, Linear Transformation, Properties of Eigen Values and Eigen Vectors, Cayley-Hamilton Theorem, Diagonalization, Powers of a Matrix. Real and Complex Matrices, Symmetric, Skew Symmetric, Orthogonal Quadratic Form, Hermitian, Skew Hermitian, Unitary Matrices.

Unit-3 (14 Lectures)

Sequences and series: Sequences, Limit of a sequence, Convergence, Divergence and Oscillation of a sequence, Infinite series, Necessary condition for Convergence, Cauchy's Integral Test, D'Alembert's Ratio Test, Cauchy's nth Root Test, Alternating Series, Leibnitz's Theorem, Absolute Convergence and Conditional Convergence, Power Series.

Unit-4 (16 Lectures)

Complex Variables and Functions: Complex Variable, Complex Function, Continuity, Differentiability, Analyticity. Cauchy-Riemann (C- R) Equations, Harmonic and Conjugate Harmonic Functions, Exponential Function, Trigonometric Functions, Hyperbolic Functions. Line Integral in Complex Plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Derivative of Analytic Functions. Sequences, Series and Power Series, Taylor's Series, Laurent Series, Zeroes and Poles. Residue integration method, Residue integration of real Integrals.

Suggested Books

1. E. Kreyszig, advanced engineering mathematics, Wiley India (2008)
2. Murray Spiegel, Seymour Lipschutz, John Schiller, Outline of Complex Variables, Schaum Outline Series,Tata McGraw Hill (2007)
3. R. K. Jain, and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House (2007)
4. C .R. Wylie and L. C. Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill (2004) 5. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Limited (2007)

Mathematics Foundation for Electronics Lab (Scilab/MATLAB/ any other Mathematical Simulation software) 60 Lectures

1. Solution of First Order Differential Equations 2. Solution of Second Order homogeneous Differential Equations 3. Solution of Second Order non-homogeneous Differential Equations 4. Convergence of a given series.
5. Divergence of a given series. 6. Solution of linear system of equations using Gauss Elimination method. 7. Solution of linear system of equations using Gauss – Seidel method. 8. Solution of linear system of equations using L-U decomposition method.

CC 3: Semiconductor Devices (Credits: Theory-04, Practicals-02)

Theory

Lectures 60 Unit 1 (14 Lectures)

Semiconductor Basics: Introduction to Semiconductor Materials, Crystal Structure, Planes and Miller Indices, Energy Band in Solids, Concept of Effective Mass, Density of States, Carrier Concentration at Normal Equilibrium in Intrinsic Semiconductors, Derivation of Fermi Level for Intrinsic & Extrinsic Semiconductors, Donors, Acceptors, Dependence of Fermi Level on Temperature and Doping Concentration,

Temperature Dependence of Carrier Concentrations. Carrier Transport Phenomena: Carrier Drift, Mobility, Resistivity, Hall Effect, Diffusion Process, Einstein Relation, Current Density Equation, Carrier Injection, Generation And Recombination Processes, Continuity Equation.

Unit 2 (14 Lectures)

P-N Junction Diode: Formation of Depletion Layer, Space Charge at a Junction, Derivation of Electrostatic Potential Difference at Thermal Equilibrium, Depletion Width and Depletion Capacitance of an Abrupt Junction. Concept of Linearly Graded Junction, Derivation of Diode Equation and I-V Characteristics. Zener and Avalanche Junction Breakdown Mechanism. Tunnel diode, varactor diode, solar cell: circuit symbol, characteristics, applications

Unit 3 (14 Lectures)

Bipolar Junction Transistors (BJT): PNP and NPN Transistors, Basic Transistor Action, Emitter Efficiency, Base Transport Factor, Current Gain, Energy Band Diagram of Transistor in Thermal Equilibrium, Quantitative Analysis of Static Characteristics (Minority Carrier Distribution and Terminal Currents), Base- Width Modulation, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations. Metal Semiconductor Junctions: Ohmic and Rectifying Contacts.

Unit 4 (18 Lectures)

Field Effect Transistors: JFET, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics. MOSFET, types of MOSFETs, Circuit symbols, Working and Characteristic curves of Depletion type MOSFET (both N channel and P Channel) and Enhancement type MOSFET (both N channel and P channel). Complimentary MOS (CMOS). **Power Devices:** UJT, Basic construction and working, Equivalent circuit, intrinsic Standoff Ratio, Characteristics and relaxation oscillator-expression. SCR, Construction,Working and Characteristics, Triac, Diac, IGBT, MESFET, Circuit symbols, Basic constructional features, Operation and Applications.

Suggested Books:

1) S. M. Sze, Semiconductor Devices: Physics and Technology, 2ndEdition, Wiley India edition (2002).
2) Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006) 3) Dennis Le Croissette, Transistors, Pearson Education (1989) 4) Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001) 5) Kanaan Kano, Semiconductor Devices, Pearson Education (2004) 6) Robert F. Pierret, Semiconductor Device Fundamentals, Pearson Education (2006)

Semiconductor Devices Lab (Hardware and Circuit Simulation Software) 60 Lectures

1. Study of the I-V Characteristics of Diode – Ordinary and Zener Diode. 2. Study of the I-V Characteristics of the CE configuration of BJT and obtain $r_{i,}$ $r_{o,}$ β. 3. Study of the I-V Characteristics of the

Common Base Configuration of BJT and obtain $r_{i,}$ $r_{o,}$ α. 4. Study of the I-V Characteristics of the Common Collector Configuration of BJT and obtain voltage gain, ri, $r_{o.}$ 5. Study of the I-V Characteristics of the UJT. 6. Study of the I-V Characteristics of the SCR. 7. Study of the I-V Characteristics of JFET. 8. Study of the I-V Characteristics of MOSFET. 9. Study of Characteristics of Solar Cell 10. Study of Hall Effect.

CC 4: Applied Physics (Credits: Theory- 04, Practicals-02)

Theory Lectures 60

Unit-1 (19 Lectures)

Quantum Physics: Inadequacies of Classical physics. Compton's effect, Photo-electric Effect, Wave-particle duality, de Broglie waves. Basic postulates and formalism of quantum mechanics: probabilistic interpretation of waves, conditions for physical acceptability of wave functions. Schrodinger wave equation for a free particle and in a force field (1 dimension), Boundary and continuity conditions. Operators in Quantum Mechanics, Conservation of probability, Time-dependent form, Linearity and superposition, Operators, Time-independent one dimensional Schrodinger wave equation, Stationary states, Eigen-values and Eigen functions. Particle in a one-dimensional box, Extension to a three dimensional box, Potential barrier problems, phenomenon of tunneling. Kronig Penney Model and development of band structure. Spherically symmetric potentials, the Hydrogen-like atom problem.

Unit-2 (11 Lectures)

Mechanical Properties of Materials: Elastic and Plastic Deformations, Hooke's Law, Elastic Moduli, Brittle and Ductile Materials, Tensile Strength, Theoretical and Critical Shear Stress of Crystals. Strengthening Mechanisms, Hardness, Creep, Fatigue, Fracture.

Unit-3 (15 Lectures)

Thermal Properties: Brief Introduction to Laws of Thermodynamics, Concept of Entropy, Concept of Phonons, Heat Capacity, Debye's Law, Lattice Specific Heat, Electronic Specific Heat, Specific Heat Capacity for Si and GaAs, Thermal Conductivity, Thermoelectricity, Seebeck Effect, Thomson Effect, Peltier Effect.

Unit-4 (15 Lectures)

Electric and Magnetic Properties: Conductivity of metals, Ohm's Law, relaxation time, collision time and mean free path, electron scattering and resistivity of metals, heat developed in current carrying conductor, Superconductivity. Classification of Magnetic Materials, Origin of Magnetic moment, Origin of dia, para, ferro and antiferro magnetism and their comparison, Ferrimagnetic materials, Saturation Magnetisation and Curie temperature, Magnetic domains, Concepts of Giant Magnetic Resistance (GMR), Magnetic recording.

Suggested Books:

1. S. Vijaya and G. Rangarajan, Material Science, Tata Mcgraw Hill (2003)
2. 2. W. E. Callister, Material Science and Engineering: An Introduction, Wiley India (2006)
3. A. Beiser, Concepts of Modern Physics , McGraw-Hill Book Company (1987)
4. A. Ghatak & S. Lokanathan, Quantum Mechanics: Theory and Applications, Macmillan India (2004)

Applied Physics
Lab 60 Lectures

1. To determine Young's modulus of a wire by optical lever method.
2. To determine the modulus of rigidity of a wire by Maxwell's needle.
3. To determine the elastic constants of a wire by Searle's method.
4. To measure the resistivity of a Ge crystal with temperature by four –probe method from room temperature to 200 ^{o}C).
5. To determine the value of Boltzmann Constant by studying
forward characteristics of diode.
6. To determine the value of Planck's constant by using LEDs of at least 4 different wavelengths. 7.
To determine e/m of electron by Bar Magnet or by Magnetic Focusing.

CC 5: Electronics Circuits (Credits: Theory-04, Practicals-02)

Unit- 1 (14 Lectures) **Theory Lectures 60**

Diode Circuits: Ideal diode, piecewise linear equivalent circuit, dc load line analysis, Quiescent (Q) point. Clipping and clamping circuits. Rectifiers: HWR, FWR (center tapped and bridge). Circuit diagrams, working and waveforms, ripple factor & efficiency, comparison. Filters: types, circuit diagram and explanation of shunt capacitor filter with waveforms. Zener diode regulator circuit diagram and explanation for load and line regulation, disadvantages of Zener diode regulator.

Unit- 2 (15 Lectures)

Bipolar Junction Transistor: Review of CE, CB Characteristics and regions of operation. Hybrid parameters. Transistor biasing, DC load line, operating point, thermal runaway, stability and stability factor, Fixed bias without and with RE, collector to base bias, voltage divider bias and emitter bias (+VCC and –VEE bias), circuit diagrams and their working. Transistor as a switch, circuit and working**,** Darlington pair and its applications. BJT amplifier (CE), dc and ac load line analysis, hybrid model of CE configuration, Quantitative study of the frequency response of a CE amplifier, Effect on gain and bandwidth for Cascaded CE amplifiers (RC coupled).

Unit- 3 (13 Lectures)

Feedback Amplifiers: Concept of feedback, negative and positive feedback, advantages and disadvantages of negative feedback, voltage (series and shunt), current (series and shunt) feedback amplifiers, gain, input and output impedances . Barkhausen criteria for oscillations, Study of phase shift oscillator, Colpitts oscillator and Hartley oscillator.

Unit- 4 (18 Lectures)

MOSFET Circuits: Review of Depletion and Enhancement MOSFET, Biasing of MOSFETs, Small Signal Parameters, Common Source amplifier circuit analysis, CMOS circuits. **Power Amplifiers:** Difference between voltage and power amplifier, classification of power amplifiers, Class A, Class B, Class C and their comparisons. Operation of a Class A single ended power amplifier. Operation of Transformer coupled Class A power amplifier, overall efficiency. Circuit operation of complementary symmetry Class B push pull power amplifier, crossover distortion, heat sinks. **Single tuned amplifiers**: Circuit diagram, Working and Frequency Response for each, Limitations of single tuned amplifier, Applications of tuned amplifiers in communication circuits.

Suggested Books:

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition, 2013, PHI
2. Electronic devices, David A Bell, Reston Publishing Company 3. D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002) 4. Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002) 5. J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
6. J. R. C. Jaegar and T. N. Blalock, Microelectronic Circuit Design, Tata McGraw Hill (2010) 7. J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill (1991) 8. Allen Mottershed, Electronic Devices and Circuits, Goodyear Publishing Corporation

Electronics Circuits Lab (Hardware and Circuit

Simulation Software) 60 Lectures

1. Study of the half wave rectifier and Full wave rectifier.
2. Study of power supply using C filter and Zener diode.
3. Designing and testing of 5V/9 V DC regulated power supply and find its load-regulation
4. Study of clipping and clamping circuits .
5. Study of Fixed Bias, Voltage divider and Collector-to-Base bias Feedback configuration for transistors.
6. Designing of a Single Stage CE amplifier.
7. Study of Class A, B and C Power Amplifier.
8. Study of the Colpitt's Oscillator.
9. Study of the Hartley's Oscillator.
10. Study of the Phase Shift Oscillator
11. Study of the frequency response of Common Source FET amplifier.

CC 6: Digital Electronics and Verilog/VHDL (Credits: Theory-04, Practicals-02)

Theory Lectures 60

Unit-1 (11 Lectures)

Number System and Codes: Decimal, Binary, Hexadecimal and Octal number systems, base conversions, Binary, octal and hexadecimal arithmetic (addition, subtraction by complement method, multiplication), representation of signed and unsigned numbers, Binary Coded Decimal code. **Logic Gates and Boolean algebra**: Introduction to Boolean Algebra and Boolean operators, Truth Tables of OR, AND, NOT, Basic postulates and fundamental theorems of Boolean algebra, Truth tables, construction and symbolic representation of XOR, XNOR, Universal (NOR and NAND) gates. **Digital Logic families**: Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Speed power product, TTL and CMOS families and their comparison.

Unit-2 (13 Lectures)

Combinational Logic Analysis and Design: Standard representation of logic functions (SOP and POS), Karnaugh map minimization, Encoder and Decoder, Multiplexers and Demultiplexers, Implementing logic functions with multiplexer, binary Adder, binary subtractor, parallel adder/subtractor.

Unit-3 (18 Lectures)

Sequential logic design: Latches and Flip flops , S-R Flip flop, J-K Flip flop, T and D type Flip flop, Clocked and edge triggered Flip flops, master slave flip flop, Registers, Counters (synchronous and asynchronous and modulo-N), State Table, State Diagrams, counter design using excitation table and equations. , Ring counter

and Johnson counter. **Programmable Logic Devices:** Basic concepts- ROM, PLA, PAL, CPLD, FPGA

Unit-4 (18 Lectures)

Introduction to Verilog: A Brief History of HDL, Structure of HDL Module, Comparison of VHDL and Verilog, Introduction to Simulation and Synthesis Tools, Test Benches. Verilog Modules, Delays, data flow style, behavioral style, structural style, mixed design style, simulating design. Introduction to Language Elements, Keywords, Identifiers, White Space Characters, Comments, format, Integers, reals and strings.
Logic Values, Data Types-net types, undeclared nets, scalars and vector nets, Register type, Parameters. Expressions, Operands, Operators, types of Expressions **Data flow Modeling and Behavioral Modeling:** Data flow Modeling: Continuous assignment, net declaration assignments, delays, net delays. Behavioral Modeling: Procedural constructs, timing controls, block statement, procedural assignments, conditional statement, loop statement, procedural continuous assignment. **Gate level modeling** - Introduction, built in Primitive Gates, multiple input gates, Tri-state gates, pull gates, MOS switches, bidirectional switches, gate delay, array instances, implicit nets, Illustrative Examples (both combinational and sequential logic circuits).

OR

Introduction to VHDL: A Brief History of HDL, Structure of HDL Module, Comparison of VHDL and Verilog, Introduction to Simulation and Synthesis Tools, Test Benches. VHDL Modules, Delays, data flow style, behavioral style, structural style, mixed design style, simulating design. Introduction to Language Elements, Keywords, Identifiers, White Space Characters, Comments, format. VHDL terms, describing hardware in VHDL, entity, architectures, concurrent signal assignment, event scheduling, statement concurrency, structural designs, sequential behavior, process statements, process declarative region, process statement region, process execution, sequential statements, architecture selection, configuration statements, power of configurations. **Behavioral Modeling**: Introduction to behavioral modeling, inertial delay, transport delay , inertial delay model, transport delay model, transport vs inertial delay, simulation delta drivers, driver creation, generics, block statements, guarded blocks. **Sequential Processing:** Process statement, sensitivity list, signal assignment vs variable assignment, sequential statements, IF, CASE ,LOOP, NEXT, ,EXIT and ASSERT statements, assertion BNF, WAIT ON signal, WAIT UNTIL expression, WAIT FOR time expression, multiple wait conditions, WAIT Time-Out, Sensitivity List vs WAIT Statement
Concurrent Assignment, Passive Processes. **Data types:** Object types-signal, variable, constant, Data types –scalar types, composite types, incomplete types, File Type caveats, subtypes, Subprograms and functions

Suggested Books:

1. M. Morris Mano Digital System Design, Pearson Education Asia, (Fourth Edition)
2. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
3. W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India(2000)
4. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)
5. A Verilog HDL Primer – J. Bhasker, BSP, 2003 II Edition.
6. Verilog HDL-A guide to digital design and synthesis-Samir Palnitkar, Pearson, 2nd edition.

Digital Electronics and Verilog/VHDL Lab (Hardware and Circuit Simulation Software) 60 lectures

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. To convert a Boolean expression into logic gate circuit and assemble it using logic gate IC's.
3. Design a Half and Full Adder.
4. Design a Half and Full Subtractor.
5. Design a seven segment display driver.
6. Design a 4 X 1 Multiplexer using gates.
7. To build a Flip- Flop Circuits using elementary gates. (RS, Clocked RS, D-type).
8. Design a counter using D/T/JK Flip-Flop.
9. Design a shift register and study Serial and parallel shifting of data.

Experiments in Verlog/VHDL

1. Write code to realize basic and derived logic gates.
2. Half adder, Full Adder using basic and derived gates.
3. Half subtractor and Full Subtractor using basic and derived gates. 4. Clocked D FF, T FF and JK FF (with Reset inputs).
5. Multiplexer (4x1, 8x1) and Demultiplexer using logic gates.
6. Decoder (2x4, 3x8), Encoders and Priority Encoders.
7. Design and simulation of a 4 bit Adder. 8. Code converters (Binary to Gray and vice versa). 9. 2 bit Magnitude comparator. 10. 3 bit Ripple counter.

CC 7: C Programming and Data Structures (Credits: Theory-04, Practicals-02)

Theory Lectures 60

Unit- 1 (12 Lectures)

C Programming Language: Introduction, Importance of C, Character set, Tokens, keywords, identifier, constants, basic data types, variables: declaration & assigning values. Structure of C program Arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, bit wise operators, expressions and evaluation of expressions, type cast operator, implicit conversions, precedence of operators. Arrays-concepts, declaration, accessing elements, storing elements, two-dimensional and multi-dimensional arrays. Input output statement and library functions (math and string related functions).

Unit-2 (19 Lectures)

Decision making, branching & looping: Decision making, branching and looping: if, if-else, else-if, switch statement, break, for loop, while loop and do loop. Functions: Defining functions, function arguments and passing, returning values from functions. **Structures:** defining and declaring a structure variables, accessing structure members, initializing a structure, copying and comparing structure variables, array of structures, arrays within structures, structures within structures, structures and functions. Pointers. **Introduction to C++:** Object oriented programming, characteristics of an object-oriented language.

Unit-3 (15 Lectures)

Data Structures: Definition of stack, array implementation of stack, conversion of infix expression to prefix, postfix expressions, evaluation of postfix expression. Definition of Queue, Circular queues, Array implementation of queues. Linked List and its implementation, Link list implementation of stack and queue, Circular and doubly linked list.

Unit-4 (14 Lectures)

Searching and sorting: Insertion sort, selection sort, bubble sort, merge sort, linear Search, binary search. **Trees :** Introduction to trees, Binary search tree, Insertion and searching in a BST, preorder, postorder and inorder traversal (recursive)

Suggested Books:

1. Yashavant Kanetkar, Let Us C , BPB Publications
2. Programming in ANSI C, Balagurusamy, 2nd edition, TMH.
3. Byron S Gottfried, Programming with C , Schaum Series
4. Brian W. Kernighan, Dennis M. Ritchie, The C Programming Language, Prentice Hall
5. Yashavant Kanetkar, Pointers in C, BPB Publications
6. S. Sahni and E. Horowitz, “Data Structures”, Galgotia Publications
7. Tanenbaum: “Data Structures using C”, Pearson/PHI.
8. Ellis Horowitz and Sartaz Sahani “Fundamentals of Computer Algorithms”, Computer Science Press.

C Programming and Data Structures Lab
60 Lectures

1. Generate the Fibonacci series up to the given limit N and also print the number of elements in the series.
2. Find minimum and maximum of N numbers.
3. Find the GCD of two integer numbers.
4. Calculate factorial of a given number.
5. Find all the roots of a quadratic equation $Ax^2 + Bx + C = 0$ for non – zero coefficients A, B and C. Else report error.
6. Calculate the value of sin (x) and cos (x) using the series. Also print sin (x) and cos (x) value using

library function.

7. Generate and print prime numbers up to an integer N.
8. Sort given N numbers in ascending order.
9. Find the sum & difference of two matrices of order MxN and PxQ.
10. Find the product of two matrices of order MxN and PxQ.
11. Find the transpose of given MxN matrix.
12. Find the sum of principle and secondary diagonal elements of the given MxN matrix.
13. Calculate the subject wise and student wise totals and store them as a part of the structure.
14. Maintain an account of a customer using classes.
15. Implement linear and circular linked lists using single and double pointers.
16. Create a stack and perform Pop, Push, Traverse operations on the stack using Linear Linked list
17. Create circular linked list having information about a college and perform Insertion at front, Deletion at end.
18. Create a Linear Queue using Linked List and implement different operations such as Insert, Delete, and Display the queue elements.
19. Implement polynomial addition and subtraction using linked lists.
20. Implement sparse matrices using arrays and linked lists.
21. Create a Binary Tree to perform Tree traversals (Preorder, Postorder, Inorder) using the concept of recursion.
22. Implement binary search tree using linked lists. Compare its time complexity over that of linear search.
23. Implement Insertion sort, Merge sort, Bubble sort, Selection sort.

CC 8: Operational Amplifiers and Applications (Credits: Theory-04, Practicals-02)

Theory Lectures 60

Unit-1 (18 Lectures)

Basic Operational Amplifier: Concept of differential amplifiers (Dual input balanced and unbalanced output), constant current bias, current mirror, cascaded differential amplifier stages with concept of level translator, block diagram of an operational amplifier (IC 741)

Op-Amp parameters: input offset voltage, input offset current, input bias current, differential input resistance, input capacitance, offset voltage adjustment range, input voltage range, common mode rejection ratio, slew rate, supply voltage rejection ratio.

Unit-2 (18 Lectures)

Op-Amp Circuits: Open and closed loop configuration, Frequency response of an op-amp in open loop and closed loop configurations, Inverting, Non-inverting, Summing and difference amplifier, Integrator, Differentiator, Voltage to current converter, Current to voltage converter. **Comparators:** Basic comparator, Level detector, Voltage limiters, Schmitt Trigger. **Signal generators:** Phase shift oscillator, Wein bridge oscillator, Square wave generator, triangle wave generator, saw tooth wave generator, and Voltage controlled oscillator(IC 566).

Unit-3 (12 Lectures)

Multivibrators (IC 555): Block diagram, Astable and monostable multivibrator circuit, Applications of Monostable and Astable multivibrators. Phase locked loops (PLL): Block diagram, phase detectors, IC565. **Fixed and variable IC regulators:** IC 78xx and IC 79xx -concepts only, IC LM317- output voltage equation

Unit-4 (12 Lectures)

Signal Conditioning circuits: Sample and hold systems, Active filters: First order low pass and high pass butterworth filter, Second order filters, Band pass filter, Band reject filter, All pass filter, Log and antilog amplifiers.

Suggested Books:

1. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
2. R. F. Coughlin and F. F. Driscoll, Operational amplifiers and Linear Integrated circuits, Pearson Education (2001)
3. J. Millman and C.C. Halkias, Integrated Electronics, Tata McGraw-Hill,(2001)
4. A.P.Malvino, Electronic Principals,6th Edition , Tata McGraw-Hill,(2003)
5. K.L.Kishore,OP-AMP and Linear Integrated Circuits, Pearson(2011)

Operational Amplifiers and Application Lab (Hardware and Circuit Simulation Software) 60 Lectures

1. Study of op-amp characteristics: CMRR and Slow rate.
2. Designing of an amplifier of given gain for an inverting and non-inverting configuration using an op-amp.
3. Designing of analog adder and subtractor circuit.
4. Designing of an integrator using op- amp for a given specification and study its frequency response.

5. Designing of a differentiator using op- amp for a given specification and study its frequency response.
6. Designing of a First Order Low-pass filter using op-amp.
7. Designing of a First Order High-pass filter using op-amp.
8. Designing of a RC Phase Shift Oscillator using op-amp.
9. Study of IC 555 as an astable multivibrator.
10. Study of IC 555 as monostable multivibrator.
11. Designing of Fixed voltage power supply using IC regulators using 78 series and 79 series

CC 9: Signals & Systems
(Credits: Theory-04, Practicals-02)

Theory Lectures
60

Unit-1 (17 Lectures)

Signals and Systems: Continuous and discrete time signals, Transformation of the independent variable, Exponential and sinusoidal signals, Impulse and unit step functions, Continuous-Time and Discrete-Time Systems, Basic System Properties.

Unit-2 (13 Lectures)

Linear Time -Invariant Systems (LTI): Discrete time LTI systems, the Convolution Sum, Continuous time LTI systems, the Convolution integral. Properties of LTI systems, Commutative, Distributive, Associative. LTI systems with and without memory, Invariability, Causality, Stability, Unit Step response. Differential and Difference equation formulation, Block diagram representation of first order systems.

Unit-3 (18 Lectures)

Fourier Series Representation of Periodic Signals: Continuous-Time periodic signals, Convergence of the Fourier series, Properties of continuous-Time Fourier series, Discrete-Time periodic signals, Properties of Discrete-Time Fourier series. Frequency-Selective filters, Simple RC highpass and lowpass filters **Fourier Transform:** Aperiodic signals, Periodic signals, Properties of Continuous-time Fourier transform, Convolution and Multiplication Properties, Properties of Fourier transform and basic Fourier transform Pairs.

Unit-4 (12 Lectures)

Laplace Transform: Laplace Transform, Inverse Laplace Transform, Properties of the Laplace Transform, Laplace Transform Pairs, Laplace Transform for signals, Laplace Transform Methods in Circuit Analysis, Impulse and Step response of RL, RC and RLC circuits.

Suggested Book:

1. V. Oppenheim, A. S. Wilsky and S. H. Nawab, Signals and Systems, Pearson Education (2007)
2. S. Haykin and B. V. Veen, Signal and Systems, John Wiley & Sons (2004)
3. C. Alexander and M. Sadiku, Fundamentals of Electric Circuits , McGraw Hill (2008)
4. H. P. Hsu, Signals and Systems, Tata McGraw Hill (2007)
5. S. T. Karris, Signal and Systems: with MATLAB Computing and Simulink Modelling, Orchard Publications (2008)
6. W. Y. Young, Signals and Systems with MATLAB, Springer (2009)
7. M. Roberts, Fundamentals of Signals and Systems, Tata McGraw Hill (2007)

Signals & Systems Lab (Scilab/MATLAB/ Other Mathematical Simulation software)

60

Lectures

1. Generation of Signals: continuous time
2. Generation of Signals: discrete time
3. Time shifting and time scaling of signals.
4. Convolution of Signals
5. Solution of Difference equations.
6. Fourier series representation of continuous time signals.
7. Fourier transform of continuous time signals.
8. Laplace transform of continuous time signals.
9. Introduction to Xcos/similar function and calculation of output of systems represented by block diagram

CC 10: Electronic Instrumentation (Credits: Theory-04, Practicals- 02)

Theory Lectures 60

Unit-1 (15 Lectures)

Qualities of Measurement: Specifications of instruments, their static and dynamic characteristics, Error (Gross error, systematic error, absolute error and relative error) and uncertainty analysis. Statistical analysis of data and curve fitting. **Basic Measurement Instruments:** PMMC instrument, galvanometer, DC measurement - ammeter, voltmeter, **o**hm meter, AC measurement, Digital voltmeter systems (integrating and non-integrating types), digital multimeters, digital frequency meter system (different modes and universal counter). **Connectors and Probes:** low capacitance probes, high voltage probes, current probes, identifying electronic connectors – audio and video, RF/Coaxial, USB etc.

Unit-2 (15 Lectures)

Measurement of Resistance and Impedance: Low Resistance: Kelvin's double bridge method, Medium

Resistance by Voltmeter Ammeter method, Wheatstone bridge method, High Resistance by Megger. A.C. bridges, Measurement of Self Inductance, Maxwell's bridge, Hay's bridge, and Anderson's bridge, Measurement of Capacitance, Schering's bridge, DeSauty's bridge, Measurement of frequency, Wien's bridge. **A-D and D-A Conversion:** 4 bit binary weighted resistor type D-A conversion, circuit and working. Circuit of R-2R ladder. A-D conversion characteristics, successive approximation ADC. (Mention of relevant ICs for all).

Unit-3 (16 Lectures)

Oscilloscopes: CRT, wave form display and electrostatic focusing, time base and sweep synchronization, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Dual trace oscilloscope,

Sampling Oscilloscope, DSO and Powerscope: Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time). **Signal Generators**: Audio oscillator, Pulse Generator, Function generators.

Unit-4 (14 Lectures)

Transducers and sensors: Classification of transducers, Basic requirement/characteristics of transducers, active & passive transducers, Resistive (Potentiometer, Strain gauge – Theory, types, temperature compensation and applications), Capacitive (Variable Area Type – Variable Air Gap type – Variable Permittivity type), Inductive (LVDT) and piezoelectric transducers. Measurement of displacement, velocity and acceleration (translational and rotational). Measurement of pressure (manometers, diaphragm, bellows), Measurement of temperature (RTD, thermistor, thermocouple, semiconductor IC sensors), Light transducers (photoresistors, photovoltaic cells, photodiodes).

Suggested Books:

1. H. S. Kalsi, Electronic Instrumentaion, TMH(2006)
2. W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice-Hall (2005).
3. Instrumentation Measurement and analysis: Nakra B C, Chaudry K, TMH
4. E.O.Doebelin, Measurement Systems: Application and Design, McGraw Hill Book - fifth Edition(2003).
5. Joseph J Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education (2005)
6. David A. Bell, Electronic Instrumentation and Measurements, Prentice Hall (2013).
7. Oliver and Cage, “Electronic Measurements and Instrumentation”, TMH (2009).
8. Alan S. Morris, “Measurement and Instrumentation Principles”, Elsevier (Buterworth Heinmann- 2008).
9. A. K Sawhney, Electrical and Electronics Measurements and Instrumentation, DhanpatRai and Sons (2007).
10. C. S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).

Electronic Instrumentation Lab 60 Lectures

1. Design of multi range ammeter and voltmeter using galvanometer.
2. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
3. Measurement of Capacitance by de’Sautys.

4. Measure of low resistance by Kelvin's double bridge.
5. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of Strain using half and full bridge.)
6. To determine the Characteristics of LVDT.
7. To determine the Characteristics of Thermistors and RTD.
8. Measurement of temperature by Thermocouples and study of transducers like AD590 (two terminal temperature sensor), PT-100, J- type, K-type.
9. To study the Characteristics of LDR, Photodiode, and Phototransistor:Variable Illumination. (ii) Linear Displacement.
10. Characteristics of one Solid State sensor/ Fiber optic sensor

CC 11: Microprocessor and Microcontrollers (Credits: Theory- 04, Practicals-02)

Theory Lectures 60

Unit-1 (18 Lectures)

Introduction to Microprocessor: Introduction, Applications, Basic block diagram, Speed, Word size, Memory capacity, Classification of microprocessors (mention of different microprocessors being used) **Microprocessor 8085:** Features, Architecture -block diagram, General purpose registers, register pairs, flags, stack pointer, program counter, types of buses. Multiplexed address and data bus, generation of control signals, pin description of microprocessor 8085. Basic interfacing concepts, Memory mapped I/O and I/O mapped I/O. **8085 Instructions:** Operation code, Operand & Mnemonics. Instruction set of 8085, instruction classification, addressing modes, instruction format. Data transfer instructions, arithmetic instructions, increment & decrement instructions, logical instructions, branch instructions and machine control instructions. Assembly language programming examples.

Unit-2 (10 Lectures)

Stack operations, subroutine, call and return instructions. Delay loops, use of counters, timing diagrams-instruction cycle, machine cycle, T- states, time delay. Interrupt structure of 8085A microprocessor, processing of vectored and non-vectored interrupts, latency time and response time; Handling multiple interrupts

Microcontrollers: Introduction, different types of microcontrollers, embedded microcontrollers, processor architectures. Harvard vs. Princeton, CISC vs. RISC architectures, microcontroller memory types, microcontroller features, clocking, I/O pins, interrupts, timers, peripherals.

Unit-3 (18 Lectures)

PIC16F887 Microcontroller: Core features, Architecture, pin diagram, memory organization- Program and data memory organization, I/O Ports, oscillator module, Timer modules (Timer 0, Timer 1 and Timer 2), comparator module, analog-to-digital converter (ADC) module, data EEPROM, Enhanced capture/compare/PWM module , EUSART, master synchronous serial port (MSSP) module, special features of the CPU, interrupts, addressing modes, instruction set.

Unit-4 (14 Lectures)

Interfacing to PIC16F887: LED, Switches, Solid State Relay, Seven Segment Display, 16x2 LCD display, 4x4 Matrix Keyboard, Digital to Analog Converter, Stepper Motor and DC Motor. Interfacing program examples using C language.

Suggested Books:

1. Microprocessor Architecture, Programming and Applications with 8085, Ramesh S.Gaonkar - Wiley Eastern Limited- IV Edition.
2. Fundamentals of Microprocessor & Microcomputer:B. Ram—Danpat Rai Publications.
3. Microchip PIC16F87X datasheet
4. PIC Microcontrollers, Milan Verle, , mikro Elektronika, 1st edition (2008) 5. Muhammad Ali Mazidi, "Microprocessors and Microcontrollers", Pearson, 2006

Microprocessor and Microcontrollers Lab 60 Lectures 8085 Assembly language programs:

1. Program to transfer a block of data. 2. Program for multibyte addition 3. Program for multibyte subtraction 4. Program to multiply two 8-bit numbers. 5. Program to divide a 16 bit number by 8 bit number. 6. Program to search a given number in a given list. 7. Program to generate terms of Fibonacci series. 8. Program to find minimum and maximum among N numbers 9. Program to find the square root of an integer. 10. Program to find GCD of two numbers. 11. Program to sort numbers in ascending/descending order. 12. Program to verify the truth table of logic gates.

PIC Microcontroller Programming Note: Programs to be written using C programming language

1. LED blinking with a delay of 1 second. 2. Solid State Relay Interface 2. Interfacing of LCD (2X16). 3. Interfacing of stepper motor and Rotating stepper motor by N steps clockwise/anticlockwise with

speed control. 4. To test all the gates of a given IC74XX is good or bad. 5. Generate sine, square, saw tooth, triangular and staircase waveform using DAC interface. 6. Display of 4-digit decimal number using the multiplexed 7-segment display interface. 7. Analog to digital conversion using internal ADC and display the result on LCD. 8. Implementation of DC-Volt meter (0-5V) using internal ADC and LCD 9. Digital to analog conversion using PWM (pulse delay to be implemented using timers). 10. Speed control of DC motor using PWM (pulse delay to be implemented using timers). 11. Interfacing of matrix keyboard (4X4). 12. Serial communication between microcontroller and PC.

CC 12: Electromagnetics (Credits: Theory-04, Practicals-02)

Theory Lectures 60

Unit-1 (16 Lectures)

Vector Analysis: Scalars and Vectors, Vector Algebra, Rectangular (Cartesian) Coordinate System, Vector

Components and Unit Vector, Vector Field, Products, Cylindrical Coordinates, Spherical Coordinates, Differential Length, Area and Volume, Line Surface and Volume integrals, Del Operator, Gradient of a Scalar, Divergence and Curl of a Vector, the Laplacian. **Electrostatic Fields:** Coulomb's Law and Electric Field, Field due to Discrete and Continuous Charge Distributions, Electric Flux Density, Gauss's Law and Applications, Divergence Theorem and Maxwell's First Equation. Electric Potential, Potential due to a Charge and Charge distribution, Electric dipole. Electric Fields in Conductors, Current and Current Density, Continuity of Current, Metallic Conductor Properties and Boundary Conditions, Method of Images. Dielectric materials, Polarization, Dielectric Constant, Isotropic and Anisotropic dielectrics, Boundary conditions, Capacitance and Capacitors. Electrostatic Energy and Forces.

Unit- 2 (14 Lectures)

Poisson's Equation and Laplace's Equation: Derivation of Poisson's and Laplace's equation, Uniqueness Theorem, Examples of Solution of Laplace's Equation: Cartesian, Cylindrical and Spherical Coordinates.
Magnetostatics: Biot Savert's law and Applications, Magnetic dipole, Ampere's Circuital Law, Curl and Stoke's Theorem, Maxwell's Equation, Magnetic Flux and Magnetic Flux Density, Scalar and Vector Magnetic Potentials. Magnetization in Materials and Permeability, Anisotropic materials, Magnetic Boundary Conditions, Inductors and Inductances, Magnetic Energy, Magnetic Circuits. Inductances and Inductors, Magnetic Energy, Forces and Torques.

Unit-3 (13 Lectures)

Time-Varying Fields and Maxwell's Equations: Faraday's Law of Electromagnetic Induction, Stationary Circuit in Time-Varying Magnetic Field, Transformer and Motional EMF, Displacement Current, Maxwell's Equations in differential and integral form and Constitutive Relations. Potential Functions, Lorentz gauge and the Wave Equation for Potentials, Concept of Retarded Potentials. Electromagnetic Boundary Conditions.
Time-Harmonic Electromagnetic Fields and use of Phasors

Unit-4 (17 Lectures)

Electromagnetic Wave Propagation: Time-Harmonic Electromagnetic Fields and use of Phasors, the Electromagnetic Spectrum, Wave Equation in a source free isotropic homogeneous media, Uniform Plane Waves in Lossless and Lossy unbounded homogeneous media, Wave Polarization, Phase and Group velocity, Flow of Electromagnetic Power and Poynting Vector. Uniform Plane wave incident on a Plane conductor boundary, concept of reflection and standing wave. **Guided Electromagnetic Wave Propagation:** Waves along Uniform Guiding Structures, TEM, TE and TM waves, Electromagnetic Wave Propagation in Parallel Plate and Rectangular Metallic Waveguides.

Suggested Books:

1. Murray. R. Spiegel, Vector Analysis, Schaum series, Tata McGraw Hill (2006)
2. M. N. O. Sadiku, Elements of Electromagnetics, Oxford University Press (2001)
3. W. H. Hayt and J. A. Buck, Engineering Electromagnetics, Tata McGraw Hill (2006)
4. D. C. Cheng, Field and Wave Electromagnetics, Pearson Education (2001)
5. J. A. Edminster, Electromagnetics, Schaum Series, Tata McGraw Hill (2006)
6. N. Narayan Rao, Elements of Engineering Electromagnetics, Pearson Education (2006)

7. Introduction to Electrodynamics, D.J. Griffiths, Pearson Education (2012)
8. Electromagnetic Wave and Radiating System, Jordan and Balmain, Prentice Hall (1979)

Electromagnetics Lab (using Scilab/ any other similar freeware) **60 Lectures**

1. Understanding and Plotting Vectors.
2. 2. Transformation of vectors into various coordinate systems.
3. 2D and 3D Graphical plotting with change of view and rotation.
4. Representation of the Gradient of a scalar field, Divergence and Curl of Vector Fields.
5. Plots of Electric field and Electric Potential due to charge distributions.
6. Plots of Magnetic Flux Density due to current carrying wire.
7. Programs and Contour Plots to illustrate Method of Images
8. Solutions of Poisson and Laplace Equations – contour plots of charge and potential distributions
9. Introduction to Computational Electromagnetics: Simple Boundary Value Problems by FiniteDifference/Finite Element Methods.

CC 13: Communication Electronics (Credits: Theory-04, Practicals- 02)

Theory Lectures 60

Unit-1 (10 Lectures)

Electronic communication: Block diagram of an electronic communication system, electromagnetic spectrum-band designations and applications, need for modulation, concept of channels and base-band signals. Concept of Noise, Types of Noise, Signal to noise ratio, Noise Figure, Noise Temperature, Friss formula.

Unit-2 (20 Lectures)

Amplitude Modulation: Amplitude Modulation, modulation index and frequency spectrum. Generation of AM, Amplitude Demodulation (diode detector), Concept of Double side band suppressed carrier, Single side band suppressed carrier, other forms of AM (Pilot Carrier Modulation, Vestigial Side Band modulation, Independent Side Band Modulation). Block diagram of AM Transmitter and Receiver

Angle modulation: Frequency and Phase modulation, modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM (direct and indirect methods), FM detector (PLL). Block diagram of FM Transmitter and Receiver Comparison between AM, FM and PM.

Unit -3 (14 Lectures)

Pulse Analog Modulation: Channel capacity, Sampling theorem, PAM, PDM, PPM modulation and detection techniques, Multiplexing, TDM and FDM. **Pulse Code**

Modulation: Need for digital transmission, Quantizing, Uniform and Non- uniform Quantization,

Quantization Noise, Companding, Coding, Decoding, Regeneration.

Unit -4 (16 Lectures)

Digital Carrier Modulation Techniques: Block diagram of digital transmission and reception, Information capacity, Bit Rate, Baud Rate and M-ary coding. Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Binary Phase Shift Keying (BPSK) and Quadrature Phase Shift Keying (QPSK)

Suggested Books:

1. Electronic communication systems- Kennedy, 3rd edition, McGraw international publications 2. Principles of Electronic communication systems – Frenzel, 3rd edition, McGraw Hill 3. Communication Systems, S. Haykin, Wiley India (2006) 4. Advanced electronic communications systems – Tomasi, 6th edition, PHI. 5. Communication Systems, S. Haykin, Wiley India (2006)

Communication Electronics Lab (Hardware and Circuit Simulation Software) 60 Lectures

1. Study of Amplitude Modulation 2. Study of Amplitude Demodulation 3. Study of Frequency Modulation 4. Study of Frequency Demodulation 5. Study of Pulse Amplitude Modulation 6. AM Transmitter/Receiver 7. FM Transmitter/Receiver 8. Study of TDM, FDM 9. Study of Pulse Width Modulation 10. Study of Pulse Position Modulation 11. Study of Pulse Code Modulation 12. Study of Amplitude Shift Keying 13. Study of Phase Shift Keying, 14. Study of Frequency Shift Keying.

CC 14: Photonics (Credits: Theory-04, Practicals-02)

Theory Lectures 60

Unit-1 (22 Lectures)

Light as an Electromagnetic Wave: Plane waves in homogeneous media, concept of spherical waves. Reflection and transmission at an interface, total internal reflection, Brewster's Law. Interaction of electromagnetic waves with dielectrics: origin of refractive index, dispersion. **Interference :** Superposition of waves of same frequency, Concept of coherence, Interference by division of wavefront, Young's double slit, Division of Amplitude, thin film interference, anti-reflecting films, Newton's rings; Michelson interferometer. Holography. **Diffraction:** Huygen Fresnel Principle, Diffraction Integral, Fresnel and Fraunhoffer approximations. Fraunhoffer Diffraction by a single slit, rectangular aperture, double slit, Resolving power of microscopes and telescopes; Diffraction grating: Resolving power and Dispersive power

Unit-2 (13 Lectures)

Polarization: Linear, circular and elliptical polarization, polarizer-analyzer and Malus' law; Double refraction by crystals, Interference of polarized light, Wave propagation in uniaxial media. Half wave and quarter wave plates. Faraday rotation and electro-optic effect.

Unit-3 (13 Lectures)

Light Emitting Diodes: Construction, materials and operation. **Lasers:** Interaction of radiation and matter, Einstein coefficients, Condition for amplification, laser cavity, threshold for laser oscillation, line shape function. Examples of common lasers. The semiconductor injection laser diode. **Photodetectors:** Bolometer, Photomultiplier tube, Charge Coupled Device. Photo transistors and Photodiodes (p-i-n, avalanche), quantum efficiency and responsivity. **LCD Displays:** Types of liquid crystals, Principle of Liquid Crystal Displays, applications, advantages over LED displays.

Unit-4 (12 Lectures)

Guided Waves and the Optical Fiber: TE and TM modes in symmetric slab waveguides, effective index, field distributions, Dispersion relation and Group Velocity. Step index optical fiber, total internal reflection, concept of linearly polarized waves in the step index circular dielectric waveguides, single mode and multimode fibers, attenuation and dispersion in optical fiber.

Suggested Books:

1. Ajoy Ghatak, Optics, Tata McGraw Hill, New Delhi (2005)
2. E. Hecht, Optics, Pearson Education Ltd. (2002)
3. J. Wilson and J. F. B. Hawkes, Optoelectronics: An Introduction, Prentice Hall India (1996)
4. S. O. Kasap, Optoelectronics and Photonics: Principles and Practices, Pearson Education (2009)
5. Ghatak A.K. and Thyagarajan K., "Introduction to fiber optics," Cambridge Univ. Press. (1998)

Photonics Lab 60 Lectures

1. To verify the law of Malus for plane polarized light.
2. To determine wavelength of sodium light using Michelson's Interferometer.
3. To determine wavelength of sodium light using Newton's Rings.
4. To determine the resolving power and Dispersive power of Diffraction Grating.
5. Diffraction experiments using a laser.
6. Study of Faraday rotation.
7. Study of Electro-optic Effect.
8. To determine the specific rotation of scan sugar using polarimeter.
9. To determine characteristics of LEDs and Photo- detector.
10. To measure the numerical aperture of an optical fiber.

DSE 1: Power Electronics (Credits: Theory-04, Practicals-02)

Theory Lectures 60

Unit- 1 (12 Lectures)

Power Devices: Need for semiconductor power devices, Power diodes, Enhancement of reverse blocking capacity, Introduction to family of thyristors. **Silicon Controlled Rectifier (SCR)**: structure, I-V characteristics, Turn-On and Turn-Off characteristics, ratings, Factors affecting the characteristics/ratings of SCR, Gate-triggering circuits, Control circuits design and Protection circuits, Snubber circuit.

Unit- 2 (14 Lectures)

Diac and Triac: Basic structure, working and V-I characteristic of, application of a Diac as a triggering device for a Triac. **Insulated Gate Bipolar Transistors (IGBT)**: Basic structure, I-V Characteristics, switching characteristics, device limitations and safe operating area (SOA) etc. **Application of SCR:** SCR as a static switch, phase controlled rectification, single phase half wave, full wave and bridge rectifiers with inductive & non- inductive loads; AC voltage control using SCR and Triac as a switch. **Power MOSFETs**: operation modes, switching characteristics, power BJT, second breakdown, saturation and quasi-saturation state.

Unit- 3 (17 Lectures)

Power Inverters: Need for commutating circuits and their various types, d.c. link invertors, Parallel capacitor commutated invertors with and without reactive feedback and its analysis, Series Invertor, limitations and its improved versions, bridge invertors. **Choppers:** basic chopper circuit, types of choppers(Type A-D), step-down chopper, step-up chopper, operation of d.c. chopper circuits using self commutation (A & B-type commutating circuit), cathode pulse turn-off chopper(using class D commutation), load sensitive cathode pulse turn-off chopper (Jones Chopper), Morgan's chopper

Unit- 4 (17 Lectures)

Electromechanical Machines: DC Motors, Basic understanding of field and armature, Principle of operation, EMF equation, Back EMF, Factors controlling motor speed, Thyristor based speed control of dc motors, AC motor (Induction Motor only), Rotor and stator, torque & speed of induction motor, Thyristor control of ac motors(block diagrams only)

Suggested Books:

1. Power Electronics, P.C. Sen, TMH
2. Power Electronics & Controls, S.K. Dutta
3. Power Electronics, M.D. Singh & K.B. Khanchandani, TMH
4. Power Electronics Circuits, Devices and Applications, 3rd Edition, M.H. Rashid, Pearson Education
5. Power Electronics, Applications and Design, Ned Mohan, Tore.
6. Power Electronics, K. HariBabu, Scitech Publication.
7. Power Electronics, M.S. Jamil Asghar, PHI.
8. A Textbook of Electrical Technology-Vol-II, B.L. Thareja, A.K. Thareja, S.Chand

Power Electronics Lab 60 Lectures

1. Study of I-V characteristics of DIAC
2. Study of I-V characteristics of a TRIAC
3. Study of I-V characteristics of a SCR
4. SCR as a half wave and full wave rectifiers with R and RL loads
5. DC motor control using SCR.
6. DC motor control using TRIAC.
7. AC voltage controller using TRIAC with UJT triggering.
8. Study of parallel and bridge inverter.
9. Design of snubber circuit
10. VI Characteristic of MOSFET and IGBT (Both)
11. Study of chopper circuits

DSE 2: Digital Signal Processing
(Credits: Theory-04, Practicals-02)

Theory Lectures 60

Unit- 1 (15 Lectures)

Discrete Time systems: Discrete sequences, linear coefficient difference equation, Representation of DTS, LSI Systems. Stability and causality, frequency domain representations and Fourier transform of DT sequences.

Unit- 2 (15 Lectures)

Z-Transform: Definition and properties, Inverse Z Transform and stability. Parsevals Theorem and applications. **System Function**: signal flow graph, its use in representation and analysis of Discrete Time Systems. Techniques of representations. Matrix generation and solution for DTS evaluations.

Unit- 3 (15 Lectures)

Discrete Fourier Transform: DFT assumptions and Inverse DFT. Matrix relations, relationship with

FT and its inverse, circular convolution, DFT theorems, DCT. Computation of DFT. FFT Algorithms and processing gain, Discrimination, interpolation and extrapolation. Gibbs phenomena. FFT of real functions interleaving and resolution improvement. Word length effects.

Unit- 4 (15 Lectures)

Digital Filters: Analog filter review. System function for IIR and FIR filters, network representation. Canonical and decomposition networks. IIR filter realization methods and their limitations. FIR filter realization techniques. Discrete correlation and convolution; Properties and limitations.

Suggested Books:

1. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
2. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall, 1997.

Digital Signal Processing Lab (Scilab/MATLAB/Other Mathematical Simulation software) 60 Lectures

1. Generation of unit sample sequence, unit step, ramp function, discrete time sequence, real sinusoidal sequence.
2. Generate and plot sequences over an interval.
3. Given x[n], write program to find X[z].
4. Fourier Transform, Discrete Fourier Transform and Fast Fourier Transform
5. Design of a Butterworth analog filter for low pass and high pass.
6. Design of digital filters.

DSE 3: Computer Networks
(Credits: Theory-04, Practicals-02)

Theory Lectures 60

Unit- I (15 Lectures)

Data Communications: Components, protocols and standards,Network and Protocol Architecture, Reference Model ISO-OSI, TCP/IP-Overview ,topology, transmission mode, digital signals, digital to digital encoding, digital data transmission, DTE-DCE interface, interface standards, modems, cable modem, transmission media- guided and unguided, transmission impairment, Performance, wavelength and Shannon capacity. Review of Error Detection and Correction codes. **Switching:** Circuit switching (space-division, time division and space-time division), packet switching (virtual circuit and Datagram approach), message switching.

Unit-2 (15 Lectures)

Data Link Layer: Design issues, Data Link Control and Protocols: Flow and Error Control, Stop-and-wait ARQ. Sliding window protocol, Go-Back-N ARQ, Selective Repeat

ARQ, HDLC, Point-to –Point Access: PPP Point –to- Point Protocol, PPP Stack, **Medium Access Sub layer:** Channel allocation problem, Controlled Access, Channelization, multiple access protocols, IEEE standard 802.3 & 802.11 for LANS and WLAN, high- speed LANs, Token ring, Token Bus, FDDI based LAN, Network Devices-repeaters, hubs, switches bridges.

Unit-3 (15 Lectures)

Network Layer: Design issues, Routing algorithms, Congestion control algorithms, Host to Host Delivery: Internetworking, addressing and routing, IP addressing (class full & Classless), Subnet, Network Layer Protocols: ARP, IPV4, ICMP, IPV6, ICMPV6.

Unit- 4 (15 Lectures)

Transport Layer: Process to Process Delivery: UDP; TCP, congestion control and Quality of service.
Application Layer: Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail (SMTP), file transfer (FTP), HTTP and WWW.

Suggested Books:

1. S. Tannenbum, D. Wetherall, "Computer Networks", Prentice Hall, Pearson, 5th Ed 2. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill, 4th Ed

Computer Networks Lab 60 Lectures

1. Introduction to Computer Network laboratory Introduction to Discrete Event Simulation Discrete Event Simulation Tools - ns2/ns3, Omnet++
2. Using Free Open Source Software tools for network simulation of telnet and ftp between N sources - N sinks (N = 1, 2, 3). Evaluate the effect of increasing data rate on congestion.
3. Using Free Open Source Software tools for network simulation to study the effect of queuing disciplines on network performance - Random Early Detection/Weighted RED / Adaptive RED.
4. Using Free Open Source Software tools for network simulation for http, ftp and DBMS access in networks
5. Using Free Open Source Software tools for network simulation to study effect of VLAN on network performance - multiple VLANs and single router.
6. Using Free Open Source Software tools for network simulation to study effect of VLAN on network performance - multiple VLANs with separate multiple routers.
7. Using Free Open Source Software tools for network simulation to study the performance of wireless networks

BACHELOR OF SCIENCE(ITM)

SEMESTER-I

C:1-PROGRAMMING USING C

(Credit:6, Theory:4, Practical: 2)

UNIT- I

Introduction to Programming Language, Introduction to C Programming, Character Set, C Tokens, Keywords & Identifiers, Constants, Variables, Data Types, Variables, Storage Classes, Operators (Arithmetic, Relational, Logical, Assignment, Increment & Decrement, Conditional, Bitwise), Expressions, Input and Output Operations.

UNIT- II

Decision Making and Branching: Simple IF Statement, IF. ELSE Statement, Nesting IF. ELSE Statement, ELSE IF Ladder, Switch Statement, Operator, GOTO Statement. Decision Making and Looping: The WHILE Statement, The DO Statement, The FOR Statement, Jumps in LOOPS. Arrays, Character Arrays and Strings.

UNIT- III

User-defined Functions: Need, Elements & Definition, Function Calls, Function Definition, Cate- gory of Functions, Recursion. Structures and Unions: Defining, Declaring, Accessing, Initialization Structure, Arrays of Structures, Arrays within Structures, Structures and Functions, Unions.

UNIT- IV

Pointers: Accessing the Address of a Variable, Declaring Pointer Variables, Initializations of Pointer Variable, Accessing a Variable through its Pointer, Chain of Pointers, Pointer Expressions, Pointer Increments and Scale Factor, Pointers and Arrays, Pointers and Character Strings, Array of Pointers, Pointers as Function Arguments, Functions Returning Pointers, Pointers to Functions, Pointers to Structures, Troubles with Pointers.

UNIT- V

File Management in C: Defining and Opening a File, Closing a File, Input/ Output Operations on Files, Error Handling During I/O Operations, Random Access to Files, Command Line Arguments, Dynamic Memory Allocation.

Recommended Books:

1. E. Balaguruswamy, Programming in ANSI C,4/e, (TMH).
2. Paul Deitel, Harvey Deitel, C: How to Program, 8/e, Prentice Hall.
3. J. R. Hanly, Problem Solving & Program Design in C, 7/e, Pearson.
4. B. Kernighan & D.M. Ritche, The C Programming Language, 2/e PHI.

C: 2-COMPUTER ORGANIZATION

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Character Codes, Decimal System, Binary System, Decimal to Binary Conversion, Hexadecimal Notation, Boolean Algebra, Basic Logic Functions: Electronic Logic Gates, Synthesis of Logic Functions, Minimization of Logic Expressions, Minimization using Karnaugh Maps, Synthesis with NAND and NOR Gates.

UNIT-II

Flip-Flops, Gated Latches, Master-Slave Flip-Flops, Edge-Triggering, T Flip-Flops, JK Flip-Flops.

Registers and Shift Registers, Counters, Decoders, Multiplexers, Programmable Logic Devices (PLDs), Programmable Array Logic (PAL), Complex Programmable Logic Devices (CPLDs), Field-Programmable Gate Array (FPGA), Sequential Circuits, Timing Diagrams, The Finite State Machine Model, Syn- thesis of Finite State Machines.

UNIT-III

Basic Structure of Computers: Computer Types, Functional Units, Input Unit, Memory Unit, Arithmetic and Logic Unit, Output Unit, Control Unit, Basic Operational Concepts, Bus Structures, Software. Machine Instructions and Programs: Numbers, Arithmetic Operations, and Characters: Number Representation, Addition of Positive Numbers, Addition and Subtraction of Signed Numbers, Overflow of Integer Arithmetic, Characters, Memory Locations and Addresses, Byte Address ability, Word Alignment, Accessing Numbers, Characters, and Character Strings, Memory Operations, Instructions and Instruction Sequencing, Register Transfer Notation, Basic Instruction Types, Instruction Execution and Straight-Line Sequencing, Branching, Condition Codes, Generating Memory Addresses, Addressing Modes, Implementation of Variables and Constants, Indirection and Pointers, Indexing and Arrays, Relative Addressing.

UNIT-IV

THE ARM EXAMPLE: Registers, Memory Access, and Data Transfer, Register Structure, Mem- ory Access Instructions and Addressing Modes, Register Move Instructions, Arithmetic and Logic Instructions: Arithmetic Instructions, Logic Instructions, Branch Instructions, Setting Condition Codes, Assembly Language, Psedo-Instructions, I/O Operations, Subroutines, Vector Dot Product Program, Byte-Sorting Program, Linked-List Insertion and Deletion Subroutines. Basic Input-Output Operations, Stacks and Queues, Subroutines. PowerPC Example: Basic PowerPC Processor Organization, Load and Store Instructions, Arithmetic and Logic Instructions, Flow Control Instructions, Compare Instructions, Logic Instructions, Subroutines.

UNIT-V

Memory System: Semiconductor RAM Memories, Internal Organization of Memory Chips, Static Memories, Asynchronous DRAMS, Synchronous DRAMS, Structure of Large Memories, Memory System Considerations, RAMBUS Memory. Read-Only Memories: ROM, PROM, EPROM, EEP- ROM, Flash Memory, Speed, Size, and Cost of Memory. Secondary Storage: Magnetic Hard Disks, Optical Disks, Magnetic Tape Systems.

Recommended Books:

1. Carl Hamacher, Z. Vranesic, S. Zaky: Computer Organization, 5/e (TMH)
2. William Stallings: Computer Organization and Architecture (Design for Performance), 9/e
3. S. Brown, & Z. Vranesic, Fundamentals of Digital Logic Design with VHDL, 2/e, McGraw-Hill
4. J. P. Uyemura, A First Course in Digital System Design, An Integrated Approach, Cengage Learning.

GE:1-DISCRETE STRUCTURES

(Credit:6, Theory:4, Practical: 2)

UNIT-I Logic and Proofs: Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Normal Forms, Proof Methods and Strategy, Mathematical Induction, Strong Induction and Well-Ordering, Recursive Definitions and Structural Induction, Recursive Algorithms.

UNIT-II

Basic Structures: Sets, Set Operations, Functions, Recursive Functions, Sequences and Summations. Relations: Relations and their Properties, n-ary Relations and their Applications, Representing Relations, Closures of Relations, Equivalence Relations, Partial Ordering. Boolean.

UNIT-III

Algebra: Boolean Functions, Representing Boolean Functions, Logic Gates, Minimization of Circuits. Algebraic Structures & Coding Theory: The Structure of Algebras, Semi-groups, Monoids and Groups, Homomorphism, Normal Subgroups, and Congruence Relations, Rings, Integral Domains and Fields, Quotient and Product Algebras, Coding Theory. Polynomial Rings and Polynomial Codes.

UNIT-IV

Counting: Basics of Counting, The Pigeonhole Principle, Permutations and Combinations, Binomial Coefficients, Generalized Permutations and Combinations, Generating Permutations and Combinations. Advanced Counting Techniques, Applications of Inclusion-Exclusion, Discrete probability, Conditional probability, Bayes Theorem.

UNIT-V

Graphs: Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Havel-Hakimi Theorem, Representing Graphs and Graph Isomorphism, Connectivity, Cut-Sets, Euler and Hamiltonian Paths, Shortest-Path Problem, Planar Graphs, Graph Coloring, Network Flows.

Recommended Books:

1. Kenneth H Rosen, Discrete Mathematics & Its Applications, McGraw-Hill. 7/e.
2. J. L. Hein, Discrete Structures, Logic, and Computability, 3rd Edition, Jones and Bartlett Publishers, 2009
3. C.L. Liu , D.P. Mahopatra, Elements of Discrete mathematics, 2nd Edition , Tata McGraw Hill, 1985
4. M. O. Albertson and J. P. Hutchinson, Discrete Mathematics with Algorithms , John wiley Publication, 1988.

SEMESTER-II

C: 3-PERSONAL MANAGEMENT & ORGANIZATIONAL BEHAVIOUR

(Credit:6, Theory:4, Practical: 2)

C: 4-PROGRAMMING USING C++

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Principles of Object-Oriented Programming: Object-Oriented Programming (OOP) Paradigm, Basic Concepts of OOP, Benefits of OOP, Object Oriented Languages, Applications of OOP. Beginning with C++: Applications of C++, C++ statements, Example with Class, Structure of C++ Program, Creating the Source File, Compiling and Linking. Tokens, Expressions and Control Structures: To- kens, Keywords, Identifiers & Constants, Basic Data Types, User-Defined Data Types, Derived Data Types, Symbolic Constants, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Operators in C++, Scope Resolution Operator, Member Deferencing Operators, Memory Management Operators, Manipulators, Type Cast Operators, Expressions and their Types, Special Assignment Expressions, Implicit Conversions, Operator Overloading, Operator Precedence, Control Structures.

UNIT- II

Functions in C++: The Main Function, Function Prototyping, Call By Reference, Return by Ref- erence, Inline Functions, Default Arguments, Const. Arguments, Function Overloading, Friend & Virtual Functions, Math. Library Functions. Classes and Objects: Specifying a Class, Defining Member Functions, Making an outside Function Inline, Nested Member Functions, Private Member Functions, Arrays within a Class, Memory Allocation for Objects, Static Data Members, Static Mem- ber Functions, Arrays of Objects, Objects as Function Arguments, Friendly Functions, Returning Objects, Cons. Member Functions, Pointer to Members, Local Classes.

UNIT- III

Constructors & Destructors: Constructors, Parameterized Constructors, Multiple Constructors in a Class, Constructors with Default Arguments, Dynamic Initialization of Objects, Copy Construc- tor, Dynamic Constructors, Constructing Two-Dimensional Arrays, Const. Objects, Destructors. Operator Overloading and Type Conversions: Defining Operator Overloading, Overloading Unary Operators, Overloading Binary Operators, Overloading Binary Operators using Friends, Manipulation of Strings using Operators, Rules for Overloading Operators, Type Conversions.

UNIT- IV

Inheritance : Defining Derived Classes, Single Inheritance, Making a Private Member Inheritance, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance, Virtual Base Classes, Abstract Classes, Constructors in Derived Classes, Member Classes, Nesting of Classes. Pointers, Virtual Functions and Polymorphism: Pointers, Pointers to Objects, this Pointer, Pointers to Derived Classes, Virtual Functions, Pure Virtual Functions.

UNIT- V

Managing Console I/O Operations: C++ Streams, C++ Stream Classes, Unformatted I/OOpera- tions, Formatted Console I/O Operations, Managing Output with Manipulators. Files: Classes for File Stream Operations, Opening and Closing a File, Detecting end-of-file, File Modes, File Pointers and their Manipulations, Sequential Input and Output Operations, Updating a File: Random Access, Error Handling During File Operations, Command-line Arguments.

Recommended Books:

1. E. Balgurusamy, Object Oriented Programming with C++ :, 4/e (TMH).
2. Paul Deitel, Harvey Deitel, ”C++: How to Program”,9/e. Prentice Hall.
3. J. Farrell, Object-Oriented Programming, Cengage Learning.
4. BjarneStroustroup, ”Programming – Principles and Practice using C++”, 2/e,Addison-Wesley 2014.

C: 5-DATA STRUCTURES

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Introduction and Overview: Definitions, Concept of Data Structures, Overview of Data Struc- tures, Implementation of Data Structures. Arrays: Terminology, One-Dimensional Array, Multi-Dimensional Arrays, Pointer Arrays.

UNIT-II

Linked Lists: Single Linked List, Circular Linked List, Double Linked List, Circular Double Linked List, Application of Linked Lists, Memory Representation, Boundary Tag System, De-allocation Strategy, Buddy System, Compaction.

UNIT-III

Stacks: Definition, Representation of Stack (Array, Linked List), Operations on Stacks, Applications of Stack (Evaluation of Arithmetic Expressions, Code Generation, Implementation of Recursion, Factorial Calculation, Quick Sort, Tower of Hanoi, Activation Record Management).

UNITIV

Queues: Definition, Representation of Queues (Array, Linked List), Circular Queue, Deque, Priority Queue, Application of Queues (Simulation, CPU Scheduling in Multiprogramming Environment, Round Robin Algorithm).

UNITV

Tree: Binary Trees, Properties of Binary Tree, Linear Representation of Binary a Binary Tree, Linked Representation of a Binary Tree, Physical Implementation of Binary Tree in Memory, Operations on Binary Tree (Insertion, Deletion, Traversal, Merging of two Binary Trees), Types of Binary Trees (Expression Tree, Binary Search Tree, Heap Tree, Threaded Binary Trees, Height Balanced Binary Tree, Weighted Binary Tree, Decision Trees).

Recommended Books:

1. D. Samanta, Classic Data Structures:, 2/e (PHI).
2. D.S Malik, Data Structure using C++, 2/e, Cengage Learning, 2010.
3. Adam Drozdek, ”Data Structures and algorithm in C++”, 3/e, Cengage Learning, 2012.
4. Robert L. Kruse, ”Data Structures and Program Design in C++”, Pearson.

GE:2-STATISTICS FOR BUSINESS

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Probability and Probability Distribution: Events and the Sample Space, Calculating Probabilities using Simple events, Useful counting rules, Probability rules: Addition rule, Conditional probability and multiplication rule, Bayes rule.

UNIT-II

Probability Distributions: Random Variable, Discrete random variable, Mean and Standard deviation of discrete random variable, Discrete Probability Distributions: Binomial, Poisson and Hypergeometric probability distribution, Continuous Probability distribution: Normal distribution.

UNIT-III

Sampling Distribution: sampling plans and experimental designs, Sampling distribution of a statistic, Central Limit theorem, Sampling distribution of the Sample mean and Proportion. Large Sample Estimation: Point estimation, Interval estimation, Confidence interval of population mean, Population proportion, difference between two population means, difference between two population proportions.

UNIT-IV

Large Sample Tests of Hypothesis: Test of a Population mean, Test of difference of two population means, Test of hypothesis for a binomial proportion, Test of hypothesis for the difference between two binomial proportions. Inference from Small Samples: Students t Distribution, Small Sample inferences concerning a population mean and difference between two population means, Inferences concerning a population variance and difference between two population variances.

UNIT-V

Analysis of Variance: One-way classification, Two-way classification. Linear regression andCorrelation: Method of least squares, Analysis of variance for linear regression, Testing the usefulness of the linear regression model, Estimation and Prediction using the fitted line. Carl Pearsons coefficient of Correlation, Test of hypothesis concerning the Correlation coefficient.

Recommended Books:

1. William Mendenhall, Robert J. Beaver, Barbara M. Beaver, Probability and Statistics 14/e,CENGAGE Learning.
2. W. W. Hines, D.C. Montgomery, D.M. Goldsman, & C.M. Borror, Probability & Statistics in Engineering”

SEMESTER-III

C: 6-OPERATING SYSTEMS

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Operating System, Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Distributed Systems, Special Purpose Systems, Computing

Environments, Open-Source Operating Systems. Operating System Services, User Operating Sys- tem Interface, System Calls, Types of System Calls, System Programs, Operating-System Design and Implementation, Operating System Structure, Virtual Machines, Operating System Debugging, Operating System Generations. System Boot.

UNIT-II

Process: Process Concept, Process Scheduling, Operations on Processes, Inter-Process Communication, Examples of IPC Systems, Communication in Client-Server Systems. Multithreaded Programming: Multithreading Models, Thread Libraries, Threading Issues, Operating-System Examples.

UNIT-III

Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Thread Schedul- ing. Multiple-Process Scheduling. Synchronization: The Critical Section Problem, Petersons So- lution, Synchronization Hardware, Semaphores, Classical Problems of Synchronization, Monitors, Synchronization Examples, Atomic Transactions.

UNIT-IV

Deadlocks: System Model, Deadlock Characterization, Methods of Handling Deadlocks, Deadlock Prevention, Deadlock avoidance, Deadlock Detection, Recovery from Deadlock. Memory Management Strategies: Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation, Example: The Intel Pentium.

UNIT-V

Virtual-Memory Management: Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files, Allocating Kernel Memory. File System: File Concept, Access Methods, Directory and Disk Structure, File-System Mounting, File Sharing, Protection.

Recommended Books:

1. A Silberschatz, P.B. Galvin, G. Gagne, Operating Systems Concepts, 8/e, John Wiley Publica- tions 2008.
2. A.S. Tanenbaum, Modern Operating Systems, 3/e, Pearson Education 2007.
3. W. Stallings, Operating Systems, Internals & Design Principles, 5/e, Prentice Hall of India. 2008.
4. G. Nutt, Operating Systems: A Modern Perspective, 2/e, Pearson Education 1997.

C: 7-BUSINESS ACCOUNTING

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Introduction to Financial Accounting. Accounting as an Information System. Importance, Scope, and Limitations. Users of Accounting Information. Generally Accepted Accounting Principles. The Accounting Equation.Nature of Accounts and Rules of Debit and Credit.Recording Transactions in General Journal. Recording Transactions in three column Cash Book. An overview of Subsidiary books Purchase Book, Purchase Returns Book, Sales Book, and Sales Returns Book. Opening and Closing Entries. Preparation of Ledger Accounts.

UNIT-II

Introduction to International Financial Reporting Standards (IFRS). Understanding Accounting Standards issued by the ICAI related to Disclosure of Accounting Policies, Depreciation Accounting, and Revenue Recognition. Methods of charging Depreciation Straight-line Method, and Written-down-value Method. Preparation of Trial Balance. Adjustment Entries. Post-adjusted Trial Balance. Bank Reconciliation Statement.

UNIT-III

Preparation of Financial Statements: Preparing Trading Account, Profit & Loss Account and Balance Sheet for a Sole Proprietor. Understanding contents of Financial Statements of a Joint Stock Company as per Companies Act 2013. Understanding the contents of a Corporate Annual Report. Preparation of Cash Flow Statement as per AS-3 (revised).

UNIT-IV

Analyzing Financial Statements: Objectives of Financial Statement Analysis; Sources of Informa- tion; Standards of Comparison; Techniques of Financial Statement Analysis - Horizontal Analysis, Vertical Analysis, and Ratio Analysis. Meaning and Usefulness of Financial Ratios; Analysis of Financial Ratios from the perspective of different Stakeholders like Investors, Lenders, and Short-term Creditors; Profitability Ratios, Solvency Ratios, Liquidity Ratios, and Turnover Ratios; Limitations of Ratio Analysis.

Recommended Books:

1. S.N. Maheshwari, Suneel K. Maheshwari, and Sharad K. Maheshwari: An Introduction to Accountancy, Vikas Publishing House Pvt. Ltd.
2. R. Narayanaswamy, Financial Accounting: A Managerial Perspective, PHI Learning Pvt. Ltd.
3. Charles T. Horngren, Gart L. Sundem, John A. Elliott, and Donna R. Philbrick, Introduction to Financial Accounting, Pearson.
4. J.R. Monga, Financial Accounting: Concepts and Applications, Mayur Paperbacks.
5. T.P. Ghosh, Financial Accounting for Managers: Taxmann Allied Services Pvt. Ltd.

C: 8-MANAGERIAL ECONOMICS

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Demand, Supply and Market equilibrium: individual demand, market demand, individual supply, market supply, market equilibrium; Elasticities of demand and supply : Price elasticity of demand, income elasticity of demand, cross price elasticity of demand, elasticity of supply; Theory of consumer behavior : cardinal utility theory, ordinal utility theory(indifference curves, budget line, consumer choice, price effect, substitution effect, income effect for normal, inferior and giffen goods), revealed preference theory.

UNIT-II

Producer and optimal production choice : optimizing behavior in short run(geometry of product curves, law of diminishing margin productivity, three stages of production), optimizing behavior in long run (isoquants, isocost line, optimal combination of resources) Costs and scale : traditional theory of cost (short run and long run, geometry of cot curves, envelope curves), modern theory of cost (short run and long run), economies of scale, economies of scope.

UNIT-III Theory of firm and market organization : perfect competition (basic features, short run equilibrium of firm/industry, long run equilibrium of firm/industry, effect of changes in demand, cost and imposition of taxes) ; monopoly (basic features, short run equilibrium, long run equilibrium, effect of changes in demand, cost and imposition of taxes, comparison with perfect competition, welfare cost of monopoly), price discrimination, multiplant monopoly ; monopolistic competition (basic features, demand and cost, short run equilibrium, long run equilibrium, excess capacity) ; oligopoly (Cournots model, kinked demand curve model, dominant price leadership model, prisoners dilemma)

UNIT-IV

Factor market : demand for a factor by a firm under marginal productivity theory (perfect compe- tition in the product market, monopoly in the product market), market demand for a factor, supply of labour, market supply of labour, factor market equilibrium.

Recommended Books:

1. Dominick Salvatore (2009). Principles of Microeconomics (5th ed.) Oxford University Press.
2. Lipsey and Chrystal. (2008). Economics.(11th ed.) Oxford University Press.
3. Koutosyannis (1979). Modern Micro Economics. Palgrave Macmillan.

4. Pindyck, Rubinfeld and Mehta. (2009). Micro Economics. (7th ed.), Pearson.

SEC:1-BUSINESS COMMUNICATION

(Credits:2)

GE:1-NUMERICAL TECHNIQUES

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Introduction: Numbers and their accuracy, Chopping and Rounding off, Errors: Absolute and Relative errors, Floating point representations of numbers, Loss of significance. Solution of Algebraic and Transcendental Equations: Bisection Method, Newton-Raphson Method, Secant Method, Method of false position, Rate of convergence and comparison of iterative methods.

UNIT-II

Interpolation and Numerical Differentiation: Polynomial Interpolation, Interpolating polynomial: Lagrange form, Newton form, Nested form, Divided difference Interpolation, Inverse Interpolation, Errors in polynomial Interpolation. First derivative and second derivative via Taylor Series, Richardson Extrapolation.

UNIT-III

Numerical Integration: Trapezoidal Rule, Composite Trapezoidal rule, Simpsons 1/3 rule, Simpsons 3/8 rule, Gaussian Quadrature formulae (1-point, 2-point, 3-point)

UNIT-IV

Solution of System of Linear Equations: Gaussian Elimination method and Pivoting, LU factorization method, ill Conditioning, Iterative Methods: Jacobi iterative method, Gauss Seidel iterative method. Eigen Values and Eigen Vectors: Eigen value properties, Computation Eigen values by Power method.

UNIT-V

Solution of Ordinary Differential Equations: Taylor Series method, Runge-Kutta method of order 2 and order 4, Predictor-Corrector method: Adams-Bashforth-Moultan method. Smoothing of Data and the Method of Least Squares: Linear and non-linear least square method.

Recommended Books:

1. E. Ward Cheney and David R. Kincaid ,Numerical Methods and Applications CENGAGE Learn- ing India Private Ltd., New Delhi.
2. S.R.K. Iyengar, R.K. Jain, & M.K. Jain, Numerical Methods for Scientific & Engineering Computation, 6/e, New Age Int. Pub.
3. S.S. Sastry, Introductory Methods of Numerical Analysis, 5/e, EEE
4. Steven C. Chapra, Applied Numerical Methods with MATLAB, 2/e, McGraw-Hill.

SEMESTER-IV

C: 9-JAVA PROGRAMMING

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Introduction to Java: Java Architecture and Features, Understanding the semantic and syntax

differences between C++ and Java, Compiling and Executing a Java Program, Variables, Constants, Keywords Data Types, Operators (Arithmetic, Logical and Bitwise) and Expressions, Comments, Doing Basic Program Output, Decision Making Constructs (conditional statements and loops)and Nesting, Java Methods (Defining, Scope, Passing and Returning Arguments, Type Conversion and Type and Checking, Built-in Java Class Methods).

UNIT-II

Arrays, Strings and I/O: Creating & Using Arrays (One Dimension and Multi-dimensional), Referencing Arrays Dynamically, Java Strings: The Java String class, Creating & Using String Objects, Manipulating Strings, String Immutability & Equality, Passing Strings To & From Methods, String Buffer Classes. Simple I/O using System.out and the Scanner class, Byte and Character streams, Reading/Writing from console and files. Object-Oriented Programming Overview: Principles of Object-Oriented Programming, Defining & Using Classes, Controlling Access to Class Members, Class Constructors, Method Overloading, Class Variables & Methods, Objects as parameters, final classes, Object class, Garbage Collection.

UNIT-III

Inheritance, Interfaces, Packages, Enumerations, Autoboxing and Metadata: Inheritance: (Single Level and Multilevel, Method Overriding, Dynamic Method Dispatch, Abstract Classes), Interfaces and Packages, Extending interfaces and packages, Package and Class Visibility, Using Standard Java Packages (util, lang, io, net), Wrapper Classes, Autoboxing/Unboxing, Enumerations and Metadata.

UNIT-IV

Exception Handling, Threading, Networking and Database Connectivity: Exception types, uncaught exceptions, throw, built-in exceptions, Creating your own exceptions; Multi-threading: The Thread class and Runnable interface, creating single and multiple threads, Thread prioritization, synchronization and communication, suspending/resuming threads. Using java.net package, Overview of TCP/IP and Datagram programming. Accessing and manipulating databases using JDBC.

UNIT-V

Applets and Event Handling: Java Applets: Introduction to Applets, Writing Java Applets, Working with Graphics, Incorporating Images & Sounds. Event Handling Mechanisms, Listener Interfaces, Adapter and Inner Classes. The design and Implementation of GUIs using the AWT controls, Swing components of Java Foundation Classes such as labels, buttons, text fields, layout managers, menus, events and listeners; Graphic objects for drawing figures such as lines, rectangles, ovals, using different fonts. Overview of servlets.

Recommended Books:

1. E. Balagurusamy, Programming with Java, 4/e, TMH
2. Bruce Eckel, ”Thinking Java”, 8/e, Pearson India, 2010.
3. John R. Hubbard, ”Programming with JAVA”, Schaum’s Series, 2/e, 2004.
4. Cay S. Horstmann, GaryCornell, ”Core Java 2 Volume 1 ,9/e,Printice Hall.2012.

C: 10-DATABASE MANAGEMENT SYSTEM

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Databases and Database Users, Database System Concepts and Architecture, Data Modelling using

the Entity-Relationship (ER) Model, The Enhanced Entity-Relationship (EER) Model.

UNIT-II

Relational Model: The Relational Data Model and Relational Database Constraints, The Relational Algebra and Relational Calculus.

UNIT-III

Relational Database Design by ER- and EER-to-Relational Mapping, SQL-99: Schema Definition, Constraints, Queries, and Views, Introduction to SQL Programming Techniques.

UNIT-IV

Functional Dependencies and Normalization for Relational Databases, Relational Database Algorithms and Further Dependencies, Practical Database Design Methodology and use of UML Diagrams.

UNIT-V

Disk Storage, Basic File Structures, and Hashing, Indexing Structures for Files, Algorithms for Query Processing and Optimization, Physical Database Design and Tuning.

Recommended Books:

1. R. Elmasri, S.B. Navathe, Fundamentals of Database Systems, 6/e, Pearson Education, 2010.
2. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts 6/e, McGraw Hill, 2010.
3. R. Ramakrishanan, J. Gehrke, Database Management Systems, McGraw-Hill.
4. C. Coronel, S. Morris, & P. Rob, Database Principles (Fundamentals of Design, Implementation, and Management), 9/e, Cengage Learning.

C: 11-MANAGEMENT ACCOUNTING

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Nature, Scope of Management Accounting: Meaning, definition, nature and scope of Manage- ment Accounting; Comparison of Management Accounting with Cost Accounting and Financial Accounting. Cost concepts: Meaning, Scope, Objectives, and Importance of Cost Accounting; Cost, Costing, Cost Control, and Cost Reduction; Elements of Cost, Components of total Cost, Cost Sheet. Classification of Costs: Fixed, Variable, Semivariable, and Step Costs; Product, and Period Costs; Direct, and Indirect Costs; Relevant, and Irrelevant Costs; Shut-down, and Sunk Costs; Controllable, and Uncontrollable Costs; Avoidable, and Unavoidable Costs; Imputed / Hypothetical Costs; Out-of-pocket Costs; Opportunity Costs; Expired, and Unexpired Costs; Conversion Cost. Cost Ascertainment: Cost Unit and Cost Center. Introduction to Overhead allocation, Overhead apportionment, and Overhead absorption.

UNIT-II

Cost-Volume-Profit Analysis: Contribution, Profit-Volume Ratio, Margin of safety, Cost Break- even Point, Composite Break-even Point, Cash Break-even Point, Key Factor, Break-even Analysis. Relevant Costs and Decision Making: Pricing, Product Profitability, Make or Buy, Exploring new markets, Export Order, Sell or Process Further, Shut down vs. Continue.

UNIT-III

Budgets and Budgetary Control: Meaning, Types of Budgets, Steps in Budgetary Control, Fixed and Flexible Budgeting, Cash Budget. Responsibility Accounting: Concept, Significance, Different

responsibility centers, Divisional performance Financial measures, Transfer pricing.

UNIT-IV

Standard Costing and Variance Analysis: Meaning of Standard Cost and Standard Costing, Advantages, Limitations and Applications; Material, Labor, Overhead and Sales variances. Introduction to Target Costing, Life Cycle Costing, Quality Costing, and Activity based Costing.

Recommended Books:

1. C.T. Horngren, Gary L. Sundem, Jeff O. Schatzberg, and Dave Burgstahler: Introduction to Management Accounting, Pearson.
2. M.N. Arora: A Textbook of Cost and Management Accounting, Vikas Publishing House Pvt. Ltd.
3. M.Y. Khan, and P.K. Jain, Management Accounting: Text Problems and Cases, McGraw Hill Education (India) Pvt. Ltd.
4. S.N. Maheshwari, and S.N. Mittal, Cost Accounting: Theory and Problems, Shree Mahavir Book Depot (Publishers).

SEC: 2-HTML PROGRAMMING

(Credit:2)

UNIT-I

Introduction

The Basics: The Head, the Body, Colors, Attributes, Lists, ordered and unordered.

UNIT-II

Links: Introduction, Relative Links, Absolute Links, Link Attributes, Using the ID Attribute to Link within a Document.

UNIT-III

Images: Putting an Image on a Page, Using Images as Links, Putting an Image in the Background

UNIT-IV

Tables, Creating a Table , Table Headers, Captions, Spanning Multiple Columns, Styling Table

UNIT-V

Forms: Basic Input and Attributes, Other Kinds of Inputs, Styling forms with CSS, Where To Go From Here

Recommended Books:

Introduction to HTML and CSS -O' Reilly.

GE:4-QUANTITATIVE TECHNIQUES

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Linear Programming: Formulation of L.P. Problems, Graphical Solutions (Specialcases: Multiple optimal solution, infeasibility, unbounded solution); Simplex Methods(Special cases: Multiple optimal solution, infeasibility, degeneracy, unbounded solution)Big-M method and Two-phase method; Duality and Sensitivity (emphasis on formulation & economic interpretation); Formulation of Integer programming, Zero-oneprogramming, Goal Programming.

UNIT-II

Elementary Transportation: Formulation of Transport Problem, Solution by N.W. Corner Rule, Least Cost method, Vogels Approximation Method (VAM), Modified Distribution Method. (Special cases: Multiple Solutions, Maximization case,Unbalanced case, prohibited routes)Elementary Assignment: Hungarian Method, (Special cases: Multiple Solutions,Maximization case, Unbalanced case, Restrictions on assignment).

UNIT-III

Network Analysis: Construction of the Network diagram, Critical Path- floatand slack analysis (Total float, free float, independent float), PERT, Project TimeCrashing.

UNIT-IV

Decision Theory: Pay off Table, Opportunity Loss Table, Expected Monetary Value, Expected Opportunity Loss, Expected Value of Perfect Information and Sample Information.

UNIT-V

Markov Chains: Predicting Future Market Shares, Equilibrium Conditions (Questions based on Markov analysis) Limiting probabilities, Chapman Kolmogrov equation. Introduction to Game Theory: Pay off Matrix- Two person Zero-Sum game, Pure strategy, Saddle point; Dominance Rule, Mixed strat- egy, Reduction of $m \times n$ game and solution of 2×2, $2 \times s$, and $r \times 2$ cases by Graphical and Algebraic methods; Introduction to Simulation: Monte Carlo Simulation.

Recommended Books:

1. N. D. Vohra: Quantitative Management, Tata McGraw Hill.
2. P. K. Gupta, Man Mohan, KantiSwarup: Operations Research, Sultan Chand.
3. V. K. Kapoor: Operations Research, Sultan Chand & Sons.
4. J. K. Sharma: Operations Research Theory & Applications, Macmillan India, Limited.

SEMESTER-V

C: 12-DATA COMMUNICATIONS
(Credit:6, Theory:4, Practical: 2)

UNIT-I

Introduction: Data Communications, Networks, The Internet, Protocols and Standards. Network Models: Layered Tasks, The OSI Model, Layers in the OSI Model, TCP/ IP Protocol Suite, Ad- dressing.

UNIT-II

Data and Signals: Analog and Digital, Periodic Analog Signals, Digital Signals, Transmission Im- pairment, Data Rate Limits, Performance. Digital Transmission: Digital-To-Digital Conversion, Analog-To-Digital Conversion, Transmission Modes. Analog Transmission: Digital-To-Analog Con- version, Analog-To-Analog Conversion.

UNIT-III

Multiplexing and Spreading: Multiplexing, Spread Spectrum. Transmission Media: Guided Media, Unguided Media (Wireless). Switching: Circuit Switched, Datagrams, Virtual Circuit Networks, Structure of a Switch. Telephone Network, Dial-Up MODEMS, Digital Subscriber Line (DSL), Cable TV Networks, Cable TV for Data Transfer.

UNIT-IV

Error Detection and Correction: Introduction, Block Coding, Linear Block Codes, Cyclic Codes, Checksum. Data Link Control: Framing, Flow and Error Control, Protocols, Noiseless Channels, Noisy Channels, HDLC, Point-To-Point Protocol. Multiple Access: Random Access, Controlled Access, Channelization. Wired LANs: IEEE Standards, Standard Ethernet, Changes in the Standard, Fast Ethernet, Gigabit Ethernet: Wireless LANs: IEEE 802.11, Bluetooth.

UNIT-V— Connecting LANs: Connecting Devices, Backbone Networks, Virtual LANs. Wireless LANs: Cellular Telephony, Satellite Networks. SONET: Architecture, SONET Layers, SONET Frames, STS Multiplexing, SONET Networks, Virtual Tributaries. Virtual-Circuit Networks. Frame Relay, ATM, ATM LANs.

Recommended Books:

1. B. A. Forouzan, Data Communications and Networking, 4/e, THM ,2007.
2. A. S. Tanenbaum, & David J. Wetherall, Computer Networks, 5/e,Pearson

C: 13-SOFEWARE ENGINEERING
(Credit:6, Theory:4, Practical: 2)

UNIT-I

Professional Software Development, Software Engineering Ethics, Software Processes, Software Pro- cess Models, Process Activities, Coping with Change, The Rational Unified Process, Agile Software Development, Agile Methods, Plan-Driven and Agile Development, Extreme Programming, Agile Project Management, Scaling Agile Methods.

UNIT-II

Requirements Engineering, Functional and Non-Functional Requirements, The Software Requirements Document, Requirements Specification, Requirements Engineering Processes, Requirements Elicitation and Analysis, Requirements Validation, Requirements Management, System Modelling, Context Models, Interaction Models, Structural Models, Behavioural Models, Model-Driven, Engineering, Architectural Design, Architectural Design Decisions, Architectural Views, Architectural Patterns, Application Architectures.

UNIT-III

Design and Implementation: Object-Oriented Design using the UML, Design Patterns, Implementation Issues, Open Source Development, Software Testing: Development Testing, Test-Driven Development, Release Testing, User Testing, Software Evolution: Evolution Processes, Program Evolution Dynamics, Software Maintenance, Legacy System Management, Dependability and Security.

UNIT-IV

Socio-technical Systems: Complex Systems, Systems Engineering, System Procurement, System Development, System Operation. Dependability and Security: Dependability Properties, Availability and Reliability, Safety, Security. Dependability and Security Specification: Risk-Driven Require- ments, Specification, Safety Specification, Reliability Specification, Security, Specification, Formal Specification.

UNIT-V

Dependability Engineering: Redundancy and Diversity, Dependable Processes, Dependable Systems Architectures, Dependable Programming. Security Engineering: Security Risk Management, Design for Security, System Survivability. Dependability and Security Assurance: Static Analysis, Reliability Testing, Security Testing, Process Assurance, Safety and Dependability Cases.

Recommended Books:

1. I. Sommerville, Software Engineering, 9/e, Addison Wesley.
2. R. Mall, Fundamentals of Software Engineering, 3/e, PHI.
3. R.S. Pressman, Software Engineering, A Practitioners Approach, 7/e, McGraw-Hill, 2009.
4. K.K. Aggarwal and Y. Singh, Software Engineering,2/e, New Age International Publishers, 2008.

DSE: 1-PROGRAMMING IN VISUAL BASIC

(Credit:6, Theory:4, Practical: 2)

UNIT-I

GUI Environment: Introduction to graphical user interface (GUI), programming language (procedural, object oriented, event driven), the GUI environment, compiling, debugging, and running the programs. Controls : Introduction to controls textboxes, frames, check boxes, option buttons, images, setting borders and styles, the shape control, the line control, working with multiple controls and their properties, designing the user interface, keyboard access, tab controls, default & cancel property, coding for controls.

UNIT-II

Operations: Data types, constants, named & intrinsic, declaring variables, scope of variables, val function, arithmetic operations, formatting data. Decision Making: If statement, comparing strings, compound conditions (and, or, not), nested if statements, case structure, using if statements with

option buttons & check boxes, displaying message in message box, testing whether input is valid or not.

UNIT-III

Modular programming: Menus, sub-procedures and sub-functions defining / creating and modifying a menu, using common dialog box, creating a new sub-procedure, passing variables to procedures, passing argument by value or by reference, writing a function/ procedure. Forms Handling : Multiple forms creating, adding, removing forms in project, hide, show method, load, unload statement,me keyword, referring to objects on a different forms.

UNIT-IV

Iteration Handling: Do/loops, for/next loops, using msgbox function, using string function Arrays and Grouped Data Control: Arrays - 1-dimension arrays, initializing an array using for each, user- defined data types, accessing information with user-defined data types, using list boxes with array, two dimensional arrays. lists, loops and printing list boxes & combo boxes, filling the list using property window/additem method, clear method, list box properties, removing an item from a list, list box/ combo box operations.

UNIT-V

Database Connectivity: Database connectivity of forms with back end tool like mysql, populating the data in text boxes, list boxes etc. searching of data in database. using forms. Updating/ editing of data based on a criterion.

Recommended Books:

Programming in Visual Basic 6.0 by Julia Case Bradley, Anita C. Millispangh (Tata Mcgraw Hill Edition 2000 (Fourteenth Reprint 2004).

DSE: 2-FINANCIAL MANAGEMENT

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Nature of Financial Management: Finance and related disciplines; Scope of Financial Management; Profit Maximization, Wealth Maximization - Traditional and Modern Approach; Functions of finance Finance Decision, Investment Decision, Dividend Decision; Objectives of Financial Management; Organisation of finance function; Concept of Time Value of Money, present value, future value, and annuity; Risk & Return: Historical return, expected return, absolute return, holding period return, annualized return, arithmetic & geometric return; Risk - Systematic & unsystematic risk their sources and measures.

UNIT-II

Long -term investment decisions: Capital Budgeting - Principles and Techniques; Nature and meaning of capital budgeting; Estimation of relevant cash flows and terminal value; Evaluation techniques - Accounting Rate of Return, Net Present Value, Internal Rate of Return & MIRR, Net Terminal Value, Profitably Index Method. Concept and Measurement of Cost of Capital: Explicit and Implicit costs; Measurement of cost of capital; Cost of debt; Cost of perpetual debt; Cost of Equity Share; Cost of Preference Share; Cost of Retained Earning; Computation of over-all cost of capital based on Historical and Market weights.

UNIT-III

Capital Structures: Approaches to Capital Structure Theories - Net Income approach, Net Operating Income approach, Modigliani-Miller (MM) approach, Traditional approach, Capital Structure and Financial Distress, Trade-Off Theory.

Dividend Policy Decision - Dividend and Capital; The irrelevance of dividends: General, MM hypothesis; Relevance of dividends: Walter's model, Gordon's model; Leverage Analysis: Operating and Financial Leverage; EBIT -EPS analysis; Combined leverage.

UNIT-IV

Working Capital Management: Management of Cash - Preparation of Cash Budgets (Receipts and Payment Method only); Cash management technique, Receivables Management Objectives; Credit Policy, Cash Discount, Debtors.

Outstanding and Ageing Analysis; Costs - Collection Cost, Capital Cost, Default Cost, Delinquency Cost, Inventory Management (Very Briefly) - ABC Analysis; Minimum Level; Maximum Level; Reorder Level; Safety Stock; EOQ, Determination of Working Capital.

Recommended Books:

1. M.Y. Khan & P.K. Jain: Financial Management Text Problem and Cases, Tata McGraw Hill Pubilshlng Co. Ltd.
2. R. P. Rustogi: Financial Management: Theory Concepts and Practices, Taxmann Publication.
3. I.M. Pandey: Financial Management: Theory and Practices, Vikas Publishing House.
4. R.A. Brealey, S.C. Myers, F. Allen & P. Mohanty: Principles of Corporate Finance, McGraw Hill Higher Education.
5. J.V. Horne & J.M. Wachowicz: Fundamentals of Financial Management Prentice Hall.

SEMESTER-VI

C: 14-INTERNET TECHNOLOGY

(Credit:6, Theory:4, Practical: 2)

UNIT-I

Java: Use of Objects, Array and Array List class.

UNIT-II

JavaScript: Data types, operators, functions, control structures, events and event handling.

UNIT-III

JDBC: JDBC Fundamentals, Establishing Connectivity and working with connection interface, Work- ing with statements, Creating and Executing SQL Statements, Working with Result Set Objects. **UNIT-IV** JSP: Introduction to Java Server Pages, HTTP and Servlet Basics, The Problem with Servlets, The Anatomy of a JSP Page, JSP Processing, JSP Application Design with MVC, Setting Up the JSP Environment, Implicit JSP Objects, Conditional Processing, Displaying Values, Using an expression to Set an Attribute, Declaring Variables and Methods, Error Handling and Debugging, Sharing Data Between JSP Pages, Requests, and Users, Database Access.

UNIT-V

Java Beans: Java Beans Fundamentals, JAR files, Introspection, Developing a simple Bean, Connecting to DB.

Recommended Books:

1. Ivan Bayross, Web Enabled Commercial Application Development Using HTML, DHTML, Javascript, Perl CGI , BPB Publications, 2009.
2. Cay Horstmann, BIG Java, Wiley Publication , 3/e, 2009.
3. Herbert Schildt , Java 7, The Complete Reference, , 8/e, 2009.
4. Jim Keogh ,The Complete Reference J2EE, TMH, , 2002.

C: 15-PROGRAMMING IN NET

(Credit:6, Theory:4, Practical: 2)

DSE: 3-E-COMMERCE

(Credit:6, Theory:4, Practical: 2)

UNIT-I

An introduction to Electronic commerce: What is E-Commerce (Introduction And Definition), Main activities E-Commerce, Goals of E-Commerce, Technical Components of E-Commerce, Functions of E-Commerce, Advantages and disadvantages of E-Commerce, Scope of E-Commerce, Electronic Commerce Applications, Electronic Commerce and Electronic Business(C2C)(C2G,G2G, B2G, B2P, B2A, P2P, B2A, C2A, B2B, B2C).

UNIT-II

The Internet and WWW: Evolution of Internet, Domain Names and Internet Organization (.edu, .com, .mil, .gov, .net etc.) , Types of Network, Internet Service Provider, World Wide Web, Internet & Extranet, Role of Internet in B2B Application, building own Website, Cost, Time, Reach, Registering a Domain Name, Web promotion, Target email, Baner, Exchange, Shopping Bots.

UNIT-III

Internet Security: Secure Transaction, Computer Monitoring, Privacy on Internet, Corporate Email privacy, Computer Crime(Laws , Types of Crimes), Threats, Attack on Computer System, Software Packages for privacy, Hacking, Computer Virus(How it spreads, Virus problem, virus protection, Encryption and Decryption, Secret key Cryptography, DES, Public Key Encryption, RSA, Authorisation and Authentication, Firewall, Digital Signature(How it Works).

UNIT-IV

Electronic Data Exchange: Introduction, Concepts of EDI and Limitation, Applications of EDI, Disadvantages of EDI, EDI model,Electronic Payment System: Introduction, Types of Electronic Payment System, Payment Types, Value Exchange System, Credit Card System, Electronic Fund Transfer, Paperless bill, Modern Payment Cash, Electronic Cash.

UNIT-V

Planning for Electronic Commerce: Planning Electronic Commerce initiates, Linking objectives to business strategies, Measuring cost objectives, Comparing benefits to Costs, Strategies for developing electronic commerce web sites.

Recommended Books:

1. E-Commerce Concepts, Models, Strategies-G.S.V.Murthy, Himalaya Publishing House.
2. E- Commerce:-Kamlesh K Bajaj and Debjani Nag.
3. Electronic commerce-Gray P. Schneider.
4. E-Commerce, Fundamentals & Applications: Chand (Wiley) Web and E-Commerce.

DSE: 4-PROJECT WORK

(Credit:6)

MATHEMATICS (HONOURS)

SEMESTER-I

C:1-CALCULUS-I
(Total Marks: 100)

Part-I (Marks: 70)
4 Lectures, 1 Tutorial (per week)

Unit-I

Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of the type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$, concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, LHospitals rule, applications in business, economics and life sciences.

Unit-II

Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \tan^n x dx$, $\int \sec^n x dx$, $\int (\log x)^n dx$, $\int \sin^n x \cos^n x dx$, volumes by slicing, disks and washers methods, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution.

Unit-III

Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification into conics using the discriminant, polar equations of conics. Sphere, Cone, Cylinder, Conicoids.

Unit-IV

Vector triple product, Introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration.

Part-II(PRACTICAL)
(Marks: 30)

List of Practical (Using any software/MATLAB) Practical/Lab work to be performed on a Computer.

1. Plotting the graphs of the functions e^{ax+b}, $\log(ax+b)$, $1/(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $|ax+b|$ and to illustrate the effect of a and b on the graph.
2. Plotting the graphs of the polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.

3. Sketching parametric curves (eg. Trochoid, Cycloid, Epicycloids, Hypocycloid).
4. Obtaining the surface of revolution of curves.
5. Tracing of conics in cartesian/polar coordinates.
6. Sketching Ellipsoid, Hyperboloid of one and two sheets, Elliptic cone, Elliptic, Paraboloid, Hyperbolic paraboloid using cartesian coordinates.
7. Matrix operation (addition, multiplication, inverse, transpose).

Books Recommended:

1. H. Anton, I. Bivens and S. Davis: Calculus, 10-th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002. Chapters: 3 (3.1, 3.2), 5 (5.2-5.5), 6(6.5, 6.8), 10 (10.1-10.5), 11(11.1, 11.4), 12(12.1, 12.2, 12.3, 12.6).
2. B.P. Acharya and D.C. Sahu: Analytical Geometry of Quadratic Surfaces, B.P. Acharya and D.C. Sahu, Kalyani Publishers, New Delhi, Ludhiana, Chapters: 2 and 3.
3. Shantinarayan: Text Book of Calculus(Part-II), S. Chand & Co. Pvt. Ltd., New Delhi, Chapters: 6,7, 10 (Art. 33-36).
4. Shantinarayan: Text Book of Calculus(Part-III), S. Chand & Co., Pvt. Ltd., New Delhi, Chapters: 1(Art.1,2), 3 (Art.7,8), 6 (15 restricted).

Books for Reference:

1. G.B. Thomas and R.L. Finney: Calculus, 9-th Ed., Pearson Education, Delhi, 2005.
2. R. Courant and F. John: Introduction to Calculus and Analysis (Volumes I & II), Springer- Verlag, New York, Inc., 1989.
3. Shanti Narayan and P.K. Mittal: Analytical Solid Geometry, S. Chand & Co. Pvt. Ltd., New Delhi.
4. M.J. Strauss, G.L. Bradley and K. J. Smith: Calculus, 3-rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.

C:2-ALGEBRA-I

Total Marks: 100-(Theory: 80 Marks+Mid-Sem: 20 Marks)

5 Lectures, 1 Tutorial (per week)

Unit-I

Polar representation of complex numbers, *n*-th roots of unity, De Moivres theorem for rational indices and its applications.

Unit-II

Equivalence relations, Basic Terminology, Functions, Inverse and composition of functions, One-to-One correspondence and cardinality of a set, Division algorithm, Divisibility and Euclidean algorithm, Prime numbers, Congruence relation between integers, Principles of Mathematical Induction, Statement of Fundamental Theorem of Arithmetic.

Unit-III

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $Ax = b$, solution sets of linear systems, applications of linear systems, linear independence.

Unit-IV

Introduction to linear transformations, Matrix of a linear transformation, Inverse of a matrix, Characterizations of invertible matrices. Subspaces of R^n, Dimension of subspaces of R^n and Rank of a matrix, Eigen values, Eigen Vectors and Characteristic equation of a matrix.

Books Recommended:

1. Titu Andreescu and Dorin Andrica: Complex Numbers from A to Z, Birkhauser, 2006. Chapter: 2.
2. Edgar G. Goodaire and Michael M. Parmenter: Discrete Mathematics with Graph Theory, 3-rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005. Chapters: 2(2.4), 3, 4(4.1 – 4.1.6, 4.2 – 4.2.12, 4.3 – 4.3.9, 4.4 – 4.4.8), 5(5.1 – 5.1.4).
3. David C. Lay: Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007. Chapters:1(1.1 – 1.9), 2(2.1 – 2.3, 2.8, 2.9), 5(5.1, 5.2).

SEMESTER-II

C:3-REAL ANALYSIS (ANALYSIS-I)

Total Marks: 100-(Theory: 80 Marks+Mid-Sem: 20 Marks)

5 Lectures, 1 Tutorial (per week)

Unit-I

Review of Algebraic and Order Properties of R, Upper bound & Lower bound, Least upper bound (LUB), Greatest lower bound (GLB), LUB & GLB property of an ordered field, Completeness of an ordered field, Incompleteness of Q, Supremum and Infimum, Roots, Archimedean property, Rational & Irrational density theorems, Decimal representations of real numbers.

Unit-II

Idea of countable, uncountable sets and theorems relating to these sets, Sequences, Convergence & divergence of sequences, Limit of a sequence & Limit Theorems, Monotonic sequences, Weierstrass completeness principle, Nested Intervals, Cantor's completeness principle, Idea about higher order cardinals (restricted).

Unit-III

Subsequences, Bolzano Weierstrass theorem for sequences, Cluster points, Cauchy(Fundamental)

sequence, Cauchys Convergence Criterion, Limit superior and Limit inferior, Convergence and divergence of infinite series, Series of positive terms, Tests of convergence.

Unit-IV

Absolute convergence, Rearrangement of terms of a series, Conditional convergence of a series, Open sets, Closed sets, Limit points, Closure, Interior and Boundary of sets. Bolzano Weierstrass theorem for sets.

Book Recommended:

1. G. Das and S. Pattanayak: Fundamentals of Mathematics Analysis, TMH Pub-lishing Co. ,Chapters: 2(2.1-2.7), 3(3.1-3.4), 4(4.1-4.8, 4.11-4.13), 5(5.1-5.5).

Books for Reference:

1. R.G. Bartle and D. R. Sherbert: Introduction to Real Analysis, 3-rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
2. Gerald G. Bilodeau , Paul R. Thie, G.E. Keough: An Introduction to Analysis, 2-nd Ed., Jones & Bartlett, 2010.
3. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner: Elementary Real Analysis, Prentice Hall, 2001.
4. S.K. Berberian: A First Course in Real Analysis, Springer Verlag, New York, 1994.
5. S.C. Mallik and S. Arora: Mathematical Analysis, New Age International Publications.
6. D. Somasundaram and B. Choudhury: A First Course in Mathematical Analysis, Narosa Pub-lishing House.
7. S.L. Gupta and Nisha Rani: Real Analysis, Vikas Publishing House Pvt. Ltd., New Delhi.

C-:4-DIFFERENTIAL EQUATIONS

(Total Marks:100)

Part-I (Marks: 70)

4 Lectures, 1 Tutorial (per week)

Unit-I

Basic concepts of Differential equations and mathematical models. First order and first degree Ordinary differential equations(variables separable, homogeneous, exact, and linear). Applications of first order differential equations(Growth, Decay and Chemical Reactions, Heat flow, Oxygen debt, Economics). Equations of first order but of higher degree.

Unit-II

Second order linear equations(both homogeneous and non-homogeneous) with constant coefficients, second order equations with variable coefficients, variation of parameters, method of undetermined coefficients, Euler's equation, Second order differential equations with variable coefficients, Equations reducible to linear equations with constant coefficients.

Unit-III

Power series solutions of second order differential equations.

Unit-IV

Laplace transforms and its applications to solutions of differential equations.

Part-II(PRACTICAL)

(Marks: 30)

List of Practical (Using any Software/MATLAB) Practical/Lab work to be performed on a Computer.

1. Plotting of second order solution of family of differential equations.
2. Plotting of third order solution of family of differential equations.
3. Growth model (exponential case only).
4. Decay model (exponential case only).
5. Oxygen debt model.
6. Economic model.
7. Vibration problems.

Book Recommended:

1. J. Sinha Roy and S. Padhy: A Course of Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi. Chapters: 1, 2, 3, 4(4.1-4.8), 5, 7, 9(9.1-9.5, 9.10, 9.11, 9.13).

Books for Reference:

1. Martin Braun: Differential Equations and their Applications, Springer International.
2. M.D. Raisinghania: Advanced Differential Equations, S. Chand & Company Ltd., New Delhi.
3. G. Dennis Zill: A First Course in Differential Equations with Modelling Applications, Cengage Learning India Pvt. Ltd.
4. S.L. Ross: Differential Equations, John Wiley & Sons, India, 2004.

SEMESTER-III

C-5: THEORY OF REAL FUNCTIONS (ANALYSIS-II)

Total Marks: 100-(Theory: 80 Marks+Mid-Sem: 20 Marks)

5 Lectures, 1 Tutorial (per week)

Unit-I

Limits of functions ($s - \delta$ approach), Sequential criterion for limits, Divergence criteria. Limit theorems, one-sided limits. Infinite limits and limit at infinity. Continuous functions, Sequential criterion for continuity, Algebra of continuous functions and theorems related to continuity of functions.

Unit-II

Discontinuity and kinds of discontinuity, Further properties of continuity, Uniform continuity, Differentiable functions, Left hand & Right hand derivatives, Algebra of differentiable functions, Caratheodory's theorem.

Unit-III

Mean value conditions, Global and local maximum & minimum, Rolle's theorem, Generalized mean value theorem, Cauchy mean value theorem, Lagrange's mean value theorem and their applications, Darbouxs theorem, Indeterminant forms, Higher order derivatives(Leibnitz theorem), Taylor's theorem and its applications to approximating functions by means of polynomials.

Unit-IV

Maxima and Minima, Taylor's theorem with different forms of remainder, Maclaurin's theorem, Deduction of Taylor's theorem from mean value theorem, Taylor's and Maclaurin's infinite series, Taylors series and Maclaurins series expansions of exponential and trigonometric functions, $\ln(1 + x)$, $1/(ax + b)$ and $(1 + x)^n$.

Books Recommended:

1. G. Das and S. Pattanayak: Fundamentals of Mathematics Analysis, TMH Publishing Co., Chapters:6(6.1-6.7), 7(7.1-7.7), 9(9.7 only).
2. S.C. Mallik and S. Arora: Mathematical Analysis, New Age International Publications,Chap- ter: 6(8.1-8.6).

Books for Reference:

1. R. Bartle and D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003.
2. K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004.
3. A. Mattuck, Introduction to Analysis, Prentice Hall, 1999.
4. S.R. Ghorpade and B.V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.

C-6: GROUP THEORY (ALGEBRA-II)

Total Marks: 100-(Theory: 80 Marks+Mid-Sem: 20 Marks)

5 Lectures, 1 Tutorial (per week)

Unit-I

Symmetries of a square, Dihedral groups, Definition and examples of groups including permuta- tion groups and quaternion groups (illustration through matrices), Elementary properties of groups.

Subgroups and examples of subgroups, Centralizer, Normalizer, Center of a group, Product of two subgroups.

Unit-II

Properties of cyclic groups, Classification of subgroups of cyclic groups. Cycle notation for permutations, Properties of permutations, Even and Odd permutations, Alternating group, Properties of cosets, Lagranges theorem and consequences including Fermats Little theorem.

Unit-III

External direct product of a finite number of groups, Normal subgroups, Factor groups, Cauchys theorem for finite abelian groups.

Unit-IV

Group homomorphisms, properties of homomorphisms, Cayleys theorem, Properties of isomorphisms, First isomorphism theorem, Second and Third isomorphism theorems (Statements only).

Book Recommended:

1. Joseph A. Gallian: Contemporary Abstract Algebra(4-th Edn.), Narosa Publishing House, New Delhi, Chapters: I, II, III, IV, V, VI(up to Theorem 6.2 only), VII, VIII, IX, X, XI.

Books for Reference:

1. D.S. Malik, J.M. Mordeson, and M.K. Sen: Fundamentals of Abstract Algebra, McGraw-Hill, 1997.
2. John B. Fraleigh: A First Course in Abstract Algebra, 7-th Ed., Pearson, 2002.
3. M. Artin: Abstract Algebra, 2-nd Ed., Pearson, 2011.
4. Joseph J. Rotman: An Introduction to the Theory of Groups, 4-th Ed., Springer Verlag, 1995.
5. I.N. Herstein: Topics in Algebra, Wiley Eastern Limited, India, 1975.

C-7: PARTIAL DIFFERENTIAL EQUATIONS & SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS

(Total Marks: 100)

Part-I (Marks: 70)

04 Lectures (per week)

Unit-I

Systems of Linear Differential Equations: Basic theory of linear systems, Trial solution method for linear system with constant coefficients, Simultaneous linear first order equations in three variables, Methods of solution, Pfaffian differential equations, methods of solutions of Pfaffian differential equations in three variables.

Unit-II

Formation of first order partial differential equations, Linear and non-linear partial differential equations of first order, Special types of first-order equations, Solutions of partial differential equations of first order satisfying given conditions.

Unit-III

Linear partial differential equations with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients, Partial differential equations with variable coefficients, Some standard forms of variable coefficients.

Unit-IV

Laplace equation, Solution of Laplace equations by separation of variables, One-dimensional Wave equation, Solution of the Wave equation(method of separation of variables), Diffusion equation, Solution of one-dimensional diffusion equation, Method of separation of variables.

Part-II(PRACTICAL)
(Marks: 30)

List of Practical (Using any Software/MATLAB) Practical/Lab work to be performed on a Computer.

1. To find the general solution of the non-homogeneous system of the form:

$$\frac{dx}{dt} = a_1x + b_1y + f_1(t), \quad \frac{dy}{dt} = a_2x + b_2y + f_2(t)$$

with given conditions.

2. Plotting the integral surfaces of a given first order PDE with initial data.
3. Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - c^2\frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions:

(a) $u(x, 0) = \varphi(x)$, $u_t(x, 0) = \psi(x)$, $x \in \mathrm{R}$, $t > 0$. (b) $u(x, 0) = \varphi(x)$, $u_t(x, 0) = \psi(x)$, $u_x(0, t) = 0$, $x \in (0, \infty)$, $t > 0$. (c) $u(x, 0) = \varphi(x)$, $u_t(x, 0) = \psi(x)$, $u(0, t) = 0$, $x \in (0, \infty)$, $t > 0$. (d) $u(x, 0) = \varphi(x)$, $u_t(x, 0) = \psi(x)$, $u(0, t) = 0$, $u(1, t) = 0$, $0 < x < l$, $t > 0$.

4. Solution of Diffusion equation $\frac{\partial u}{\partial t} - k^2\frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions:

(a) $u(x, 0) = \varphi(x)$, $u(0, t) = a$, $u(l, t) = b$, $0 < x < l$, $t > 0$.
(b) $u(x, 0) = \varphi(x)$, $x \in \mathrm{R}$, $0 < t < T$.
(c) $u(x, 0) = \varphi(x)$, $u(0, t) = a$, $x \in (0, \infty)$, $t \geq 0$.

Book Recommended:

1. J.Sinha Roy and S. Padhy: A Course on Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi, Ludhiana, 2012.
   Chapters: 8 (8.1-8.3), 11, 12, 13(13.1-13.5), 15(15.1 & 15.5 only), 16(16.1 & 16.1.1 only), 17(17.1-17.3).

Books for References:

1. Tyn Myint-U and Lokenath Debnath: Linear Partial Differential Equations for Scientists and Engineers, 4-th edition, Springer, Indian reprint, 2006.

2. S.L. Ross: Differential equations, 3-rd Ed., John Wiley and Sons, India, 2004.

SEMESTER-IV

C-8: NUMERICALMETHODS
(Total Marks: 100)

Part-I (Marks: 70)
04 Lectures (per week)

Unit-I

Rate of convergence, Algorithms, Errors: Relative, Absolute, Round off, Truncation. Numeri- cal solution of non-linear equations : Bisection method, Regular-Falsi method, Secant method, Newton-Raphson method, Fixed-point Iteration method, Newton-Raphson method for multiple roots, Aitken's O^2 process, Muller's method. Rate of convergence of these methods.

Unit-II

System of linear equations: Gaussian Elimination method, Gauss-Jordan method, Gauss Jacobi method, Gauss-Seidel method and their convergence analysis, .

Unit-III

Polynomial interpolation: Existence uniqueness of interpolating polynomials, Lagrange and Newtons divided difference interpolation, Error in interpolation, Central difference & averaging operators, Gauss-forward and backward difference interpolation, Simple numerical methods for derivatives, Interpolatory formulas.

Unit-IV

Numerical Integration: Some simple quadrature rules, Newton-Cotes rules, Trapezoidal rule, Simpsons rule, Simpsons $\frac{3}{8}$-th rule, Compound quadrature rules, Compound mid-point rule, Compound Trapezoidal rule, Compound Simpsons rule, Gauss-Legendre 2-point & 3-point rules. Numerical solutions of Differential Equations: Eulers method. Runge-Kutta methods of orders two, three and four.

Part-II(PRACTICAL)
(Marks: 30)

List of Practical (Using any Software/MATLAB) Practical/Lab work to be performed on a Computer.

1. Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + $- - - - - - - - - -$ +1/N.
2. To find the absolute value of an integer.
3. Enter 100 integers into an array and sort them in an ascending order.

4. Bisection Method.
5. Newton-Raphson Method.
6. Secant Method.
7. Regular-Falsi Method.
8. LU decomposition Method.
9. Gauss-Jacobi Method.
10. SOR Method or Gauss-Siedel Method.
11. Lagrange Interpolation or Newton Interpolation.
12. Simpsons rule.

Note: For any of the CAS (Computer aided software) Data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, arrays should be introduced to the students.

Book Recommended:

1. B.P. Acharya and R.N. Das: A Course on Numerical Analysis, Kalyani Publishers, New Delhi, Ludhiana. Chapters: 0(0.2, 0.8), 1(1.8, 1.9), 2(2.1-2.4, 2.6-2.9), 3(3.1-3.4, 3.6-3.11), 5(5.1- 5.3), 6(6.1-6.3, 6.5, 6.10, 6.11), 7(7.1-7.5 & 7.7).
2. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.

Books for Reference:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain: Numerical Methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher, India, 2007.
2. C.F. Gerald and P.O. Wheatley: Applied Numerical Analysis, Pearson Education, India,2008.
3. Uri M. Ascher and Chen Greif: A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013.
4. John H. Mathews and Kurtis D. Fink: Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.
5. P. Khandasamy, K. Thilagavathy and K. Gunavathi: Numerical Methods, S. Chand & Com- pany Ltd., 2012.
6. E. Balagurusamy: Numerical Methods, Tata McGraw-Hill Pub. Co. Ltd., 1999.

C-9: RIEMANN INTEGRATION & SERIES OF FUNCTIONS (ANALYSIS-III)

Total Marks: 100-(Theory: 80 Marks+Mid-Sem: 20 Marks)

5 Lectures, 1 Tutorial (per week)

Unit-I

Riemann integration, Inequalities of upper and lower sums, Riemann conditions of integrability. Riemann sum and definition of Riemann integral through Riemann sums, Equivalence of two definitions, Riemann integrability of monotone and continuous functions, Properties of the Riemann integral, Definition and integrability of piecewise continuous and monotone functions, Fundamental theorems of Calculus.

Unit-II

Improper integrals; Series and Integrals, Absolute convergence of integrals, Convergence of Beta and Gamma functions.

Unit-III

Point-wise and Uniform convergence of sequence of functions, Cauchy's criterion & Weierstrass M-test for uniform convergence, Dedekind test, Uniform convergence and Continuity, Term by term integration of series, Term by term differentiation of series.

Unit-IV

Power series (Cauchy Hadamard Theorem), Radius of convergence, Differentiation and integration of power series, Abels Limit Theorem, Stirling's formula, More about Taylor's series, Weierstrass Approximation Theorem.

Books Recommended:

1. G. Das and S. Pattanayak: Fundamentals of Mathematics Analysis, TMH Publishing Co., Chapters: 4(4.14 only), 8 (8.1-8.6), 9 (9.1-9.6, 9.8).
2. S.C. Mallik and S. Arora: Mathematical Analysis, New Age International Ltd., New Delhi, Chapters: 11(3.3, 4.3 only), 12(Restricted).

Books for Reference:

1. K.A. Ross, Elementary Analysis: The Theory of Calculus, Undergraduate Texts in Mathemat- ics, Springer (SIE), Indian reprint, 2004.
2. R.G. Bartle D.R. Sherbert: Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
3. Charles G. Denlinger: Elements of Real Analysis, Jones & Bartlett (Student Edition), 2011.
4. Shanti Narayan and M.D. Raisinghania: Elements of Real Analysis, S. Chand & Co. Pvt. Ltd.

C-10: RING THEORY & LINEAR ALGEBRA (ALGEBRA-III)

Total Marks: 100-(Theory: 80 Marks+Mid-Sem: 20 Marks)

5 Lectures, 1 Tutorial (per week)

Unit-I

Definition and examples of rings, Properties of rings, Subrings, Integral domains and Fields, Characteristic of a ring, Ideal, Ideal generated by a subset of a ring, Factor rings, Operations on Ideals, Prime and Maximal ideals.

Unit-II

Ring homomorphisms, Properties of ring homomorphisms, Isomorphism Theorems I, II and III, Field of quotients.

Unit-III

Vector spaces, Subspaces, Algebra of subspaces, Quotient spaces, Linear combination of vectors, Linear span, Linear independence, Basis and Dimension, Dimension of subspaces.

Unit-IV

Linear transformations, Null space, Range, Rank and Nullity of a linear transformation, Matrix representation of a linear transformation, Algebra of linear transformations. Isomorphisms, Isomorphism theorems, Invertibility and Isomorphisms, Change of co-ordinate matrix.

Book Recommended:

1. Joseph A. Gallian: Contemporary Abstract Algebra(8th Edn.), Narosa Publishing House, New Delhi. Chapters: 12, 13, 14, 15.
2. Stephen H. Friedberg, Arnold J. Insel, and Lawrence E. Spence: Linear Algebra, 4th Ed., Prentice- Hall of India Pvt. Ltd., New Delhi, 2004. Chapters: 1 (1.2-1.6), 2(2.1-2.5).

Books for Reference:

1. John B. Fraleigh: A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin: Abstract Algebra, 2nd Ed., Pearson, 2011.
3. S. Lang: Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
4. Gilbert Strang: Linear Algebra and its Applications, Cengage Learning India Pvt. Ltd.
5. S. Kumaresan: Linear Algebra- A Geometric Approach, Prentice Hall of India,1999.
6. Kenneth Hoffman, and Ray Alden Kunze: Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
7. I.N. Herstein: Topics in Algebra, Wiley Eastern Pvt. Ltd.

SEMESTER-V

C-11: MULTIVARIATE CALCULUS (CALCULUS-II)

Total Marks: 100-(Theory:80 Marks+Mid-Sem: 20 Marks)

5 Lectures, 1 Tutorial (per week)

Unit-I

Functions of several variables, limit and continuity of functions of two variables, Partial differentiation, Tangent planes, Approximation and Differentiability, Chain rule for one and two independent parameters.

Unit-II

Directional derivatives and gradient, Maximal property of the gradient, Normal property of the gradient, Tangent planes and the normal lines, Extrema of functions of two variables, Method of Lagrange multipliers, Lagrange Multipliers, Constrained optimization problems, A geometrical interpretation.

Unit-III

Double integration over rectangular region and over non-rectangular region, Double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions, Volume by triple integrals. cylindrical and spherical co-ordinates. Change of variables in double integrals and triple integrals.

Unit-IV

Definition of vector field, Divergence and Curl, Line integrals, Applications of line integrals: Mass and Work, Fundamental theorem and path independence for line integrals.

Unit-V

Green's theorem, Area as a line integral, Alternative forms of Green's theorem, Normal derivatives, Surface integrals, Integrals over parametrically defined surfaces. Stokes theorem, The Divergence theorem.

Book Recommended:

1. M.J. Strauss, G.L. Bradley and K. J. Smith: Calculus, 3rd Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007. Chapters: 11(11.1(Pages: 541-543), 11.2- 11.6, 11.7(Pages:598-605), 11.8(Pages:610-614)), 12 (12.1, -12.3, 12.4(Pages:652-660), 12.5, 12.6), 13 (13.1-13.3, 13.4(Pages:712-716, 718-720), 13.5(Pages:723-726; 729-730), 13.6 (Pages:733-737), 13.7(Pages:742-745)).

Books for Reference:

1. G.B. Thomas and R.L. Finney: Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. E. Marsden, A.J. Tromba and A. Weinstein: Basic Multivariable Calculus, Springer (SIE), Indian reprint, 2005.
3. Santosh K. Sengar and S.P. Singh: Advanced Calculus, Cengage Learning India Pvt. Ltd.

C-12: PROBABILITY & STATISTICS

Total Marks:100-(Theory: 80 Marks+Mid-Sem: 20 Marks)

4 Lectures, 1 Tutorial (per week)

Unit-I

Sample space, Probability axioms, Independent events, Conditional probability & Bayes' theorem, Real random variables (discrete and continuous), Cumulative distribution function, Expectation of random variables, Some special expectations.

Unit-II

Multivariate distributions, Joint cumulative distribution functions, Joint probability distributions, Marginal & conditional distributions, Some probability distributions(Discrete case), Uniform distribution, Binomial distribution, Negative Binomial & Geometric distributions, Poisson distribution.

Unit-III

Some probability distributions(Continuous case), Uniform, Gamma, Exponential, Beta distributions, Normal distributions, Normal approximation to the Binomial distribution, Bivariate normal distribution.

Unit-IV

Distribution of two random variables, Expectation of function of two random variables, Moment generating functions, Conditional distributions & expectations, Correlation coefficient, Co-variance, Independent random variables, Linear regression for two variables.

Unit-V

Limit theorems, Markov's inequality, Chebyshevs inequality, Statement and interpretation of Weak and Strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains: Introduction, Chapman-Kolmogorov equations.

Books Recommended:

1. Irwin Miller and Marylees Miller, John E. Freund: Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006. Chapters: 2 (excluding Art.9), 3 (excluding Art.8), 4, 5(5.1, 5.2, 5.4, 5.5,5.7), 6(6.1-6.7), 14(14.1, 14.2)
2. Sheldon Ross: Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007. Chapters:8(8.1-8.4(up to pages 428)), 9(9.1, 9.2).

Books for Reference:

1. Alexander M. Mood, Franklin A. Graybill and Duane C. Boes: Introduction to the Theory of Statistics, 3rd Ed., Tata McGraw- Hill, Reprint 2007.
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, S. Chand and Com- pany Pvt. Ltd., New Delhi.
3. Sheldon Ross: A First Course in Probability, Pearson Education.
4. Robert V. Hogg, Joseph W. McKean and Allen T. Craig: Introduction to Mathematical Statistics, Pearson Education, Asia, 2102.

5. Kai Lai Chung: Elementary Probability Theory with Stochastic Processess, 3-rd Edn., Springer International Student Edition.

SEMESTER-VI

C-13: METRIC SPACES & COMPLEX ANALYSIS (ANALYSIS-IV)

Total Marks: 100-(Theory: 80 Marks+Mid-Sem: 20 Marks)

5 Lectures, 1 Tutorial (per week)

Unit-I

Metric spaces: Definition and examples, Open & Closed spheres, Neighborhoods, Interior points, Open set, Closed set, Boundary points, Limit points & isolated points, Closure of a set, Dense sets, Separable metric spaces, Sequences in metric spaces, Convergent sequences, Cauchy sequences, Complete metric spaces, Distance between sets & diameter of a set, Subspaces, Cantor's theorem.

Unit-II

Continuous functions: Definition & characterizations, Sequential criterion and other characterizations of continuity, Uniform continuity, Homeomorphism, Connectedness, Connected subsets of R, Separated sets, Disconnected sets, Contraction mappings, Banach Fixed point theorem.

Unit-III

Properties of complex numbers, Regions in the complex plane, Functions of complex variable, Mappings, Limits & Continuity of complex functions, Derivatives, Differentiation formulas, Cauchy-Riemann equations, Sufficient conditions for differentiability, Polar Co-ordinates, Analytic functions, Examples of analytic functions.

Unit-IV

Exponential function, Logarithmic function, Trigonometric function, Derivatives of these functions, Definite integrals of functions, Contours, Contour integrals and its examples, Upper bounds for moduli of contour integrals, Theorems on antiderivatives, Cauchy- Goursat theorem (statement only), Cauchy integral formula, Its extension and consequences.

Unit-V

Liouvilles theorem and the Fundamental theorem of Algebra, Convergence of sequences and series, Taylor series with examples, Laurent series (without proof) with examples, Absolute and uniform convergence of power series.

Books Recommended:

1. P.K. Jain and K. Ahmad: Metric Spaces, Narosa Publishing House, New Delhi. Chapters: 2(1-9, 12), 3(1-4), 4(1-4), 6(1-2, 4), 7(1 only).

2. James Ward Brown and Ruel V. Churchill: Complex Variables and Applications, 8th Ed., McGraw Hill International Edition, 2009. Chapters: 1(11 only), 2(12, 13, 15-25), 3(29, 30, 34), 4(37-41, 43-46, 50-53), 5(55-60, 62,63,66).

Books for Reference:

1. Satish Shirali and Harikishan L. Vasudeva: Metric Spaces, Springer Verlag, London, 2006.
2. S. Kumaresan: Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.
3. S. Arumgum, A.T. Issac and A. Somasundaram: Complex Analysis, Scitech Publ. Pvt. Ltd.
4. S. Ponnusamy: Foundations of Complex Analysis, Alpha Science International Ltd.
5. J.B. Conway: Functions of one complex variable, Springer International Student Edn..
6. N. Das: Complex Function Theory, Allied Publishers Pvt. Ltd., Mumbai.

C-14: LINEARPROGRAMMING

Total Marks: 100-(Theory: 80 Marks+Mid-Sem: 20 Marks)

5 Lectures, 1 Tutorial (per week)

Unit-I

Introduction to linear programming problems(LPP), Mathematical formulation of the LPP with illustrations, Graphical method, General Linear programming problems, Canonical & standard form of LPP.

Unit-II

Theory of Simplex method, Optimality and unboundedness, the Simplex algorithm, Simplex method in tableau format, Introduction to artificial variables, Two-phase method, Big-M method and their comparisons.

Unit-III

Duality in LPP: Introduction, General Primal-Dual pair, Formulation of the Dual problem, Primal- Dual relationships, Duality theorems, Complementary slackness theorem, Duality & Simplex method, Economic interpretation of the Duality.

Unit-IV

Transportation Problem(TP): LP formulation of TP, Existence of solution and Duality in TP, Solu- tion of Transportation problems, North-West corner method, Least-Cost method and Vogel approx- imation method for determination of starting basic solution, Algorithm for solving transportation problem, Assignment problem and its mathematical formulation, Solution methods of Assignment problem, Special cases in Assignment problems.

Unit-V

Games and Strategies: Introduction, Formulation of two person zero sum games, solving two per- son zero sum games, Maximin-Minimax principle, Games without saddle points, Games with mixed strategies, Graphical solution procedure to $(2 \times n)$ and $(m \times 2)$ games.

Book Recommended:

1. Kanti Swarup, P.K. Gupta and Man Mohan: Operations Research, S. Chand and Co. Pvt. Ltd., Chapters: 2, 3, 4, 5(5.1-5.8), 10(10.1-10.10), 11(11.1-11.4), 17(17.1-17.6).

Books for Reference:

1. G. Hadley: Linear Programming, Narosa Publishing House, New Delhi, 2002.
2. N.V.R. Naidu, G. Rajendra and T. Krishna Rao: Operations Research, I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.
3. R. Veerachamy and V. Ravi Kumar: Operations Research- I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.
4. P.K. Gupta and D.S. Hira: Operations Research, S. Chand and Company Pvt. Ltd., New Delhi.
5. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali: Linear Programming and Network Flows, 2-nd Ed., John Wiley and Sons, India, 2004.
6. F.S. Hillier and G.J. Lieberman: Introduction to Operations Research, 9-th Ed., Tata McGraw Hill, Singapore, 2009.
7. Hamdy A. Taha: Operations Research, An Introduction, 8-th Ed., PrenticeHall India, 2006.

DISCIPLINE SPECIFIC ELECTIVES(DES)

DSE-1 Programming in C++ (Compulsory)

(Total Marks; 100)

Part-I(Marks: 70)

Introduction to structured programming: data types- simple data types, floating data types, character data types, string data types, arithmetic operators and operators precedence, variables and constant declarations, expressions, input using the extraction operator ¿¿ and cin, output using the insertion operator ¡¡ and cout, preprocessor directives, increment(++) and decrement(–) operations, creating a C++ program, input/ output, relational operators, logical operators and logical expressions, if and if-else statement, switch and break statements. for, while and do-while loops and continue statement, nested control statement, value returning functions, value versus reference parameters, local and global variables, one dimensional array, two dimensional array, pointer data and pointer variables.

Book Recommended:

1. D. S. Malik: C++ Programming Language, Edition-2009, Course Technology, Cengage Learn- ing, India Edition. Chapters: 2(Pages:37-95), 3(Pages:96-129), 4(Pages:134-178), 5(Pages:181- 236), 6, 7(Pages:287-304), 9 (pages: 357-390), 14(Pages:594-600).

Books for Reference:

1. E. Balaguruswami: Object oriented programming with C++, fifth edition, Tata McGraw Hill Education Pvt. Ltd.
2. R. Johnsonbaugh and M. Kalin-Applications Programming in ANSI C, Pearson Education.
3. S. B. Lippman and J. Lajoie, C++ Primer, 3rd Ed., Addison Wesley, 2000.
4. Bjarne Stroustrup , The C++ Programming Language, 3rd Ed., Addison Welsley.

Part-II(PRACTICAL, Marks:30)

List of Practicals (Using any software) Practical/Lab work to be performed on a Computer.

1. Calculate the Sum of the series $\frac{1}{1} \pm \frac{1}{2} \pm \frac{1}{3} \pm \cdots + \frac{1}{N}$ for any positive integer N.

2. Write a user defined function to find the absolute value of an integer and use it to evaluate the function $(-1)^{n/|n|}$, for $n = -2, -1, 0, 1, 2$.

3. Calculate the factorial of any natural number.

4. Read floating numbers and compute two averages: the average of negative numbers and the average of positive numbers.

5. Write a program that prompts the user to input a positive integer. It should then output a message indicating whether the number is a prime number.

6. Write a program that prompts the user to input the value of a, b and c involved in the equation $ax^2 + bx + c = 0$ and outputs the type of the roots of the equation. Also the program should outputs all the roots of the equation.

7. write a program that generates random integer between 0 and 99. Given that first two Fibonacci numbers are 0 and 1, generate all Fibonacci numbers less than or equal to generated number.

8. Write a program that does the following:
   a. Prompts the user to input five decimal numbers.
   b. Prints the five decimal numbers.
   c. Converts each decimal number to the nearest integer.
   d. Adds these five integers.
   e. Prints the sum and average of them.

9. Write a program that uses whileloops to perform the following steps:
   a. Prompt the user to input two integers :first Num and second Num (first Num shoul be less than second Num).
   b. Output all odd and even numbers between first Num and second Num.
   c. Output the sum of all even numbers between first Num and second Num.
   d. Output the sum of the square of the odd numbers firs tNum and second Num.
   e. Output all uppercase letters corresponding to the numbers between first Num and second Num, if any.

10. Write a program that prompts the user to input five decimal numbers. The program should then add the five decimal numbers, convert the sum to the nearest integer, and print the result.

11. Write a program that prompts the user to enter the lengths of three sides of a triangle and then outputs a message indicating whether the triangle is a right triangle or a scalene triangle.

12. Write a value returning function smaller to determine the smallest number from a set of numbers. Use this function to determine the smallest number from a set of 10 numbers.

13. Write a function that takes as a parameter an integer (as a long value) and returns the number of odd, even, and zero digits. Also write a program to test your function.

14. Enter 100 integers into an array and short them in an ascending/ descending order and print the largest/ smallest integers.

15. Enter 10 integers into an array and then search for a particular integer in the array.

16. Multiplication/ Addition of two matrices using two dimensional arrays.

17. Using arrays, read the vectors of the following type: A = (12345678), B = (02340156) and compute the product and addition of these vectors.

18. Read from a text file and write to a text file.

19. Write a function, reverse Digit, that takes an integer as a parameter and returns the number with its digits reversed. For example, the value of function reverse Digit12345 is 54321 and the value of reverse Digit -532 is -235.

DSE-2

Total Marks:100-(Theory: 80 Marks+Mid-Sem: 20 Marks)
5 Lectures, 1 Tutorial (per week)
(Any one of the following)

1-DISCRETE MATHEMATICS

Unit-I

Propositional Logic, Proportional equivalences, Predicates and Quantifiers, Nested quantifiers, Rules of Inference, Methods of proof, Relations and their properties, n-ary relations and their applications, The basic counting, the Pigeon-hole principle, Generalized Permutations and Combinations.

Unit-II

Recurrence relations, Modelling with recurrence relations, Solving linear homogeneous recurrence re- lations with constant coefficients, Generating functions, Solving recurrence relations using generating functions, Principle of Inclusion-Exclusion & applications.

Unit-III

Partially ordered sets, Hasse diagram of partially ordered sets, maps between ordered sets, Boolean

expressions and Boolean functions, Duality principle, Lattices as ordered sets, Lattices as algebraic structures, sublattices, Boolean algebra and its properties.

Unit-IV

Graphs: Basic concepts and graph terminology, representing graphs and graph isomorphism, Cut-vertices and Cut-edges, Distance in a graph (restricted), Connectivity, Euler and Hamiltonian path, Shortest-Path problems, Planar graphs, Graph coloring.

Book Recommended:

1. Kenneth H. Rosen: Discrete Mathematics and Applications, Tata McGraw Hill Publications, Chapters: 1(1.1-1.6), 4(4.1, 4.2, 4.5), 5(5.1, 5.2, 5.5), 6(6.1, 6.2, 6.4-6.6), 7(7.1, 7.2), 8, 10(10.1, 10.2).

Books for References:

1. B A. Davey and H. A. Priestley: Introduction to Lattices and Order, Cambridge University Press, Cambridge, 1990.
2. Edgar G. Goodaire and Michael M. Parmenter: Discrete Mathematics with Graph Theory (2nd Edition), Pearson Education (Singapore) Pte. Ltd., Indian Reprint 2003.
3. Rudolf Lidl and Gnter Pilz: Applied Abstract Algebra (2nd Edition), Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
4. D.S. Malik: Discrete Mathematics: Theory & Applications, Cengage Learning India Pvt. Ltd.
5. Kevin Ferland: Discrete Mathematical Structures, Cengage Learning India Pvt. Ltd.

2-MATHEMATICAL MODELLING

Unit-I

Simple situations requiring Mathematical modelling. The technique of Mathematical modelling, Mathematical modelling through differential equations, linear growth and decay models, non-linear growth and decay models, compartment models, Mathematical modelling of geometrical problems through ordinary differential equations of first order.

Unit-II

Mathematical modelling in population dynamics, Mathematical modelling of epidemics through systems of ordinary differential equations of first order, compartment models through systems of ordinary differential equations, Mathematical modelling in economics through systems of ordinary differential equations of first order.

Unit-III

Mathematical models in medicine, arms race, battles and international trade in terms of systems of ordinary differential equations, Mathematical modelling of planetary motions, Mathematical modelling of circular motion and motion of satellites, mathematical modelling through linear differential equations of second order.

Unit-IV

Situation giving rise to partial differential equations models, mass balance equations: First method of getting PDE models, momentum balance equations. The second method of obtaining partial differential models, variational principles , third function, fourth method of obtaining partial differential equation models, models for traffic flow of a highway. Situation that can be modelled through graphs, mathematical models in terms of directed graphs, optimization principles and techniques, Mathematical modelling through calculus of variations.

Book Recommended:

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

3-NUMBER THEORY

Unit-I

Divisibity theorem in integers, Primes and their distributions, Fundamental theorem of arithmetic, Greatest common divisor, Euclidean algorithms, Modular arithmetic, Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture.

Unit-II

Introduction to congruences, Linear Congruences, Chinese Remainder theorem, Polynomial congruences, System of linear congruences, complete set of residues, Chinese remainder theorem, Fermats little theorem, Wilsons theorem.

Unit-III

Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mbius inversion formula, the greatest integer function, Eulers phifunction, Eulers theorem, reduced set of residues, some properties of Eulersphi-function.

Unit-IV

Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Eulers criterion, the Legendre symbol and its properties, quadratic reciprocity, quadratic congruences with composite moduli.

Book Recommended:

1. D.M. Burton: Elementary Number Theory, McGraw Hill, Chapters: 2(2.1 to 2.4), 3(3.1 to 3.3), 4(4.1 to 4.4), 5(5.1 to 5.4), 6(6.1 to 6.3), 7(7.1 to 7.3), 8(8.1 to 8.2), 9(9.1 to9.3).

Books for Reference:

1. K.H. Rosen: Elementary Number Theory & its Applications, Pearson Addition Wesley.
2. I. Niven and H.S. Zuckerman: An Introduction to Theory of Numbers, Wiley Eastern Pvt. Ltd.

3. Tom M. Apostol: Introduction to Analytic Number Theory, Springer International Student Edn.

4. Neville Robinns: Beginning Number Theory (2nd Edition), Narosa Publishing House Pvt. Limited, Delhi, 2007.

4-BOOLEAN ALGEBRA & AUTOMATA THEORY

Unit-I

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, lattices as ordered sets, lattices as algebraic structures, sublattices, products and homomorphisms. Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials, QuinnMcCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.

Unit-II

Introduction: Alphabets, strings, and languages. Finite Automata and Regular Languages: deterministic and non-deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages.

Unit-III

Context Free Grammars and Pushdown Automata: Context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language accepted by PDA, deterministic PDA, Non- deterministic PDA, properties of context free languages;normal forms, pumping lemma, closure properties, decision properties.

Unit-IV

Turing Machines: Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence. Undecidability: Recursively enumerable and recursive languages, undecidable problems about Turing machines: halting problem, Post Correspondence Problem, and undecidability problems About CFGs.

Books Recommended:

1. B A. Davey and H. A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 1990.

2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, (2nd Ed.), Pearson Education (Singapore) P.Ltd., Indian Reprint 2003.

3. Rudolf Lidl and Gnter Pilz, Applied Abstract Algebra, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

4. J. E. Hopcroft, R. Motwani and J. D. Ullman, Introduction to AutomataTheory, Languages, and Computation, 2nd Ed., Addison-Wesley, 2001.

5. H.R. Lewis, C.H. Papadimitriou, C. Papadimitriou, Elements of the Theory of Computation, 2nd Ed., Prentice-Hall, NJ, 1997.

6. J.A. Anderson, Automata Theory with Modern Applications, Cambridge University Press, 2006.

DSE-3
Total Marks:100-(Theory:80 Marks+Mid-Sem:20 Marks) 5 Lectures,
1 Tutorial (per week)
(Any one of the following)

1-DIFFERENTIAL GEOMETRY

Unit-I
Theory of Space Curves: Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae. Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.

Unit-II
Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.

Unit-III
Developables: Developable associated with space curves and curveson surfaces, Minimal surfaces.

Unit-IV
Theory of Surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Eulers theorem. Rodrigues formula, Conjugate and Asymptotic lines.

Book Recommended:

1. C.E. Weatherburn, Differential Geometry of Three Dimensions, Cambridge University Press 2003. Chapters:1(1-4, 7,8,10), 2(13, 14, 16, 17), 3, 4(29-31, 35, 37, 38).

Books for References

1. T.J. Willmore, An Introduction to Differential Geometry, Dover Publications, 2012.
2. S. Lang, Fundamentals of Differential Geometry, Springer, 1999.
3. B. O'Neill, Elementary Differential Geometry, 2nd Ed., Academic Press, 2006.
4. A.N. Pressley-Elementary Differential Geometry, Springer.
5. B.P. Acharya and R.N. Das-Fundamentals of Differential Geometry, Kalyani Publishers, Ludhiana, New Delhi.

2-MECHANICS

Unit-I

Moment of a force about a point and an axis, couple and couple moment, Moment of a couple about a line, resultant of a force system, distributed force system, free body diagram, free body involving interior sections, general equations of equilibrium, two point equivalent loading, problems arising from structures, static indeterminacy.

Unit-II

Laws of Coulomb friction, application to simple and complex surface contact friction problems, transmission of power through belts, screw jack, wedge, first moment of an area and the centroid, other centers, Theorem of Pappus-Guldinus, second moments and the product of area of a plane area, transfer theorems, relation between second moments and products of area, polar moment of area, principal axes.

Unit-III

Conservative force field, conservation for mechanical energy, work energy equation, kinetic energy and work kinetic energy expression based on center of mass, moment of momentum equation for a single particle and a system of particles.

Unit-IV

Translation and rotation of rigid bodies, Chasles theorem, general relationship between time derivatives of a vector for different references, relationship between velocities of a particle for different references, acceleration of particle for different references.

Book Recommended:

1. I.H. Shames and G. Krishna Mohan Rao, Engineering Mechanics: Statics and Dynamics, (4th Ed.), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009. Chapters:3, 4, 5, 6(6.1-6.7), 7, 11, 12(12.5, 12.6), 13.

Books for Reference:

1. R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics, 11th Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.
2. Grant R Fowles, Analytical Mechanics, Cengage Learning India Pvt. Ltd.

3-MATHEMATICAL FINANCE

Unit-I

Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound, discrete and continuous), time value of money, inflation, net present value, internal rate of return (calculation by bisection and Newton-Raphson methods), comparison of NPV and IRR. Bonds, bond prices and yields, Macaulay and modified duration, term structure of interest rates: spot and forward rates, explanations of term structure, running present value, floating-rate bonds, immunization, convexity, putable and callable bonds.

Unit-II

Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance

and correlation), random returns, portfolio mean return and variance, diversification, portfolio diagram, feasible set, Markowitz model (review of Lagrange multipliers for 1 and 2 constraints), Two fund theorem, risk free assets, One fund theorem, capital market line, Sharpe index. Capital As- set Pricing Model (CAPM), betas of stocks and portfolios, security market line, use of CAPM in investment analysis and as a pricing formula, Jensens index.

Unit-III

Forwards and futures, marking to market, value of a forward/futures contract, replicating portfolios, futures on assets with known income or dividend yield, currency futures, hedging (short, long, cross, rolling), optimal hedge ratio, hedging with stock index futures, interest rate futures, swaps.

Unit-IV

Lognormal distribution, Lognormal model / Geometric Brownian Motion for stock prices,Binomial Tree model for stock prices, parameter estimation, comparison of the models. Options, Types of options: put / call, European / American, pay off of an option, factors affecting option prices, put call parity.

Books Recommended:

1. David G. Luenberger, Investment Science, Oxford University Press, Delhi, 1998. Chapters:1, 2, 3, 4, 6, 7, 8(8.5-8.8), 10(except 10.11, 10.12), 11(except 11.2 11.8).
2. John C. Hull, Options, Futures and Other Derivatives (6th Edition), Prentice-Hall India, Indian reprint, 2006. Chapters: 3, 5, 6, 7(except 7.10, 7.11), 8, 9.
3. Sheldon Ross, An Elementary Introduction to Mathematical Finance (2nd Edition), Cambridge University Press, USA, 2003. Chapter:3

Books for References:

1. R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics, 11th Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.
2. Grant R Fowles, Analytical Mechanics, Cengage Learning India Pvt. Ltd.

4-RING THEORY & LINEAR ALGEBRA-II

Unit-I

Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, unique factorization in Z[x].

Unit-II

Divisibility in integral domains, irreducibles, primes, unique factorization domains, Euclidean domains.

Unit-III

Dual spaces, dual basis, double dual, transpose of a linear transformationand its matrix in the

dual basis, annihilators, Eigenspaces of a linearoperator, diagonalizability, invariant subspaces and Cayley-Hamiltontheorem, the minimal polynomial for a linear operator.

Unit-IV

Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessels inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.

Books Recommended:

1. Joseph A. Gallian: Contemporary Abstract Algebra (4th Ed.), Narosa Publishing House, 1999. Chapters: 16, 17, 18.
2. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence: Linear Algebra (4th Edition), Prentice-Hall of India Pvt. Ltd., New Delhi, 2004. Chapters: 2(2.6 only), 5(5.1, 5.2, 5.4), 6(6.1, 6.4, 6.6), 7(7.3 only).

Books for Reference:

(For LINEAR ALGEBRA)

1. S Lang: Introduction to Linear Algebra (2nd edition), Springer, 2005
2. Gilbert Strang: Linear Algebra and its Applications, Thomson, 2007
3. S. Kumaresan: Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999.
4. 4. Kenneth Hoffman, Ray Alden Kunze: Linear Algebra 2nd Ed., Prentice-Hall Of India Pvt. Limited, 1971.

(For RING THEORY)

1. John B.Fraleigh: A first course in Abstract Algebra, 7th Edition, Pearson Education India, 2003.
2. Herstein: Topics in Algebra (2nd edition), John Wiley & Sons, 2006
3. M ichael Artin: Algebra (2nd edition), Pearson Prentice Hall, 2011
4. Robinson, Derek John Scott.: An introduction to abstract algebra, Hindustan book agency, 2010.

DSE-4

PROJECT WORK/DISSERTATION (Compulsory)

Total Marks:100-(Project:75 Marks+Viva-Voce:25 Marks)

SKILL ENHANCEMENT COURSES (SEC)
(Credit: 2 each, Total Marks:50) SEC-1 to SEC-4

SEC-1

COMMUNICATIVE ENGLISH & WRITING SKILL (Compulsory)

SEC-2

(Any one of the following)

1-COMPUTER GRAPHICS

Development of computer Graphics: Raster Scan and Random Scan graphics storages, displays processors and character generators, colour display techniques, interactive input/output devices. Points, lines and curves: Scan conversion, line-drawing algorithms, circle and ellipse generation, conic-section generation, polygon filling anti aliasing. Two-dimensional viewing: Coordinate systems, linear transformations, line and polygon clipping algorithms.

Books Recommended:

1. D. Hearn and M.P. Baker-Computer Graphics, 2nd Ed., PrenticeHall of India, 2004.
2. J.D. Foley, A van Dam, S.K. Feiner and J.F. Hughes-Computer Graphics: Principals and Practices, 2nd Ed., Addison-Wesley, MA, 1990.
3. D.F. Rogers-Procedural Elements in Computer Graphics, 2nd Ed., McGraw Hill Book Company, 2001.
4. D.F. Rogers and A.J. Admas-Mathematical Elements in Computer Graphics, 2nd Ed., McGraw Hill Book Company, 1990.

2-LOGIC & SETS

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations. Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations, nary relations.

Books Recommended:

1. 1. R.P. Grimaldi-Discrete Mathematics and Combinatorial Mathematics, Pearson Education, 1998.

2. P.R. Halmos-Naive Set Theory, Springer, 1974.

3. E. Kamke-Theory of Sets, Dover Publishers, 1950.

3-COMBINATORIAL MATHEMATICS

Basic counting principles, Permutations and Combinations (with and without repetitions), Binomial theorem, Multinomial theorem, Counting subsets, Set-partitions, Stirling numbers Principle of Inclusion and Exclusion, Derangements, Inversion formulae Generating functions: Algebra of formal power series, Generating function models, Calculating generating functions, Exponential generating functions. Recurrence relations: Recurrence relation models, Divide and conquer relations, Solution of recurrence relations, Solutions by generating functions. Integer partitions, Systems of distinct representatives.

Books Recommended:

1. J.H. van Lint and R.M. Wilson-A Course in Combinatorics, 2nd Ed., Cambridge University Press, 2001.

2. V. Krishnamurthy-Combinatorics, Theory and Application, Affiliated East-West Press 1985.

3. P.J. Cameron-Combinatorics, Topics, Techniques, Algorithms, Cambridge University Press, 1995.

4. M. Jr. Hall-Combinatorial Theory, 2nd Ed., John Wiley & Sons, 1986.

5. S.S. Sane-Combinatorial Techniques, Hindustan Book Agency, 2013.

6. R.A. Brualdi-Introductory Combinatorics, 5th Ed., Pearson Education Inc., 2009.

4-INFORMATION SECURITY

Overview of Security: Protection versus security; aspects of securitydata integrity, data availability, privacy; security problems, user authentication, Orange Book. Security Threats: Program threats, worms, viruses, Trojan horse, trap door, stack and buffer over flow; system threats- intruders; communication threats- tapping and piracy. Security Mechanisms: Intrusion detection, auditing and logging, tripwire, system-call monitoring.

Books Recommended:

1. C. Pfleeger and S.L. Pfleeger-Security in Computing , 3rd Ed., Prentice-Hall of India, 2007.

2. D. Gollmann-Computer Security, John Wiley and Sons, NY, 2002.

3. J. Piwprzyk, T. Hardjono and J. Seberry-Fundamentals of Computer Security, Springer- Verlag Berlin, 2003.

4. J.M. Kizza-Computer Network Security, Springer, 2007.

5. M. Merkow and J. Breithaupt-Information Security: Principles and Practices, Pearson Education, 2006.

GENERIC ELECTIVES(Interdisciplinary)
(04 Papers, 02 papers each from two Allied disciplines) (Credit: 06 each, Marks:100)
GE-1 to GE-4

GE-1 : CALCULUS & ORDINARY DIFFERENTIAL EQUATIONS
Total Marks:100-(Theory: 80 Marks+Mid-Sem: 20 Marks)

Unit-I

Curvature, Asymptotes, Tracing of Curves (Cartenary, Cycloid, Folium of Descartes), Rectification, Quardrature, Elementary ideas about Sphere, Cones, Cylinders and Conicoids.

Unit-II

Review of limits, continuity and differentiability of functions of one variables and their properties, Limit and Continuity of functions of several variables, Partial derivatives, Partial derivatives of higher orders, Homogeneous functions, Change of variables, Mean value theorem, Taylors theorem and Maclaurins theorem for functions of two variables(statements & applications).

Unit-III

Maxima and Minima of functions of two and three variables, Implicit functions, Lagranges multipliers (Formulae & its applications), Concepts of Multiple integrals & its applications.

Unit-IV

Ordinary Differential Equations of order one and degree one (variables separable, homogeneous, exact and linear). Equations of order one but higher degree. Second order linear equations with constant coefficients, homogeneous forms, Second order equations with variable coefficients, Variation of parameters.

Books Recommended:

1. S.K. Sengar and S.P. Singh: Advanced Calculus, Cengage Learning India Pvt. Ltd.(6th Indian Reprint), Chapters: 1(1.11-1.14 restricted), 2(2.1-2.13 restricted), 4(4.1-4.11), 5, 7(7.1-7.3 restricted), 11(resticted).
2. Shantinarayan: Text Book of Calculus, Part-II, S. Chand and Co., Chapter-8 (Art. 24, 25, 26)
3. Shantinarayan: Text Book of Calculus, Part-III, S. Chand and Co., Chapter-1 (Art 1,2), 3, 4(Art. 10 to 12 ommitting Simpsons Rule), 5(Art-13) and 6(Art-15).
4. B.P. Acharya and D.C. Sahu: Analytical Geometry of Quadratic Surfaces, Kalyani Publishers, New Delhi, Ludhiana.

5. J. Sinharoy and S. Padhy: A Course of Ordinary and Partial Differential Equations, Kalyani Publishers. Chapters: 2(2.1 to 2.7), 3, 4(4.1 to 4.7), 5.

Books for Reference:

1. Shanti Narayan and P.K. Mittal: Analytical Solid Geometry, S. Chand & Company Pvt. Ltd., New Delhi.
2. David V. Weider: Advanced Calculus, Dover Publications.
3. Martin Braun: Differential Equations and their Applications-Martin Braun, Springer International.
4. M.D. Raisinghania: Advanced Differential Equations, S. Chand & Company Ltd., New Delhi.
5. G. Dennis Zill: A First Course in Differential Equations with Modelling Applications, Cengage Learning India Pvt. Ltd.

GE-2: LINEAR ALGEBRA, ABSTRACT ALGEBRA & NUMERICAL ANALYSIS

Total Marks:100-(Theory: 80 Marks+Mid-Sem: 20 Marks)

Unit-I

Vector space, Subspace, Span of a set, Linear dependence and Independence, Dimensions and Basis. Linear transformations, Range, Kernel, Rank, Nullity, Inverse of a linear map, Rank-Nullity theorem.

Unit-II

Matrices and linear maps, Rank and Nullity of a matrix, Transpose of a matrix, Types of matri- ces. Elementary row operations, System of linear equations, Matrix inversion using row operations, Determinant and Rank of matrices, Eigen values, Eigen vectors.

Unit-III

Group Theory: Definition and examples, Subgroups, Normal subgroups, Cyclic groups, Cosets, Quotient groups, Permutation groups, Homomorphism. Elementary ideas about Rings, Field (definitions, statements, and examples only).

Unit-IV

Convergence, Errors: Relative, Absolute, Round off, Truncation. Transcendental and Polynomial equations: Bisection method, Newtons method, Secant method. Rate of convergence of these methods. System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Interpolation: Lagrange and Newtons methods. Error bounds. Finite difference operators. Gregory forward and backward difference interpolation (statements, definitions and uses/examples only).

Books Recommended:

1. V. Krishnamurty, V. P. Mainra, J. L. Arora: An introduction to Linear Algebra, Affiliated East-West Press Pvt. Ltd., New Delhi, Chapters: 3, 4(4.1 to 4.7), 5(except 5.3), 6(6.1, 6.2, 6.5, 6.6, 6.8), 7(7.4 only).

2. I.N. Herstein: Topics in Algebra, Wiley Eastern Pvt. Ltd. Chapters: 2(2.1-2.7), 3(3.1, 3.2).
3. B.P. Acharya and R.N. Das: A Course on Numerical Analysis, Kalyani Publishers, New Delhi, Ludhiana. Chapters: 1, 2(2.1 to 2.4, 2.6, 2.8, 2.9), 3(3.1 to 3.4), 4(4.1, 4.2), 5(5.1- 5.3), 6(6.1-6.3, 6.10, 6.11).

Books for References:

1. I.H. Seth: Abstract Algebra, Prentice Hall of India Pvt. Ltd., New Delhi.
2. S. Kumaresan: Linear Algebra, A Geometric Approach, Prentice Hall of India.
3. Rao and Bhimasankaran: Linear Algebra, Hindustan Publishing House.
4. S. Singh: Linear Algebra, Vikas Publishing House Pvt. Ltd., New Delhi.
5. Gilbert Strang: Linear Algebra & its Applications, Cengage Learning India Pvt. Ltd.
6. Gallian: Contemporary Abstract Algebra, Narosa publishing House.
7. Artin: Algebra, Prentice Hall of India.
8. V.K. Khanna and S.K. Bhambri: A Course in Abstract Algebra, Vikas Publishing House Pvt. Ltd., New Delhi.

PHYSICS(HONOURS)

SEMESTER-I

C-I: MATHEMATICAL PHYSICS-I

(Credits: Theory-04, Practicals-02)
Marks:100 (Theory:70, Practical: 30)
Theory: 40 Classes (1 hr. duration)

The emphasis of course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems, seen and unseen.

UNIT-I

Calculus: Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials, Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers. (4 Lectures)

Vector Calculus: Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. (5 Lectures)

UNIT-II

Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates, Derivation of Gra- dient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. Comparison of velocity and acceleration in cylindrical and spherical coordinate system. (7 Lectures)

Dirac Delta function and its properties: Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function. (3 Lectures)

UNIT-III

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalarfield and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities, Gradient, divergence, curl and Laplacian in spherical and cylindrical coordinates. (8 Lectures)

UNIT-IV

Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of in- finitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applica- tions (no rigorous proofs). (13 Lectures)

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013,7th Edn., Elsevier.

2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning.

3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
7. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
8. Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press
9. Mathematical Physics and Special Relativity-M. Das, P.K. Jena and B.K. Dash (Srikrishna Prakashan) 2nd Edition 2009
10. Mathematical Physics–H. K. Dass, Dr. Rama Verma (S. Chand Higher Academics), th Edition 2011.
11. Mathematical PhysicsC. Harper, (Prentice Hall India) 2006.
12. Mathematical Physics-Goswami (Cengage Learning) 2014
13. Mathematical Method for Physical Sciences- M. L. Boas (Wiley India) 2006

PHYSICS LAB-C:I

20 Classes (2 hrs. duration)

The aim of this Lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

- Highlights the use of computational methods to solve physical problems.
- The course will consist of lectures (both theory and practical) in the Lab.
- Evaluation done not on the programming but on the basis of formulating the problem.
- Aim at teaching students to construct the computational problem to be solved.
- Students can use any one operating system Linux or Microsoft Windows.

Topics	Description with Applications
Introduction and Overview	Computer architecture and organization, memory and Input/output devices.
Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow & overflow emphasize the importance of making equations in terms of dimensionless variables, Iterative methods.
Errors and error Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.
Review of C & C++ programming fundamentals	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (If-statement. If-else Statement. Nested if Structure. Else-if Statement. Ternary Operator.
	Goto Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops), Arrays (1D & 2D) and strings, user defined functions, Structures and Unions, Idea of classes and objects.
Programs	Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search.
Random number generation	Area of circle, area of square, volume of sphere, value of π.

Referred Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn. , 2012, PHI Learning Pvt. Ltd.
2. Schaum's Outline of Programming with C++. J. Hubbard, 2000, McGraw–Hill Pub.
3. Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal, 3rd Edn. 2007, Cambridge University Press.
4. A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.
5. Elementary Numerical Analysis, K.E. Atkinson, 3 rd Edn. , 2007 , Wiley India Edition.
6. Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.
7. An Introduction to computational Physics, T. Pang, 2nd Edn., 2006,Cambridge Univ. Press.

C-2: MECHANICS

(Credits: Theory-04, Practicals-02)
Marks:100 (Theory:70, Practical: 30)
Theory: 40 Classes (1 hr. duration)

UNIT-I

Rotational Dynamics: Centre of Mass and Laboratory frames. Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation. (9 Lectures)

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. (3 Lectures)

UNIT-II

Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire. (3 Lectures)

Fluid Motion: Kinematics of Moving Fluids: Poiseuilles Equation for Flow of a Liquid through a Capillary Tube . (3 Lectures)

Oscillations: SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor. (5 Lectures)

UNIT-III

Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. (3 Lectures)

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Keplers Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). Physiological effects on astronauts.(5 Lectures)

UNIT-IV

Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum. Energy-Momentum Four Vector. (9 Lectures)

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.

5. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
(Additional Books for Reference)
8. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
9. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
10. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A.Serway, 2010, Cengage Learning
11. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
12. Mechanics - J. C. Slater and N. H. Frank (McGraw-Hill)

PHYSICS LAB-C:II

20 Classes (2 hrs. duration)

1. To study the random error in observations.
2. To determine the height of a building using a Sextant.
3. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
4. To determine the Moment of Inertia of a Flywheel.
5. To determine g and velocity for a freely falling body using Digital Timing Technique
6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuilles method).
7. To determine the Young's Modulus of a Wire by Optical Lever Method.
8. To determine the Modulus of Rigidity of a Wire by Maxwells needle. 9. To determine the elastic Constants of a wire by Searles method.
9. To determine the value of g using Bar Pendulum.
10. To determine the value of g using Katers Pendulum

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, AsiaPublishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal

SEMESTER-II

C-3: ELECTRICITY AND MAGNETISM

(Credits: Theory-04, Practicals-02)
Marks:100 (Theory:70, Practical: 30)
Theory: 40 Classes (1 hr. duration)

UNIT-I

Electric Field and Electric Potential: Electric field: Electric field lines. Electric flux. Gauss Law with applications to charge distributions with spherical, cylindrical and planar symmetry. (3 Lectures)

Conservative nature of Electrostatic Field. Electrostatic Potential. Laplaces and Poissonequations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole. (3 Lectures)

Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere. (4 Lectures)

UNIT-II

Magnetic Field: Magnetic force between current elements and definition of Magnetic Field B. Biot-Savarts Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Amperes Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current ele- ments. Torque on a current loop in a uniform Magnetic Field. Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. CDR. (10 Lectures)

UNIT-III

Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss Law in di- electrics. (4 Lecturers)

Magnetic Properties of Matter: Magnetization vector (M). Magnetic Intensity (H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hys-teresis. (4 Lecturers)

Electromagnetic Induction: Faradays Law. Lenzs Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. (2 Lectures)

UNIT-IV

Electrical Circuits: AC Circuits: Kirchhoffs laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width,. Parallel LCR Circuit. (5 Lectures)

Network theorems: Ideal Constant-voltage and Constant-current Sources. Network Theorems:

Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Growth & decay of currents in RC, RL, and LCR Series circuits for DC. (5 Lectures)

Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
4. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
5. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
6. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

PHYSICS LAB-C:III

20 Classes (2 hrs. duration)

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (a) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a series RC Circuit.
3. To determine an unknown Low Resistance using Potentiometer.
4. To determine an unknown Low Resistance using Carey Fosters Bridge.
5. To compare capacitances using DeSautys bridge.
6. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
7. To verify the Thevenin and Norton theorems.
8. To verify the Superposition, and Maximum power transfer theorems.
9. To determine self inductance of a coil by Andersons bridge.
10. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
11. To study the response curve of a parallel LCR circuit and determine its (a) Antiresonant frequency and (b) Quality factor Q.
12. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer
13. Determine a high resistance by leakage method using Ballistic Galvanometer.
14. To determine self-inductance of a coil by Rayleighs method.

15. To determine the mutual inductance of two coils by Absolute method.

Reference Books:

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

C-4: WAVES AND OPTICS

(Credits: Theory-04, Practicals-02)
Marks:100 (Theory:70, Practical: 30)
Theory: 40 Classes (1 hr. duration)

UNIT-I

Geometrical optics: Fermats principle, reflection and refraction at plane interface, Matrix formulation of geometrical Optics. Idea of dispersion. Application to thick lense, Ramsden and Huygens eyepiece.(5 Lecturers)

Wave Optics: Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence. Division of amplitude and wavefront. Youngs double slit experiment. Lloyds Mirror and Fresnels Biprism. Phase change on reflection: Stokes treatment. (5 Lecturers)

UNIT-II

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves. (5 Lectures)

Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures (1:1 and 1:2) and their uses. Superposition of N harmonic waves. (3 Lectures)

UNIT-III

Interference: Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclina- tion (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newtons Rings: Measurement of wavelength and refractive index. (5 Lecturers)

Interferometer: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer. . (5 Lectures)

UNIT-IV

Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. (6 Lectures)

Fresnel Diffraction: Fresnels Assumptions. Fresnels Half-Period Zones for Plane Wave. Expla- nation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnels Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire. (6 Lectures)

Reference Books:

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
4. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
7. Optics - Brijlal & Subramaniam- (S. Chand Publication) 2014.
8. Geometrical and Physical Optics R.S. Longhurst, Orient Blackswan, 01-Jan-1986
9. Vibrations and Waves - A. P. French, (CBS) Indian print 2003
10. Optics, E. Hecht (Pearson India)

PHYSICS LAB-C:IV

20 Classes (2 hrs. duration)

1. To determine the frequency of an electric tuning fork by Meldes experiment and verify 2 T law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with: Schuster‘s focusing; determination of angle of prism.
5. To determine refractive index of the Material of a prism using sodium source.
6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7. To determine the wavelength of sodium source using Michelsons interferometer.
8. To determine wavelength of sodium light using Fresnel Biprism.
9. To determine wavelength of sodium light using Newtons Rings.
10. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.

11. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.

12. To determine dispersive power and resolving power of a plane diffraction grating.

Reference Books:

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

2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal

3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition,reprinted 1985, Heinemann Educational Publishers

4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani

SEMESTER-III

C-5: MATHEMATICAL PHYSICS-II

(Credits: Theory-04, Practicals-02)
Marks:100 (Theory:70, Practical: 30)
Theory: 40 Classes (1 hr. duration)

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

UNIT-I

Fourier series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Condi- tions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier series. Parseval Identity. (11Lectures)

UNIT-II

Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance, Frobenius method and its applications to differential equations: Legendre & Hermite Differential Equations. Properties of Legendre & Hermite Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Associated Legendre polynomials and spherical harmonics. (10 Lectures)

UNIT-III

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral). (5 Lectures) Theory of Errors: Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error. (4 Lectures)

UNIT-IV

Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Conducting and dielectric sphere in an external uniform electric field. Wave equation and its solution for vibrational modes of a stretched string. (10 Lectures)

Reference Books:

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
4. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
5. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
6. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books
7. Mathematical Physics and Special Relativity –M. Das, P.K. Jena and B.K. Dash (Srikrishna Prakashan) 2nd Edition 2009
8. Mathematical Physics–H. K. Dass, Dr. Rama Verma (S. Chand Higher Academics) 6th Edition 2011.
9. Mathematical Physics C. Harper, (Prentice Hall India) 2006.
10. Mathematical Physics-Goswami (CENGAGE Learning) 2014
11. Mathematical Method for Physical Sciences – M. L. Boas (Wiley India) 2006
12. Mathematics for Physicists, P. Dennery and A. Krzywicki Dover)
13. Advanced Engineering Mathematics, E. Kreyszig (New Age Publication) 2011.

PHYSICS LAB-C:V

20 Classes (2 hrs. duration)

The aim of this Lab is to use the computational methods to solve physical problems. Course will consist of lectures (both theory and practical) in the Lab. Evaluation done not on the programming but on the basis of formulating the problem.

Topics	Description with Applications
Introduction to Numerical computation software Scilab	Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar and arrayoperations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting (2), Branching Statements and program design, Relational & logical operators, the while loop, for loop, details of loop operations, break & continue statements, nested loops, logical arrays and vectorization (2) User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays (2) an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program (2).
Curve fitting, Least square fit, Goodness of fit, standard deviation	Ohms law to calculate R, Hookes law to calculate spring constant
Solution of Linear system of equations by Gauss elimination method and Gauss Seidal method. Diagonalization of matrices, Inverse of a matrix, Eigen vectors, eigen values problems.	Solution of mesh equations of electric circuits (3 meshes) Solution of coupled spring mass systems (3 masses)

Solution of ODE First order Differential equation Euler, modified Euler and Runge-Kutta second order methods Second order differential equation. Fixed difference method.	First order differential equation • Radioactive decay • Current in RC, LC circuits with DC source • Newtons law of cooling • Classical equations of motion Second order Differential Equation • Harmonic oscillator (no friction) • Damped Harmonic oscillator • Over damped • Critical damped • Oscillatory • Forced Harmonic oscillator • Transient and • Steady state solution • Apply above to LCR circuits also.

Reference Books:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J.20 Bence, 3rd ed., 2006, Cambridge University Press
2. Complex Variables, A.S. Fokas & M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
3. First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett
4. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific andEngi- neering Applications: A.V. Wouwer, P. Saucez, C.V. Fernndez. 2014 Springer
5. Scilab by example: M. Affouf 2012, ISBN: 978-1479203444
6. Scilab (A free software to Matlab): H.Ramchandran, A.S.Nair. 2011 S.Chand & Company
7. Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing

C-6: THERMAL PHYSICS

(Credits: Theory-04, Practicals-02)
Marks:100 (Theory:70, Practical: 30)
Theory: 40 Classes (1 hr. duration)

UNIT-I

Introduction to Thermodynamics: Recapitulation of Zeroth and First law of thermodynam- ics: Second Law of Thermodynamics: Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnots Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnots Theorem. Applications of Second Law of Thermodynam- ics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. (5 Lectures)

Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Principle of Increase of Entropy. TemperatureEntropy diagrams for Carnots Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero. (6 Lectures)

UNIT-II

Thermodynamic Potentials: Extensive and Intensive Thermodynamic Variables. Thermody- namic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibbs Free Energy. Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work, Cooling due to adiabatic demagnetization, first and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations (5 Lectures)

Maxwells Thermodynamic Relations: Derivations and applications of Maxwells Relations, Maxwells Relations:(1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) Tds Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process. (5 Lectures)

UNIT-III

Kinetic Theory of Gases

Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Sterns Experiment. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases. (5 Lectures)

Molecular Collisions: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian motion and its Significance. (4 Lectures)

UNIT-IV

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equa- tion. Andrews Experiments on CO_2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waals Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joules Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule- Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule- Thomson Cooling. (10 Lectures)

Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.

6. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford Uni- versity Press

7. Heat and Thermal Physics-Brijlal & Subramaiam (S.Chand Publication) 2014

8. Thermal Physics– C. Kittel and H. Kroemer (McMillan Education India) 2010

PHYSICS LAB-C:VI

20 Classes (2hr duration)

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barnes constant flow method.

2. To determine the Coefficient of Thermal Conductivity of Cu by Searles Apparatus.

3. To determine the Coefficient of Thermal Conductivity of Cu by Angstroms Method.

4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charltons disc method.

5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).

6. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.

7. To calibrate a thermocouple to measure temperature in a specified Range using (1) Null Method, (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.

8. To determine J by Caloriemeter.

Reference Books:

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

2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal

3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

4. A Laboratory Manual of Physics for undergraduate classes,D.P.Khandelwal,1985, Vani Pub.

C-7: DIGITAL SYSTEMS AND APPLICATIONS

(Credits: Theory-04, Practicals-02)
Marks:100 (Theory:70, Practical: 30)
Theory: 40 Classes (1 hr. duration)

UNIT-I

Digital Circuits: Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers. (5 Lectures)

Boolean algebra: De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean algebra. Fundamental Products. Idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. (5 Lectures)

UNIT-II

Data processing circuits: Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders. (3 Lectures)

Arithmetic Circuits: Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor.(4 Lectures)

Timers: IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator. (3 Lectures)

UNIT-III

Integrated Circuits (Qualitative treatment only): Active & Passive components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital lCs. (5 Lectures)

Introduction to CRO: Block Diagram of CRO. Electron Gun, Deflection System and Time Base. Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. (5 Lectures)

UNIT-IV

Introduction to Computer Organization: Input/output Devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization & addressing. Memory Interfacing. Memory Map. (4 Lectures)

Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits). (2 Lectures)

Counters (4 bits): Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.(4 Lectures)

Reference Books:

1. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw
2. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning

5. Logic circuit design, Shimon P. Vingron, 2012, Springer.
6. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
7. Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.
8. Concept of Electronics: D.C.Tayal (Himalay Publication) 2011.
9. Electronics-V. K. Meheta (S. Chand Publication),2013
10. The Art of Electronics, P. Horowitz and W. Hill, CUP.

PHYSICS PRACTICAL-C:VII

20 Classes (2 hrs. duration)

1. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.
2. To test a Diode and Transistor using a Multimeter.
3. To design a switch (NOT gate) using a transistor.
4. To verify and design AND, OR, NOT and XOR gates using NAND gates.
5. To design a combinational logic system for a specified Truth Table.
6. To convert a Boolean expression into logic circuit and design it using logic gate ICs.
7. To minimize a given logic circuit.
8. Half Adder, Full Adder and 4-bit binary Adder.
9. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.
10. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
11. To build JK Master-slave flip-flop using Flip-Flop ICs
12. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.
13. To make a 4-bit Shift Register (serial and parallel) using D-type/JK Flip-Flop ICs.
14. To design an astable multivibrator of given specifications using 555 Timer.
15. To design a monostable multivibrator of given specifications using 555 Timer.

Reference Books:

1. Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill.
2. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.

3. Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, Prentice Hall.

4. Microprocessor 8085:Architecture, Programming and interfacing, A. Wadhwa, 2010, PHI Learning.

SEMESTER-IV

C-VIII: MATHEMATICAL PHYSICS-III

(Credits: Theory-04, Practicals-02)
Marks:100 (Theory:70, Practical: 30)
Theory: 40 Classes (1 hr. duration)

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

UNIT-I

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality.Cauchys theorem, Cauchys Integral formula. Simply and multiply connected. (10 Lectures)

UNIT-II

Integrals Transforms: Laurent and Taylors expansion. Residues and Residue Theorem. Application in solving Definite Integrals. Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral.(10 Lectures)

UNIT-III

Integrals Transforms: Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transform (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.(10 Lectures)

UNIT-IV

Laplace Transforms: Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of Derivatives and Integrals of Functions, Deriva- tives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits. (10 Lectures)

Reference Books:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press

2. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.

3. Advanced Engineering Mathematics, E. Kreyszig (New Age Publication) 2011.

4. Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications

5. Complex Variables, A. S. Fokas & M. J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press

6. Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7th Ed. 2003, Tata McGraw-Hill

7. First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett.

8. Mathematical Physics–H. K. Dass, Dr. Rama Verma (S. Chand Higher Academics) 6th Edition 2011.

9. Mathematical Physics C. Harper, (Prentice Hall India) 2006.

10. Mathematical Physics-Goswami (Cengage Learning) 2014

11. Mathematical Method for Physical Sciences - M. L. Boas (Wiley India) 2006

12. Introduction to the theory of functions of a complex variable- E.T.Copson (Oxford) Univ. Press, 1970

PHYSICS PRACTICAL-C:VIII

20 Classes (2 hrs. duration)

Scilab based simulations experiments based on Mathematical Physics problems like

1. Solve differential equations:
   (i) $\frac{dy}{dx} = e^{-x}$ with $y = 0$ for $x = 0$. (ii) $\frac{dy}{dx} + e^{-xy} = x^2$. (iii) $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} = -y$.

   (iv) $\frac{d^2y}{dt^2} + e^{-t}\frac{dy}{dt} = -y$.

2. Dirac Delta Function: Evaluate $\int \frac{1}{\sqrt{2\pi\sigma^2}} e^{-(x-2)^2/2\sigma^2}(x+3)dx$ for $\sigma = 1, 0.1, 0.01$ and show it tends to 5.

3. Fourier Series: Program to $\sum_{n=1}^{\infty}(0.2)^n$.
   Evaluate the Fourier coefficients of a given periodic function (square wave)

4. Frobenius method and Special functions: $\int_{-1}^{1} P_n(\mu)P_m(\mu)\, d\mu = \delta_{n,m}$. Plot $P_n(x)$, $J(x)$. Show recursion relation.

5. Calculation of error for each data point of observations recorded in experiments done in previous semesters (choose any two).

6. Calculation of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through computer program.

7. Evaluation of trigonometric functions e.g. sin θ, Given Bessels function at $N-$ points, find its value at an intermediate point. Complex analysis: Integrate $1/(x^2 + 2)$ numerically and check with computer integration.

8. Integral transform: FFT of e^{-x^2}.

Reference Books:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
2. Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications
3. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and En- gineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernndez. 2014 Springer ISBN: 978-3319067896
4. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444
5. Scilab (A free software to Matlab): H.Ramchandran, A.S.Nair. 2011 S.Chand & Company
6. Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing.

C-IX: ELEMENTS OF MODERN PHYSICS

(Credits: Theory-04, Practicals-02)
Marks:100 (Theory:70, Practical: 30)
Theory: 40 Classes (1 hr. duration)

UNIT-I

Atomic Spectra and Models: Inadequacy of classical physics, Brief Review of Black body Radiation , Photoelectric effect, Compton effect, dual nature of radiation, wave nature of particles. Atomic spectra, Line spectra of hydrogen atom, Ritz Rydberg combination principle. Alpha Particle Scattering, Rutherford Scattering Formula, Rutherford Model of atom and its limitations, Bohrs model of H atom, explanation of atomic spectra, correction for finite mass of the nucleus, Bohr correspondence principle, limitations of Bohr model, discrete energy exchange by atom, Frank Hertz Expt. Sommerfeld's Modification of Bohrs Theory. (11 Lectures)

UNIT-II

Wave Particle Duality: de Broglie hypothesis, Experimental confirmation of matter wave, Davis- son Germer Experiment, velocity of de Broglie wave, wave particle duality, Complementarity. Superposition of two waves, phase velocity and group velocity , wave packets ,Gaussian Wave Packet , spatial distribution of wave packet, Localization of wave packet in time.

Time development of a wave Packet ; Wave Particle Duality, Complementarity . Heisenberg Uncertainty Principle ,Illustration of the Principle through thought Experiments of Gamma ray microscope and electron diffraction through a slit. Estimation of ground state energy of harmonic oscillator and hydrogen atom, non existence of electron in the nucleus. Uncertainty and Complementarities. (11 Lectures)

UNIT-III

Nuclear Physics: 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. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy,

Nuclear Shell Model and magic numbers. Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life (8 Lectures)

UNIT-IV

Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.

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 driving stellar energy (brief qualitative discussions). (10 Lectures)

Reference Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan
6. Modern Physics Bernstein, Fishbane and Gasiorowicz (Pearson India) 2010
7. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles – R. Eisberg (Wiley India), 2012.

   (**Additional Books for Reference)**
8. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
9. Theory and Problems of Modern Physics, Schaum's outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
10. Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.
11. Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.
12. Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore, 2003, McGraw Hill
13. Modern Physics-Serway (CENGAGE Learnings) 2014
14. Modern Physics —Murugesan and Sivaprasad (S. Chand Higher Academics)
15. Physics of Atoms and Molecules Bransden (Pearson India) 2003

PHYSICS PRACTICAL-C:IX

20 Classes (2 hrs. duration)

1. Measurement of Plancks constant using black body radiation and photo-detector

2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
3. To determine work function of material of filament of directly heated vacuumdiode.
4. To determine the Plancks constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapour.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
9. To setup the Millikan oil drop apparatus and determine the charge of an electron.
10. To show the tunneling effect in tunnel diode using I-V characteristics.
11. To determine the wavelength of laser source using diffraction of single slit.
12. To determine the wavelength of laser source using diffraction of double slits.
13. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and 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
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011,Kitab Mahal

C-X: ANALOG SYSTEMS AND APPLICATIONS

(Credits: Theory-04, Practicals-02)
Marks:100 (Theory:70, Practical: 30)
Theory: 40 Classes (1 hr. duration)

UNIT-I

Semiconductor Diodes: P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. (5 Lectures)

Two-terminal Devices and their Applications: (1) Rectifier Diode: Half-wave Rectifiers.

Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, (2) Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodi- ode, (3) Solar Cell. (5 Lectures)

UNIT-II

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cutoff and Saturation Regions. (5 Lectures)

Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classifica- tion of Class A, B & C Amplifiers. (5 Lectures)

UNIT:III

Coupled Amplifier: RC-coupled amplifier and its frequency response.(4 Lectures)

Feedback in Amplifiers: Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. (2 Lectures)

Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators.(4 Lectures)

UNIT-IV

Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground. (5 Lectures)

Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtrac- tor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator.(5 Lectures)

Reference Books:

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning
4. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
5. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
6. Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer
7. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India
8. Electronic Devices, 7/e Thomas L. Floyd, 2008, PearsonIndia
9. Concept of Electronics: D.C.Tayal (Himalay Publication) 2011
10. Electronic devices :Circuits and Applications :W.D. Stanley Prentice Hall

11. Electronics- V. K. Meheta (S. Chand Publication)2013
12. Electronic Circuits :L.Schilling and Velove: 3rd Ed Mc Graw Hill
13. ElectronicsRaskhit & Chattopadhyay (New age International Publication)2011
14. Electricity and Electronic-D.C.Tayal (Himalaya Pub.)2011
15. Electronic devices and circuits R.L. Boylstad (Pearson India) 2009.

PHYSICS PRACTICAL-C:X

20 Classes (2 hrs. duration)

1. To study V-I characteristics of PN junction diode, and Light emitting diode.
2. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
3. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
4. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
5. To study the various biasing configurations of BJT for normal class A operation.
6. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
7. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
8. To design a Wien bridge oscillator for given frequency using an op-amp.
9. To design a phase shift oscillator of given specifications using BJT.
10. To study the Colpitt's oscillator.
11. To design a digital to analog converter (DAC) of given specifications.
12. To study the analog to digital convertor (ADC) IC.
13. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
14. To design inverting amplifier using Op-amp (741,351) and study its frequency response
15. To design non-inverting amplifier using Op-amp (741,351) & study its frequency response
16. To study the zero-crossing detector and comparator
17. To add two dc voltages using Op-amp in inverting and non-inverting mode
18. To design a precision Differential amplifier of given I/O specification using Op-amp.
19. To investigate the use of an op-amp as an Integrator.
20. To investigate the use of an op-amp as a Differentiator.

21. To design a circuit to simulate the solution of a 1st/2nd order differential equation.

Reference Books:

1. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
2. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
3. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
4. Electronic Devices & circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009, Pearson

SEMESTER-V

C-XI: QUANTUM MECHANICS AND APPLICATIONS

(Credits: Theory-04, Practicals-02)
Marks:100 (Theory:70, Practical: 30)
Theory: 40 Classes (1hr duration)

UNIT:I

Schrodinger equation & the operators: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Hermitian operator, Eigen values and Eigen functions. Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle. (8 Lectures)

UNIT:II

Time independent Schrodinger equation: Hamiltonian, stationary states and energy eigen values; expansion of an arbitrary wave function as a linear combination of energy eigen functions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wave function; Position-momentum uncertainty principle. (6 Lectures)

UNIT:III

General discussion of bound states in an arbitrary potential: continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigen functions ground state, zero point energy & uncertainty principle. One dimensional infinitely rigid box- energy eigen values and eigen functions, normalization; Quantum dot as ex- ample; Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier. (14 Lectures)

UNIT-IV

Atoms in Electric & Magnetic Fields: Electron angular momentum. Space quantization. Electron Spin and Spin Angular Momentum. Larmors Theorem. Spin Magnetic Moment. Stern- Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.

Atoms in External Magnetic Fields: Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only). (12 Lectures)

Reference Books:

1. A Text book of Quantum Mechanics, P. M.Mathews and K.Venkatesan, 2nd Ed., 2010, Mc-Graw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
3. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
4. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
5. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning. Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer
6. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press
7. Quantum Physics-S. Gasiorowicz (Wiley India) 2013
8. Quantum Mechanics -J.L. Powell and B. Craseman (Narosa) 1988
9. Introduction to Quantum Mechanics- M.Das, P.K.Jena,(SriKrishna Prakashan)
10. Basic Quantum Mechanics A.Ghatak (Mc Millan India) 2012
11. Introduction to Quantum Mechanics R. Dicke and J. Wittke
12. Quantum Mechanics- Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
13. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education
14. Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer
15. Quantum Mechanics - F. Mandl (CBS) 2013
16. Cohen-Tannoudji, B Diu and F Lalo, Quantum Mechanics (2 vols) Wiley-VCH 1977

PHYSICS PRACTICAL-C:XI

20 Classes (2hr duration)

Use C/C++/Scilab for solving the following problems based on Quantum Mechanics like

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:
   Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is -13.6 eV. Take e = 3.795 (eV)1/2, c = 1973 (eV) and m = 0.511x106 eV/c2.

2. Solve the s-wave radial Schrodinger equation for an atom:
   where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take e = 3.795 (eV)1/2, m = 0.511x106 eV/c2, and a = 3 , 5 , 7 . In these units c =1973 (eV). The ground state energy is expected to be above -12 eV in all three cases.

3. Solve the s-wave radial Schrodinger equation for a particle of mass m:
   For the anharmonic oscillator potential for the ground state energy (in MeV) of particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 940 MeV/c2, k = 100 MeV fm-2, b = 0, 10, 30 MeV fm-3In these units, c = 197.3 MeV fm. The ground state energy I expected to lie between 90 and 110 MeV for all three cases.

4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule:
   Where is the reduced mass of the two-atom system for the Morse potential Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function.
   Take: m = 940x106eV/C2, D = 0.755501 eV, α = 1.44, ρ= 0.131349 Laboratory based experiments:

5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency.

6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting

7. To show the tunneling effect in tunnel diode using I-V characteristics.

8. Quantum efficiency of CCDs

Reference Books:

1. Schaum's outline of Programming with C++. J.Hubbard, 2000,McGraw–Hill Publication

2. Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal., 3rd Edn., 2007, Cambridge University Press.

3. An introduction to computational Physics, T.Pang, 2nd Edn.,2006, Cambridge Univ. Press

4. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific & Engi- neering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernndez.2014 Springer.

5. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand & Co.

6. Scilab Image Processing: L.M.Surhone.2010 Betascript Publishing ISBN:978-6133459274

C-XII: SOLID STATE PHYSICS

(Credits: Theory-04, Practicals-02)
Marks:100 (Theory:70, Practical: 30)
Theory: 40 Classes (1 hr. duration)

UNIT:I

Crystal Structure: Solids- Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis Central and Non-Central Elements. Unit Cell. Miller Indices. Types of Lattices, Reciprocal Lattice. Brillouin Zones. Diffraction of X-rays by Crystals. Braggs Law. Atomic and

Geometrical Factor. (8 Lectures)

UNIT:II

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic and Di- atomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petits Law, Einstein and Debye theories of specific heat of solids. T3 law (6 Lectures)

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of diaand Paramagnetic Domains. Curies law, Weisss Theory of Ferromagnetism and Ferromagnetic Domains. (6 Lectures)

UNIT:III

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolar- ization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. (4 Lectures)

Lasers: Einsteins A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser. (4 Lectures)

UNIT-IV

Elementary band theory: Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, mobility, Hall Effect. Measurement of conductivity (04 probe method) & Hall coefficient. (8 Lectures)

Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, Londons Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation).(4 Lectures)

Reference Books:

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
4. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
5. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
6. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
7. Solid State Physics, M.A. Wahab, 2011, Narosa Publications
8. Solid State Physics S. O. Pillai (New Age Publication)
9. Solid State Physics- R.K.Puri & V.K. Babbar (S.Chand Publication)2013
10. Lasers and Non linear Optics B.B.Laud-Wiley Eastern.
11. LASERS: Fundamentals and Applications Thyagarajan and Ghatak (McMillanIndia), 2012

PHYSICS PRACTICAL-C:XII

20 Classes (2 hrs. duration)

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)
6. To determine the refractive index of a dielectric layer using SPR
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150 oC) and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and 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.
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

C-XIII: ELECTROMAGNETIC THEORY

(Credits: Theory-04, Practicals-02)
Marks:100 (Theory:70, Practical: 30)
Theory: 40 Classes (1 hr. duration)

UNIT:I

Maxwell Equations: Maxwells equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynt- ing Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density. (8 Lectures)

UNIT:II

EM Wave Propagation in Unbounded Media: Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance.

Propagation through conducting media, relaxation time, skin depth. Electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.(8 Lectures)

UNIT:III

EM Wave in Bounded Media: Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescent waves. Metallic reflection (normal Incidence).

Optical Fibres: Numerical Aperture. Step and Graded Indices (Definitions Only). Single and Multiple Mode Fibres (Concept and Definition Only). (12 Lectures)

UNIT-IV

Polarization of ElectromagneticWaves: Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media. Symmetric Nature of Dielectric Tensor. Fresnels Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light. Phase Retar- dation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized Light.

Rotatory Polarization: Optical Rotation. Biots Laws for Rotatory Polarization. Fresnels Theory of optical rotation. Calculation of angle of rotation. Experimental verification of Fresnels theory. Specific rotation. Laurents half-shade polarimeter. (12 Lectures)

Reference Books:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
4. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
5. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
6. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
7. Electricity and Magnetism —D C Tayal (Himalaya Publication)2014
8. Introduction to Electrodynamics-A.Z.Capri & P.V.Panat (Alpha Science) 2002
9. Optics E.Hecht, (Pearson India) (**Additional Books for Reference)**
10. Electromagnetic Fields & Waves, P.Lorrain & D.Corson, 1970, W.H.Freeman & Co.

11. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
12. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004, Cambridge University Press
13. Electromagnetic Theory-A. Murthy (S. Chand Publication)2014
14. Classical Electrodynamics, J. D. Jackson (Wiley India)

PHYSICS PRACTICAL-C:XIII

20 Classes (2 hrs. duration)

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized Light by using a Babinets compensator.
4. To study dependence of radiation on angle for a simple Dipole antenna.
5. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating.
6. To study the reflection, refraction of microwaves
7. To study Polarization and double slit interference in microwaves.
8. To determine the refractive index of liquid by total internal reflection using Wollastons air-film.
9. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
10. To study the polarization of light by reflection and determine the polarizing angle for air- glass interface.
11. To verify the Stefan‘s law of radiation and to determine Stefans constant.
12. To determine the Boltzmann constant using V-I characteristics of PN junction diode.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and 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
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
4. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

C-XIV: STATISTICAL MECHANICS

(Credits: Theory-04, Practicals-02)
Marks:100 (Theory:70, Practical: 30)
Theory: 40 Classes (1 hr. duration)

UNIT:I

Classical Statistics: Macrostate & Microstate, Elementary Concept of Ensemble, Microcanoni- cal, Canonical and grand canonical ensemble. Phase Space, Entropy and Thermodynamic Probabil- ity, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression. (12 Lectures)

UNIT:II

Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof) Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature.(8 Lectures)

UNIT:III

Radiation: Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Kirchhoffs law. Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Wiens Displacement law. Wiens Distribution Law. Sahas Ionization Formula. Rayleigh-Jeans Law. Ul- traviolet Catastrophe. Plancks Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wiens Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wiens Dis- placement law from Plancks law.(12 Lectures)

UNIT=IV

Quantum Statistics: Identical particles, macrostates and micro states. Fermions and Bosons, Bose Einstein distribution function and Fermi-Dirac Distribution function. Bose-Einstein Condensation, Bose deviation from Planck's law, Effect of temperature on F-D distribution function, degenarate Fermigas, Density of States, Fermi energy.(8 Lectures)

Reference Books:

1. Statistical Mechanics-R.K.Pathria & Paul D. Beale (Academic Press) 3rd Edition (2011)
2. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
3. Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
4. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
5. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
6. An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press.
7. An introduction to Equilibrium Statistical Mechanics: Palash Das (I.K.International Publica- tion) 2012
8. Statistical Physics - F. Mandl (CBS) 2012

9. Statistical Physics of Particles-M. Kardar (CUP 2007)

PHYSICS PRACTICAL-C:XIV

20 Classes (2 hrs. duration)

Use C/C++/Scilab for solving the problems based on Statistical Mechanics like

1. Plot Plancks law for Black Body radiation and compare it with Weins Law and Raleigh- Jeans Law at high temperature (room temperature) and low temperature.
2. Plot Specific Heat of Solids by comparing (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature (room temperature) and low temperature and compare them for these two cases
3. Plot Maxwell-Boltzmann distribution function versus temperature.
4. Plot Fermi-Dirac distribution function versus temperature.
5. Plot Bose-Einstein distribution function versus temperature.

Reference Books:

1. Elementary Numerical Analysis, K.E.Atkinson, 3 r d Edn. 2007, Wiley India Edition
2. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford Univer- sity Press.
3. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
5. Simulation of ODE/PDE Models with MATLAB, OCTAVE and SCILAB: Scientific and En- gineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernndez. 2014 Springer ISBN: 978-3319067896
6. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444
7. Scilab Image Processing: L.M.Surhone. 2010, Betascript Pub., ISBN: 978- 6133459274

Discipline Specific Elective (DSE)
(4 papers including the Project) DSE-1 to DSE-4 (6 Credits each)

CLASSICAL DYNAMICS
(Credits: Theory-05, Tutorial-01) Theory: 50 Classes (1 hr. duration)

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

UNIT-I

Classical Mechanics of Point Particles: Generalised coordinates and velocities. Hamilton's Principle, Lagrangian and Euler-Lagrange equations. Applications to simple systems such as cou- pled oscillators. Canonical momenta & Hamiltonian. Hamilton's equations of motion. Applications: Hamiltonian for a harmonic oscillator, particle in a central force field. Motion of charged particles in external electric and magnetic fields. (25 Lectures)

UNIT-II

Special Theory of Relativity: Postulates of Special Theory of Relativity. Lorentz Transformations. Minkowski space. The invariant interval, light cone and world lines. Space-time diagrams. Time-dilation, length contraction & twin paradox. Four-vectors: space -like, time-like & light-like. Four-velocity and acceleration. Metric and alternating tensors. Four-momentum and energy-momentum relation. Doppler effect from a four vector perspective. Concept of four-force. Conservation of four-momentum. Relativistic kinematics. Application to two-body decay of an unstable particle. (25 Lectures) **Reference Books:**

1. Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002,Pearson Education.
2. Mechanics, L. D. Landau and E. M. Lifshitz, 1976, Pergamon.
3. Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer.
4. Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, 2010, Oxford Press
5. Classical Mechanics-J. C.Upadhyay (Himalaya Publication) 2014
6. Classical Dynamics of Particles and Systems S. T. Thornton (Cengage Learning) 2012
7. Introduction to Classical Mechanics-R. K. Takwale, S.Puranik-(Tata Mc Graw Hill)
8. Classical Mechanics-M. Das, P.K.Jena, M. Bhuyan, R.N.Mishra (Srikrishna Prakashan)

NUCLEAR & PARTICLE PHYSICS
(Credits: Theory-05, Tutorials-01) Theory: 50
Classes (1 hr. duration)

UNIT-I

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), 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 excites states. **Nuclear Models:** Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model,

Radioactivity decay: (a) α- decay: basics of α-decay processes, theory of α- emission, Gamow factor, Geiger Nuttall law. (b)β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. (c) Elementary idea of Gamma decay.

Nuclear Reactions: Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, (25 Lectures)

UNIT-II

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 con- struction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector.

Particle Accelerators: 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. Elementary ideas of quarks and gluons. (25 Lectures)

Reference Books:

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 High Energy Physics, D.H. Perkins, Cambridge Univ. Press
4. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
5. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP-Institute of Physics Publishing, 2004).
6. Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub.Inc., 1991)
7. Atomic and Nuclear Physics -A. B. Gupta, Dipak Ghosh. (Books and Allied Publishers)
8. Physics of Atoms and Molecules Bransden (Pearson India) 2003
9. Subatomic Physics - Henley and Gracia (World Scientific) 2012

10. Introduction to Nuclear and Particle Physics-A.Das and T.Ferbel (World Scientific)

11. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).

COMPUTATIONAL PHYSICS

(Credits: Theory-05, Tutorials-01) Theory: 50 Classes (1 hr. duration)

The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

- Highlights the use of computational methods to solve physical problems
- Use of computer language as a tool in solving physics problems (applications)
- Course will consist of hands on training on the Problem solving on Computers.

UNIT-I

Introduction: Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of linux as an Editor. **Algorithms and Flowcharts:** Algorithm- Definition, properties and development. Flowchart- Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of twomatrices, Sum and Product of a finite series, calculation of sin(x) as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.

Scientific Programming: Some fundamental Linux Commands (Internal and External com- mands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of For- tran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems. (25 Lectures)

UNIT-II

Control Statements: Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder state- ments), Looping Statements (DO-CONTINUE, DO-ENDDO, DOWHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Sub- scripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems.

Programming:

1. Exercises on syntax on usage of FORTRAN
2. To print out all natural even/ odd numbers between given limits.
3. To find maximum, minimum and range of a given set of numbers.
4. To find a set of prime numbers and Fibonacci series.

(25 Lectures)

Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
2. Computer Programming in Fortran 77. V. Rajaraman (Publisher: PHI).
3. Schaums Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
4. Computational Physics: An Introduction, R. C. Verma, et al. New Age International Publish- ers, New Delhi(1999)
5. A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning
6. Elementary Numerical Analysis, K.E. Atkinson, 3 rd Edn., 2007, Wiley India Edition.

NANO MATERIALS & APPLICATIONS

(Credits: Theory-05, Tutorial-01) Theory: 50
Classes (1 hr. duration)

UNIT-I

Nanoscale Systems: Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods), Band structure and density of states of materials at nanoscale, Size Effects in nano systems, Quantum confinement: Applications of Schrodinger equation- Infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, 1D nanostructures and its consequences.

Synthesis Of Nanostructure Materials: Top down and Bottom up approach, Photolithogra- phy. Ball milling. Gas phase condensation. Vacuum deposition. Physical vapor deposition (PVD): Thermal evaporation, E-beam evaporation, Pulsed Laser deposition. Chemical vapor deposition (CVD). Sol-Gel. Electro deposition. Spray pyrolysis. Hydrothermal synthesis. Preparation through colloidal methods. MBE growth of quantum dots. (25 Lectures)

UNIT-II

Characterization: X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Trans- mission Electron Microscopy. Atomic Force Microscopy. Scanning Tunneling Microscopy.

Applications: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron devices (no derivation). CNT based transistors. Nano-material Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots - magnetic data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS). (25 Lectures)

Reference books:

1. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).
2. S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company)

3. K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology (PHI Learning Private Limited).

4. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).

5. M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, Nanoparticle Technology Handbook (Elsevier, 2007).

6. Bharat Bhushan, Springer Handbook of Nanotechnology (Springer-Verlag, Berlin, 2004).

7. Nanotechnology- Rakesh Rathi (S Chand & Company, New Delhi)

BIO-PHYSICS

(Credits: Theory-05, Tutorials-01) Theory: 50
Classes (1 hr. duration)

UNIT-I

Building Blocks & Structure of Living State: Atoms and ions, molecules essential forblife, what is life. Living state interactions: Forces and molecular bonds, electric & bthermal interactions, electric dipoles, casimir interactions, domains of physics in biology.

Heat Transfer inbio-materials: Heat Transfer Mechanism, The Heat equation, Joule heating of tissue.

Living State Thermodynamics: Thermodynamic equilibrium, fIrst law of thermodynamics and conservation of energy. Entropy and second law of thermodynamics, Physics of many particle systems, Two state systems, continuous energy distribution, Composite systems, Casimir contribution of free energy, Protein folding and unfolding. (25 Lectures)

UNIT-II

Open systems and chemical thermodynamics: Enthalpy, Gibbs Free Energy and chemical potential, activation energy and rate constants, enzymatic reactions, ATP hydrolysis & synthesis, Entropy of mixing, The grand canonical ensemble, Hemoglobin.

Diffusion and transport: Maxwell-Boltzmann statistics, Ficks law of diffusion, sedimentation of Cell Cultures, diffusion in a centrifuge, diffusion in an electric field, Lateral diffusion in membranes, Navier stokes equation, low Reynolds Number Transport, Active and passive membrane transport. **Fluids:** Laminar and turbulent fluid flow, Bernoullis equation, equation of continuity, venture ef- fect, Fluid dynamics of circulatory systems, capillary action.

Bio-energetics and Molecular motors: Kinesins, Dyneins, and microtubule dynamics, Brow- nian motion, ATP synthesis in Mitochondria, Photosynthesis in Chloroplasts, Light absorption in biomolecules, vibrational spectra of bio-biomolecules. (25 Lectures)

Reference Books:

1. Introductory Biophysics, J. Claycomb, JQP Tran, Jones & Bartelett Publishers

2. Aspects of Biophysics, Hughe S W, John Willy and Sons.

3. Essentials of Biophysics by P Narayanan, New Age International.

4. Molecular Biophysics- P.K.Banarjee (S. Chand Publication), 2014.
5. Essentials of Biophysics : P. Narayanan, (New Age International, New Delhi), 2005 .
6. Biophysics: An introduction : Rodney Cotterill, John Wiley and Sons Ltd, 2002.
7. Biophysics- Dr.G.R.Chatwal (Himalaya Pub.),2011.

Project Work (Credits: 06) (Compulsory)

SKILL ENHANCEMENT COURSE
(Credit: 04 each)- SEC-1 and SEC-2

1- Communicative English and English Writing Skill(Compulsory) (Credits: 02) Theory: 20 Classes (1 hr.duration)

2-BASIC INSTRUMENTATION SKILLS
(Credits: 02)
Theory: 20 Classes (1 hr. duration)

This course is to get exposure with various aspects of instruments and their usage through hands-on mode. Experiments listed below are to be done in continuation of the topics.

UNIT-I

Basic ofMeasurement: Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects.

Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance.

AC millivoltmeter: Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.

Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance. Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working. (10 Lectures)

UNIT-II

Signal Generators and Analysis Instruments: Block diagram, explanation and specifica- tions of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.

Digital Instruments: Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.

Digital Multimeter: Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution. (10 Lectures)

The test of lab skills will be of the following test items:

1. Use of an oscilloscope.
2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment,
4. Use of Digital multimeter/VTVM for measuring voltages
5. Circuit tracing of Laboratory electronic equipment,
6. Winding a coil / transformer.
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit
9. Balancing of bridges

Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. To measure Q of a coil and its dependence on frequency, using a Q- meter.
4. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of time period, frequency, average period using universal counter/ frequency counter.
6. Measurement of rise, fall and delay times using a CRO.
7. Measurement of distortion of a RF signal generator using distortion factor meter.
8. Measurement of R, L and C using a LCR bridge/ universal bridge.

Open Ended Experiments:

1. Using a Dual Trace Oscilloscope.
2. Converting the range of a given measuring instrument (voltmeter, ammeter).

Reference Books:

1. A text book in Electrical Technology - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBS Edn.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Logic circuit design, Shimon P. Vingron, 2012, Springer.

5. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
6. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill.
7. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
8. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India.

3-RENEWABLE ENERGY & ENERGY HARVESTING

(Credits: 02)

Theory: 20 Classes (1hr duration)

The aim of this course is not just to impart theoretical knowledge to the students but to provide them with exposure and hands-on learning wherever possible.

UNIT-I

Fossil fuels and Alternate Sources of energy: Fossil fuels and nuclear energy, their limi- tation, 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.

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non 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.(10 Lectures)

UNIT-II

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statis- tics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. Geothermal Energy: Geothermal Resources, Geothermal Technologies.

Hydro Energy: Hydropower resources, hydropower technologies, environmental impact ofhydro power sources. (10 Lectures)

Reference Books:

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).
7. http://en.wikipedia.org/wiki/Renewable energy.

4-APPLIED OPTICS

(Credits: 02)

THEORY: 20 Classes (1 hr. duration)

Theory includes only qualitative explanation. Minimum five experiments should be performed covering minimum three sections.

UNIT-I

Sources and Detectors: Lasers, Spontaneous and stimulated emissions, Theory of laser action, Einsteins coefficients, Light amplification, Characterization of laser beam, He-Ne laser, Semiconductor lasers.

Elementary ideas of Fourier Optics.

Concept of Spatial frequency filtering, Fourier transforming property of a thin lens. (10 Lectures)

UNIT-II

Holography

Basic principle and theory: coherence, resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, interferometry, and character recognition.

Photonics: Fibre Optics

Optical fibres and their properties, Principal of light propagation through a fibre, The numerical aperture, Attenuation in optical fibre and attenuation limit, Single mode and multimode fibres, Fibre optic sensors: Fibre Bragg Grating. (10 Lectures)

Reference Books:

1. Fundamental of optics, F. A. Jenkins & H. E. White, 1981, Tata McGraw Hill.
2. LASERS: Fundamentals & applications, K.Thyagrajan & A.K.Ghatak, 2010, Tata McGraw Hill
3. Fibre optics through experiments, M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books.
4. Nonlinear Optics, Robert W. Boyd, (Chapter-I), 2008, Elsevier.
5. Optics, Karl Dieter Moller, Learning by computing with model examples, 2007, Springer.
6. Optical Systems and Processes, Joseph Shamir, 2009, PHI Learning Pvt. Ltd.
7. Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHI Learning Pvt. Ltd.
8. Optical Physics, A.Lipson, S.G.Lipson, H.Lipson, 4th Edn., 1996, Cambridge Univ. Press.
9. Optics E.Hecht, (Pearson India).

GENERIC ELECTIVE (GE) (Minor-Physics)
For other Departments/Disciplines-(Credit: 06 each)

GE:I-MECHANICS & PROPERTIES OF MATTER, OSCILLATION & WAVES, THERMAL PHYSICS, ELECTRICITY, MAGNETISM & ELECTRONICS

(Credits: Theory - 04, Practicals 02)

Theory: 40 classes (1 hr. duration each)-Full Marks: 70

UNIT-I: Mechanics & Properties of Matter

Moment of Inertiasss Parallel axis and perpendicular axis theorem, M.I. of a Solid sphere and Solid cylinder, Gravitational potential and field due to a thin spherical shell and a solid sphere at external points and internal points. Relation among elastic constants, depression at free end of a light cantilever. Surface tension, pressure difference across a curved membrane, viscous flow, Poiseulles formula. (8 classes) 14 Marks

UNIT-II: Oscillation and Waves

Simple harmonic motion, damped harmonic motion, under damped, over damped and critically damped motion, Forced vibration, Resonance. Wave equation in a medium, Velocity of Longitudinal waves in an elastic medium and velocity of transverse wave in a stretched string. Composition of SHM, Lissajous figures for superposition of two orthogonal simple harmonic vibrations (a) with same frequency, (b) frequency with 2:1.(8 classes) 14 Marks

UNIT-III: Thermal Physics

Entropy, change in entropy in reversible and irreversible process, Carnot engine and its efficiency. Carnot Theorem, Second law of thermodynamics, Kelvin-Planck, Clausius formula. Thermal conductivity, differential equation for heat flow in one dimension. Maxwell thermodynamic relation (statement only), Clausius-Clapeyron equation. Black body radiation, Planck radiation formula (No derivation).(8 classes) 14 Marks

UNIT-IV: Electricity and Magnetism

Gauss law of electrostatics, use of Gauss law to compute electrostatic field due to a linear charge distribution. Magnetic induction B, Lorentz force law. Biot-Savarts law, Magnetic induction due to long straight current carrying conductor, and in the axis of a current carrying circular coil. Amperes Circuital law, its differential form. The law of electromagnetic equations, its differential and integral form. Maxwells electro-magnetic equations and their physical significance.

Growth and decay of currents in LR and RC circuits, time constant, alternating currents in RC, RL and LCR circuits, impedance, power factor, resonance.(8 classes) 14 Marks

UNIT-V: Electronics

Extrinsic and intrinsic semiconductors, P-type and N-type semiconductors. PN-Junction as rectifier, Half wave and Full wave rectifiers (Bridge type), efficiency, ripple factor, use of RC, LC, and filters, working of PNP and NPN transistors, transistor configurations in CE and CB circuits and relation between α and β. JFET, its operation and characteristics of V-I curve.(8 classes) 14 Marks

Reference Books:

1. Properties of Matter D.S. Mathur (S. Chand Publication).
2. Heat and Thermodynamics A.B. Gupta & H.B. Ray (New Central Book Agency).
3. Sound M. Ghosh (S. Chand Publication).
4. Introduction to Electrodynamics D.I. Griffith (Prentice Hall of India).
5. Foundations of Electronics Chattopadhyaya and Rakshit.
6. Physics of Degree students Vol.I M. Das, P.K. Jena, M. Bhuyan, D.K. Rout (Srikrishna Prakashan).
7. Physics of Degree students Vol.I M. Das, P.K. Jena, M. Bhuyan, and others (Srikrishna Prakashan).
8. University Physics Sears, Zemansky, H.D. Young (Addison Wesely).

GE:I LAB.

20 classes (2 hours duration each)-Full Marks: 30

1. Measurement of length (or diameter) using Vernier calipers, Screw gauge and travelling microscope.
2. To determine the moment of inertia of a fly wheel.
3. To determine the Youngs modulus Y of a wire by Searls method.
4. To determine the modulus of rigidity of a wire by Maxwells needle/Torsion Pendulum (Dynamic method).
5. To determine g by bar pendulum.
6. To determine the elastic constants of a wire by Searls method.
7. To determine the value of Y of a rubber by using travelling microscope.
8. To determine the Rigidity of modulus by static method.
9. To determine the frequency of a telescope by using Sonometer.
10. Verification of Laws of Vibration of a string by using Sonometer.
11. To compare capacitances using DeSauty bridge.
12. To determine the Law of resistance by using Foster bridge.
13. To determine the Mechanical equivalent of heat J by Callender and Barnes constants flow method.
14. To determine the J by Joules Calorimeter.
15. To determine the coefficient of viscosity of water by Capillary flow method (Poiseilles method).
16. Compare the specific heat of two liquids by method of Cooling.

Reference Books:

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

B.B. Swain.

2. A Laboratory Manual of Physics for Undergraduate Classes, D.P.Khandelwal (1985), Vani Publication.
3. A Text book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition (2011), Kitab Mahal, New Delhi.

GE:II-OPTICS, SPECIAL THEORY OF RELATIVITY, ATOMIC PHYSICS, QUANTUM MECHANICS & NUCLEAR PHYSICS

(Credits: Theory - 04, Practicals 02) Theory:
40 classes (1hr duration each)-Full Marks: 70

UNIT-I: Optics-I

Elementary ideas of monochromatic aberrations and their minimization, chromatic aberration, achromatic combination. Theory of formation of Primary and Secondary rainbow. Condition of interference. Coherent sources. Youngs Double Slit experiment. Biprism and measurement of wave length of light of by it. Colour of thin films and Newtons rings. Fresnel and Fraunhoffer diffraction, diffraction by Single slit Plane transmission grating.(8 classes) 14 Marks

UNIT-II: Optics-II and Relativity

Electromagnetic nature of light, polarized and unpolarized light, polarization by reflection and refraction. Brewsters Law, Malus Law, Double refraction. Ordinary and extraordinary rays.

Galilean transformation, Newtonian relativity and its limitation, Michelson Morley experiment and its consequence, postulates of special theory of relativity. Lorentz transformation, length contraction, time dilation, relativistic mass and momentum, mass energy relation.(8 classes) 14 Marks

UNIT-III: Atomic Physics

Inadequacy of classical physics, brief outline of Rayleigh Jeans theory and Plancks quantum theory of radiation, particle nature of electromagnetic radiation photo electric effect, Compton effect, dual nature of radiation, wave nature of particles, de-Broglie hypothesis, matter wave, wave-particle duality, Davisson-Germer experiment.

Bohrs theory of Hydrogen atom, explanation of Hydrogen Spectra correction for finite mass of the nucleus. Bohrs correspondence principle, limitations of Bohrs theory. Discrete energy, exchange by atom Frank Hertz experiment.(8 classes) 14 Marks

UNIT-IV: Quantum Mechanics

Heisenbergs Uncertainty relation. Time dependent Schrodingers wave equation in one dimension and three dimensions. The physical interpretation of the wave function. Probability density and probability current density. Equation of continuity. Normalization of the Wave function, Expectation value of an observable, Ehrenfests theorem.

Time independent Schrodingers wave equation in one dimension particle in a box, energy eigen values and eigen functions.(8 classes) 14 Marks

UNIT-V: Nuclear Physics

Properties of the nucleus Charge, Size, Spin, Magnetic Moment, Mass, Mass defect, Binding energy, Packing fraction, Nuclear force, and its characteristics features. Radioactive decay laws, average life, half life, nuclear fission, nuclear fusion, Linear accelerators, and cyclotron.(8 classes) 14 Marks

Reference Books:

1. Principles of Optics A.B. Gupta.
2. Fundamentals of Optics Jenkins and White.
3. Relativity R. Resnick.
4. Modern Physics H.S. Mani and G.K. Meheta.

5. Quantum Mechanics J.L. Powel and B. Craseman.
6. Atomic and Nuclear Physics Gupta and Ghosh (Books and allied).
7. Physics of Degree students Vol. III M. Das, P.K. Jena and others (Srikrishna Prakashan).
8. Physics of Degree students Vol. IV M. Das, P.K. Jena and others (Srikrishna Prakashan).
9. Concept of Modern Physics Arthur Beiser (Mc-graw Hill) (2009).
10. University Physics Sears, Zemansky, H.D. Young (Addison Wesely).

GE:II LAB.

20 classes (2 hours duration each)-Full Marks: 30

1. Determination of Horizontal component of Earths magnetic field and magnetic moment of a bar magnet using deflection and oscillation magnetometer.
2. Determination of E.C.E. of a Copper by taking 3 readings.
3. Familiarization with Schuster focusing and determination of angle of prism.
4. Determination of Refractive index of the material of a prism using Sodium light.
5. To determine the wavelength of light using plane diffraction grating.
6. To determine the wavelength of light using Newtons ring.
7. Determination of refractive index of (a) glass and (b) liquid by using travelling microscope.
8. Determination of radius of curvature of a convex/concave mirror by using Kohlrauschs method.
9. To determine the magnifying power of a given telescope.
10. Verification of inverse square law of magnetism by using a deflection magnetometer.
11. To draw the static characteristics of a P-N junction diode.
12. Obtain the static characteristics of a P-N-P / N-P-N transistor / Triode Valve.
13. To determine the reduction factor of a tangent Galvanometer.
14. Variation of magnetic field along the axis of a circular coil carrying current.
15. To study the characteristics of a series RC circuit.

Reference Books:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. A Laboratory Manual of Physics for Undergraduate Classes, D.P.Khandelwal (1985), Vani Publication.
3. A Text book of Practical Physics, Indu Prakash And Ramakrishna, 11th Edition (2011), Kitab Mahal, New Delhi.

PHYSICS(PASS)

SEMESTER-I

DSC 1A: MECHANICS

(Credits: Theory-04, Practicals-02) Theory:
40 Classes (1 hr. duration)-Marks: 70

UNIT-I

Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter. (2 Lectures)

Ordinary Differential Equations: 1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients. (2 Lectures)

Laws of Motion: Frames of reference. Newtons Laws of motion. Dynamics of a system of particles. Centre of Mass. (4 Lectures)

Momentum and Energy: Conservation of momentum. Work and energy. Conservation of en- ergy. Motion of rockets. (2 Lectures)

Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum. (3 Lectures)

Gravitation: Newtons 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). Keplers Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Basic idea of global posi- tioning system (GPS). Weightlessness. Physiological effects on astronauts. (7 Lectures)

UNIT-II

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) **Elasticity:** Hookes law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poissons Ratio-Expression for Poissons ratio in terms of elastic constants - Work done in stretching and 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 - q, η and σ by Searles method. (8Lectures)

Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities. (6 Lectures)

Note: *Students are not familiar with vector calculus. Hence all examples involve differentiation either in one dimension or with respect to the radial coordinate.*

Reference Books:

1. University Physics. F.W. Sears, M.W. Zemansky and H.D. Young, 13/e, 1986. Addison- Wesley
2. Mechanics Berkeley Physics, v.1: Charles Kittel, et. al. 2007, Tata McGraw-Hill.

3. Physics Resnick, Halliday & Walker 9/e, 2010, Wiley
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. Properties of Matter - D.S. Mathur (S.Chand publication) 2013
6. Mechanics- D.C.Tayal (Himalaya Publication) 2013
7. Classical Dynamics of Particles and Systems S. T. Thornton (Cengage Learning) 2012
8. Analytical Mechanics-Fowles (Cengage Learnings) 2014

DSC 1A-LAB: MECHANICS

20 Classes (2 hrs. duration)-Marks:30

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling micro-scope.
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 Maxwells needle.
6. To determine the Elastic Constants of a Wire by Searles method.
7. To determine g by Bar Pendulum.
8. To determine g by Katers Pendulum.
9. To study the Motion of a Spring and calculate (a) Spring Constant, (b) g.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and 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.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

SEMESTER-II

DSC 1B: ELECTRICITY, MAGNETISM AND EMT

(Credits: Theory-04, Practicals-02) Theory:
40 Classes (1 hr. duration)-Marks:70

UNIT-I

Vector Analysis: 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). (8 Lectures)

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 integralof 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. (12 Lectures)

UNIT-II

Magnetism:

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 materials. (6 Lectures) **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. (4 Lectures) **Maxwell's equations and Electromagnetic wave propagation:** Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electro- magnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization. (10 Lectures)

Reference Books:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education
2. Electricity & Magnetism, J.H. Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. D.J.Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.
6. Electricity and Magnetism- K.K Tewari (S. Chand Higher Academics)2013
7. Electricity and Magnetism -D. C. Tayal (Himalay Pub.)2014

DSC 1B-LAB: ELECTRICITY, MAGNETISM AND EMT

20 Classes (2 hrs. duration)-Marks:30

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:

(i) Measurement of charge and current sensitivity

(ii) Measurement of CDR

(iii) Determine a high resistance by Leakage Method

(iv) To determine Self Inductance of a Coil by Rayleighs Method. 3. To compare capacitances using DeSautys bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx) 5. To study the Characteristics of a Series RC Circuit.
6. To study a series LCR circuit LCR circuit and determine its (a) Resonant frequency, (b) Quality factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
8. To determine a Low Resistance by Carey Fosters Bridge.
9. To verify the Thevenin and Norton theorems.
10. To verify the Superposition, and Maximum Power Transfer Theorems.

Reference Books:

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
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed.2011, Kitab Mahal

SEMESTER-III

DSC 1C: THERMAL PHYSICS AND STATISTICAL MECHANICS

(Credits: Theory-04, Practicals-02) Theory:
40 Classes (1 hr. duration)-Marks: 70

UNIT-I

Laws of Thermodynamics: Thermodynamic Description of system: Zeroth Law of thermo- dynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law and Entropy, Carnots cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law ofthermo-dynamics, Unattainability of absolute zero. (10 Lectures)

Thermodynamical Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwells relations and applications - Joule-Thompson Effect, Clausius- Clapeyron Equation, Ex- pression for (CP CV), CP/CV, TdS equations. (10 Lectures)

UNIT-II

Kinetic Theory of Gases: Derivation of Maxwells law of distribution of velocities and its exper- imental 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)

Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy Density,

Derivation of Planck's law, Deduction of Wiens distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wiens displacement law from Plancks law. (6 Lectures)
Statistical Mechanics: Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Phase space - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics. (4 Lectures)

Reference Books:

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. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears and G.L. Salinger. 1988, Narosa
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
6. Thermal and Statistical Physics —M. Das , P. K. Jena and others (Sri Krishna Prakashan)
7. Heat and Thermal Physics-Brijlal & Subramaiam (S.Chand Publication) 2014
8. Thermal Physics– C. Kittel and H. Kroemer (McMillan Education India) 2010
9. Thermodynamics & Statistical Physics-J.K.Sharma, K.K.Sarkar (Himalaya Pub.)2014

DSC 1C-LAB: THERMAL PHYSICS AND STATISTICAL MECHANICS

20 Classes (2 hrs. duration)-Marks:30

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barnes constant flowmethod.
2. Measurement of Plancks constant using black body radiation.
3. To determine Stefans Constant.
4. To determine the coefficient of thermal conductivity of Cu by Searles Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstroms Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charltons 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.

Reference Books:

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

2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

3. A Laboratory Manual of Physics for Undergraduate Classes, D.P.Khandelwal,1985, Vani Publication.

SEMESTER-IV

DSC 1D: WAVES AND OPTICS

(Credits: Theory-04, Practicals-02) Theory:
40 Classes (1hr duration)-Marks: 70

UNIT-I

Fluids: Surface Tension- Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaegars method. Viscosity - Rate flow of liquid in a capillary tube - Poiseuilles formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of liquid with temperature- lubrication. (6 Lectures)

Sound: Simple harmonic motion - forced vibrations and resonance - Fouriers 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 - Sabines formula - measurement of reverberation time - Acoustic aspects of halls and auditoria. (6 Lectures)

Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures (1:1 and 1:2) and their uses. (2 Lectures)

Waves Motion- General: 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. (2 Lectures)

Wave Optics: Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle. (2 Lectures)

UNIT-II

Interference: Interference: Division of amplitude and division of wavefront. Youngs Double Slit experiment. Lloyds Mirror and Fresnels 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). Newtons Rings: measurement of wavelength and refractive index. (10 Lectures)

Michelsons Interferometer: (1) Idea of form of fringes (no theory needed), (2) Determination of wavelength, (3) Wavelength difference, (4) Refractive index, and (5) Visibility of fringes.(2 Lec- tures)

Diffraction: Fraunhofer diffraction- Single slit; Double Slit. Multiple slits and 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. (7 Lectures)

Polarization: Transverse nature of light waves. Plane polarized light production and analysis. Circular and elliptical polarization. (3 Lectures)

Reference Books:

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 Publications
4. University Physics. F.W. Sears, M.W. Zemansky and H.D. Young. 13/e, 1986. Addison- Wesley.

DSC 1D-LAB: WAVES AND OPTICS

20 Classes (2 hrs. duration)-Marks: 30

1. To investigate the motion of coupled oscillators.
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Meldes Experiment and to verify 2 T Law.
3. To study Lissajous Figures.
4. Familiarization with Schuster's focussing; determination of angle of prism.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuilles method).
6. To determine the Refractive Index of the Material of a Prism using Sodium Light.
7. To determine Dispersive Power of the Material of a Prism using Mercury Light.
8. To determine the value of Cauchy Constants.
9. To determine the Resolving Power of a Prism.
10. To determine wavelength of sodium light using Fresnel Biprism.
11. To determine wavelength of sodium light using Newtons Rings.
12. To determine the wavelength of Laser light using Diffraction of Single Slit.
13. To determine wavelength of (1) Sodium and (2) Spectral lines of the Mercury light using plane diffraction Grating 14. To determine the Resolving Power of a Plane Diffraction Grating.
15. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and 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
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

DISCIPLINE SPECIFIC ELECTIVE(DSE)

(Select Two Papers).

DSE: DIGITAL AND ANALOG CIRCUITS AND INSTRUMENTATION

(Credits: Theory-04, Practicals-02)
Theory: 40 Lectures-Marks: 70

UNIT-1:

Digital Circuits

Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binaryto Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates. (5 Lectures)

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. (5 Lectures)

UNIT-2:

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. (5 Lectures)

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β. Relations between α and β. Load Line analysis of Tran- sistors. DC Load line and Q-point. Active, Cutoff, and Saturation Regions. 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. (10 Lectures)

UNIT-3:

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. (7 Lec- tures)

Instrumentations:

Introduction to CRO: Block Diagram of CRO. Applications of CRO: (1) Study of Waveform,

(2) Measurement of Voltage, Current, Frequency, and Phase Difference.(3 Lectures)

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 (5 Lectures)

Reference Books:

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 Mc- Graw Hill
6. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.
7. OP-AMP and Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd.

DSC-LAB: DIGITAL AND ANALOG CIRCUITS AND INSTRUMENTATION

20 Classes (2 hrS. duration)-Marks:30

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 Opamp.
14. To investigate the use of an op-amp as a Differentiator.
15. To design a Wien Bridge Oscillator using an op-amp.

Reference Books:

1. Basic Electronics: A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller, 1994,Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
4. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.

DSE: SOLID STATE PHYSICS

(Credits: Theory-04, Practicals-02)

Theory: 40 Lectures-Marks: 70

Prerequisites: Knowledge of Elements of Modern Physics

UNIT-1:

Crystal Structure: Solids-Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Braggs Law. Atomic and Geometrical Factor. (8 Lectures)

Elementary Lattice Dynamics: Lattice Vibrations and Phonons-Linear Monoatomic and Di- atomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petits Law, Einstein and Debye theories of specific heat of solids. T3 law (6 Lectures)

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia and Paramagnetic Domains. Quantum Mechanical Treatment of Paramag- netism. Curies law, Weisss Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss. (8 Lectures)

UNIT-II

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depo- larization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical The- ory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons. (6 Lectures)

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. (6 Lectures)

Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meiss- ner effect. Type I and type II Superconductors, Londons Equation and Penetration Depth. Isotope effect. (6 Lectures)

Reference Books:

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, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
5. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
6. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India

7. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

DSC LAB: SOLID STATE PHYSICS

20 Classes (2 hrs. duration)-Marks: 30

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).
6. To determine the refractive index of a dielectric layer using SPR.
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To study the BH curve of iron using a Solenoid and determine the energy loss.
9. To measure the resistivity of a semiconductor (Ge) crystal with temperature by four-probe method (room temperature to 150 oC) and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and 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
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn., 2011, Kitab Mahal
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India

DSE: ELEMENTS OF MODERN PHYSICS

(Credits: Theory-04, Practicals-02)

Theory: 40 Lectures-Marks: 70

UNIT-I

Plancks quantum, Plancks constant and light as a collection of photons; Photoelectric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment.(6 Lectures)

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. (4 Lectures)

Position measurement-gamma ray microscope thought experiment; 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. (4 Lectures)

Two slit interference experiment with photons, atoms & particles; linear superposition principle as a consequence; Matter waves and wave amplitude; 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. (8 Lectures)

UNIT-II

One dimensional infinitely rigid box-energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier. (8 Lectures)

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy. (4Lectures)

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.(4 Lectures) 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. (2 Lectures)

Reference Books:

1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill.
2. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.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,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

DSC LAB: ELEMENTS OF MODERN PHYSICS

20 Classes (2 hrs. duration)-Marks: 30

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 the ionization potential of mercury.
4. To determine value of Plancks constant using LEDs of at least 4 different colours.
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 and measure its intensity variation using Photosensor & compare with incoherent source Na.
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 (a) Magnetic focusing or (b) Bar magnet.

10. To setup the Millikan oil drop apparatus and determine the charge of an electron.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and 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
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

SKILL ENHANCEMENT COURSE(Four)

(Credit: 02 each)-SEC:1 to SEC:4

1. COMMUNICATIVE ENGLISH & ENGLISH WRITINGSKILL(Compulsory)

(Credits: Theory-02)

2. COMPUTATIONAL PHYSICS

(Credits: Theory-02) Theory: 20 Classes (1 hr. duration)

UNIT-I

Introduction: Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of linux as an Editor. Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples:Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of a finite series.

Scientific Programming: Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and con- cept of instruction and program. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing. (10 Lectures)

UNIT-II

Control Statements: Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder state- ments), DO Loop Statements, Jumping Statements (Unconditional GOTO, Computed GOTO, As- signed GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subpro- gram and Subroutine), RETURN, CALL Statements), open a file, writing in a file, reading from a file.

Programming:

1. Exercises on syntax on usage of FORTRAN.
2. To print out all natural even/ odd numbers between given limits.
3. To find maximum, minimum and range of a given set of numbers.

4.To find a set of prime numbers and Fibonacci series. (10 Lectures)

Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
2. Computer Programming in Fortran 77. V. Rajaraman (Publisher: PHI).
3. Schaums Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.

4. Computational Physics: An Introduction, R. C. Verma, et al. New Age International Publish- ers, New Delhi(1999).

5. A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning.

6. Elementary Numerical Analysis, K.E. Atkinson, 3 r d Edn., 2007, Wiley India Edition.

3. BASIC INSTRUMENTATION SKILLS

(Credits: Theory-02) Theory: 20 Classes (1 hr. duration)

This course is to get exposure with various aspects of instruments and their usage through hands-on mode. Experiments listed below are to be done in continuation of the topics.

UNIT-I

Basic ofMeasurement: Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.
Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance.
AC millivoltmeter: Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.
Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance.
Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working. (10 Lectures)

UNIT-II

Signal Generators and Analysis Instruments: Block diagram, explanation and specifica- tions of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.
Digital Instruments: Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.
Digital Multimeter: Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution. (10 Lectures)

The test of lab skills will be of the following test items:

1. Use of an oscilloscope.
2. CRO as a versatile measuring device.

3. Circuit tracing of Laboratory electronic equipment.
4. Use of Digital multimeter/VTVM for measuring voltages,
5. Circuit tracing of Laboratory electronic equipment.
6. Winding a coil / transformer.
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit.
9. Balancing of bridges.

Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. To measure Q of a coil and its dependence on frequency, using a Q- meter.
4. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of time period, frequency, average period using universal counter/ frequency counter.
6. Measurement of rise, fall and delay times using a CRO.
7. Measurement of distortion of a RF signal generator using distortion factor meter.
8. Measurement of R, L and C using a LCR bridge/ universal bridge.

Open Ended Experiments:

1. Using a Dual Trace Oscilloscope.
2. Converting the range of a given measuring instrument (voltmeter, ammeter).

Reference Books:

1. A text book in Electrical Technology - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBS Edn.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Logic circuit design, Shimon P. Vingron, 2012, Springer.
5. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
6. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill.
7. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer.
8. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India.

4. RENEWABLE ENERGY AND ENERGY HARVESTING

(Credits: Theory-02) Theory:
20 Classes (1 hr. duration)

The aim of this course is not just to impart theoretical knowledge to the students but to provide them with exposure and hands-on learning wherever possible.

UNIT-I

Fossil fuels and Alternate Sources of energy: Fossil fuels and nuclear energy, their limi- tation, 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.

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non 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. (10 Lectures)

UNIT-II

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statis- tics, Wave Energy Devices.

Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.

Geothermal Energy: Geothermal Resources, Geothermal Technologies.

Hydro Energy: Hydropower resources, hydropower technologies, environmental impact ofhydro power sources.(10 Lectures)

Reference Books:

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).
7. http://en.wikipedia.org/wiki/Renewable energy.

5. APPLIED OPTICS

(Credits: Theory-02) Theory:
20 Classes (1 hr. duration)

Theory includes only qualitative explanation. Minimum five experiments should be performed covering minimum three sections.

UNIT-I

Sources and Detectors: Lasers, Spontaneous and stimulated emissions, Theory of laser action, Einsteins coefficients, Light amplification, Characterization of laser beam, He-Ne laser, Semiconductor lasers.

Elementary ideas of Fourier Optics: Concept of Spatial frequency filtering, Fourier trans- forming property of a thin lens. (10 Lectures)

UNIT-II

Holography

Basic principle and theory: coherence, resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, interferometry, and character recognition. **Photonics:** Fibre Optics, Optical fibres and their properties, Principal of light propagation through a fibre, The numerical aperture, Attenuation in optical fibre and attenuation limit, Single mode and multimode fibres, Fibre optic sensors: Fibre Bragg Grating. (10 Lectures)

Reference Books:

1. Fundamental of optics, F. A. Jenkins & H. E. White, 1981, Tata McGraw hill.
2. LASERS: Fundamentals & applications, K.Thyagrajan & A.K.Ghatak, 2010, Tata McGraw Hill
3. Fibre optics through experiments, M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books
4. Nonlinear Optics, Robert W. Boyd, (Chapter-I), 2008, Elsevier.
5. Optics, Karl Dieter Moller, Learning by computing with model examples, 2007, Springer.
6. Optical Systems and Processes, Joseph Shamir, 2009, PHI Learning Pvt. Ltd.
7. Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHI Learning Pvt. Ltd.
8. Optical Physics, A.Lipson, S.G.Lipson, H.Lipson, 4th Edn., 1996, Cambridge Univ. Press.

ZOOLOGY(HONOURS)

SEMESTER-I

C:1-DIVERSITY AND EVOLUTION OF NON-CHORDATA (PROTISTA TO PSEUDOCOELOMATES)

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Kingdom Protista

General characteristics and classification up to classes; Life cycle, pathogenicity and prophylaxis of Plasmodium vivax, Trypanosoma gambiense and Entamoeba histolytica; Locomotion and reproduction in Protista.

UNIT-II: Phylum Porifera and Ctenophora

General characteristics and classification up to classes; Canal system in sponges; General characteristics and evolutionary significance; Evolution of Parazoa and Metazoa.

UNIT-III: Phylum Cnidaria

General characteristics and classification up to classes; Metagenesis in Obelia; Polymorphism in Cnidaria; Corals and coral reefs.

UNIT-IV: Phylum Platyhelminthes

General characteristics and classification up to classes; Life cycle, pathogenicity and prophylaxis of Facsiola hepatica and Taenia solium; Parasitic adaptations.

UNIT-V: Phylum Nemathelminthes

General characteristics and classification up to classes; Life cycle, pathogenicity and prophylaxis of Ascaris lumbricoidesand Wuchereria Bancrofti; Parasitic adaptations.

Note: Classification to be followed from " Barnes RD (1982) Invertebrate Zoology; 5th Edition."

PRACTICAL

Kingdom Protista

1. Morphology of Paramecium, Binary fission and Conjugation in Paramecium.
2. Life stages of Plasmodium vivax, Trypanosma gambiense and Entamoeba histolytica (Slides/Microphotographs).
3. Examination of pond water for protists.

Phylum Porifera

4. Study of Sycon (including T.S. and L.S.), Hyalonema, and Euplectella.
5. Temporary mounts of spicules, gemmules and sponging fibres.

Phylum Cnidaria

6. Study of Obelia, Physalia, Millepora, Aurelia, Ephyra larva, Tubipora, Corallium, Alcyonium, Gorgonia and Metridium (including T.S. and L.S.).

Phylum Ctenophora

7. Any one specimen/slide.

Phylum Platyhelminthes

8. Study of adult Fasciola hepatica, Taenia solium and their life stages (Slides/microphotographs).

Phylum Nemathelminthes

9. Study of adult Ascaris lumbricoides, Wuchereria bancrofti and their life stages (Slides/microphotographs).

Note: Classification to be followed from " Barnes RD (1982) Invertebrate Zoology; 5th Edition."

Recommended Books:

1. Arora MP (2006) Non-Chordata-I. 1st edition. Himalaya Publishing House, New Delhi.
2. Arora MP (2008) Non-Chordata-II. 1st edition. Himalaya Publishing House, New Delhi.
3. Barnes RD (1982) Invertebrate Zoology. 6th Edition. Holt Saunders International Edition.
4. Barnes RSK, Calow P, Olive PJW, Golding DW & Spicer JI (2002) The Invertebrates: A New Synthesis. 3rd Edition. Blackwell Science, USA.
5. Barrington EJW (1979) Invertebrate Structure and Functions. 2nd Edition. ELBS and Nelson.
6. Boradale LA and Potts EA (1961) Invertebrates: A Manual for the use of Students. Asia Pub- lishing Home.
7. Jordan EL and Verma PS (1963) Invertebrate Zoology. Revised Edition. S. Chand, New Delhi.
8. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.

C:2-PERSPECTIVES IN ECOLOGY AND BIOSTATISTICS

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Introduction to Ecology and Ecosystem

Relevance of studying ecology; History of ecology; Laws of limiting factors; Detailed study of temperature and light as physical factors; Types of ecosystem; Food chain, Detritus and grazing food chains; Food web; Energy flow through the ecosystem; Ecological pyramids.

UNIT-II: Population

Unitary and modular populations; Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion; Exponential and logistic growth, equation and patterns, r and K strategies, Population regulation-density-dependent and independent factors; Population interactions, Gauses Principle with laboratory and field examples; Lotka-Volterra equation for competition and Predation, functional and numerical responses.

UNIT-III: Community

Community characteristics: dominance, diversity, species richness, abundance, stratification; Ecotone and edge effect; Ecosystem development (succession) with example and Theories pertaining to climax community; Nutrient and biogeochemical cycle, Nitrogen cycle and Sulphur cycle.

UNIT-IV: Conservation of Biodiversity

Types of biodiversity, its significance, loss of biodiversity; Conservation strategies (in situ and ex situ); Endangered species concept; Role of ZSI, WWF, IUCN; Wildlife (Protection) Act, 1972.

UNIT-V: Biostatistics

Concept, definition and scope of biostatics, biological data, sampling techniques, measures of central tendency (mean, median and mode), measures of dispersion, hypothesis and testing of hypothesis

(chi square test, t test and Z test), correlation and regression analysis; Data analysis using EXCEL programme.

PRACTICAL

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.
2. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community.
3. Study of an aquatic ecosystem: fauna and flora Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winklers method), Chemical Oxygen Demand and free CO_2.
4. Report on a visit to National Park/Biodiversity Park/Wildlife sanctuary.
5. Determination of mean, median, mode and standard deviation of biological data.

Recommended Books

1. Colinvaux PA (1993) Ecology. II Edition. John Wileyand Sons, Inc., USA.
2. Dash MC (1993) Fundamentals of Ecology. McGraw Hill Book Company, New Delhi.
3. Joshi N and Joshi PC (2012) Ecology and Environment. 1st Edition. Himalaya Publishing House, New Delhi.
4. Odum EP (2008)Fundamentals of Ecology. Indian Edition. Brooks/Cole.
5. Ricklefs, R.E., (2000). Ecology. 5th Edition. Chiron Press.
6. Robert Leo Smith Ecology and field biology Harper and Row.
7. Singh JS, Gupta SR and Singh SP (2014) Ecology, Environmental Science and Conservation. S. Chand, New Delhi.
8. Chainy, GBN, Mishra G and Mohanty PK. Basic Biostatistics, Kalyani Publisher.

C:3-DIVERSITY AND EVOLUTION OF NON-CHORDATA (COELOMATE NONCHORDATES)

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Phylum Annelida

General characteristics and classification up to classes; Evolution of Coelom; Metamerism and Excretion in Annelida.

UNIT-II: Phylum Arthropoda

General characteristics and classification up to classes; Vision in Arthropoda; Respiration in Arthropoda; Moulting in insects, Metamorphosis in insects; Social life in insects (bees and termites) and Larval forms in Crustacea.

UNIT-III: Phylum Onychophora

General characteristics and evolutionary significance and affinities of Peripatus.

UNIT-IV: Phylum Mollusca

General characteristics and classification up to classes; Respiration in Mollusca; Torsion and detorsion in Gastropoda; Pearl formation in bivalves and Evolutionary significance of trochophore larva.

UNIT-V: Phylum Echinodermata

General characteristics and classification up to classes; Water-vascular system in Asteroidea; Larval forms in Echinodermata and Evolutionary significance (Affinities with Chordates).

Note: Classification to be followed from " Barnes, R.D. (1982). Invertebrate Zoology, 5th Edition, Holt Saunders International Edition."

PRACTICAL

Phylum Annelida

1. Study of Aphrodite, Nereis, Sabella, Terebella, Serpula, Chaetopterus, Pheretima and Hirudinaria.
2. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.
3. T.S. through crop of leech.

Phylum Arthropoda

4. Study of Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, termite, louse, honeybee, silk moth, wasp and dragon fly. **Phylum Onychophora**

5. Any one specimen/slide.

Phylum Mollusca

6. Study of Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Mytilus, Loligo,Sepia,Octopusand Nautilus and Cypraea(cowrie).

Phylum Echinodermata

7. Study of echinoderm larvae.
8. Study of Pentaceros, Asterias, Ophiura, Clypeaster, Echinus, Echinocardium, Cucumaria and Antedon.

Note: Classification to be followed from " Barnes, R.D. (1982). Invertebrate Zoology, 5th Edition, Holt Saunders International Edition."

Recommended books

1. Arora MP (2006) Non-Chordata-I. 1st edition. Himalaya Publishing House, New Delhi.
2. Arora MP (2008) Non-Chordata-II. 1st edition. Himalaya Publishing House, New Delhi.
3. Barnes RD (1982)Invertebrate Zoology. 6th Edition. Holt Saunders International Edition.
4. Barnes RSK, Calow P, Olive PJW, Golding DW & Spicer JI (2002) The Invertebrates: A New Synthesis. 3rd Edition. Blackwell Science, USA.
5. Barrington EJW (1979) Invertebrate Structure and Functions. 2nd Edition. ELBS and Nelson.
6. Boradale LA and Potts EA (1961)Invertebrates: A Manual for the use of Students. Asia Pub- lishing Home.
7. Jordan EL and Verma PS (1963) Invertebrate Zoology. Revised Edition. S. Chand, New Delhi.
8. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.

C:4-PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Digestive System

Structural organization, histology and functions of gastrointestinal tract and its associated glands;Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins,water, minerals and vitamins; Role of gastrointestinal hormones on the secretion and control ofenzymes of gastrointestinal tract.

UNIT-II: Respiratory System

Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volume and capacity; Transport of oxygen in the blood; Oxygen- hemoglobin and myoglobin, dissociation curve and the factors influencing it; Carbon monoxide poisoning; Carbon dioxide transport in the blood; buffering action of blood and haemoglobin and Control of respiration.

UNIT-III: Excretory System

Structure of kidney and its histological details;Renal blood supply; Mechanism of urine formation and its regulation and Regulation of acid-base balance.

UNIT-IV: Blood

Components of blood and their functions; Structure and functions of haemoglobin; Haemopoiesis; Haemostasis, Coagulation of blood and Disorders of blood.

UNIT-V: Heart

Structure of heart; Coronary circulation; Structure of conducting and working of myocardialfibers; Origin and conduction of cardiac impulses functions of AV node; Cardiac cycle; Cardiac output and its regulation-Frank-Starling Law of the heart; Nervous and chemical regulation of heart rate; Blood pressure and its regulation and Electrocardiogram.

PRACTICAL

1. Enumeration of red blood cells using haemocytometer.
2. Estimation of haemoglobin using Sahli'shaemoglobinometer.
3. Preparation of haemin and haemochromogen crystals.
4. Recording of blood pressure using a Sphygmomanometer.
5. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung and kidney.

Recommended Books

1. Arey LB (1974) Human Histology. 4th Edition. W.B. Saunders, USA.
2. Chatterjee CC (2008) Human Physiology. Vol. I and II. Medical Allied Agency, Kolkata.
3. GuytonAC and Hall JE (2006) Textbook of Medical Physiology. 9th Edition. W.B. Saunders Company, Philadelphia.
4. Tortora GJ and Derrickson B (2012) Principles of Anatomy & Physiology. 13th Edition John Wiley and sons, USA.
5. Victor PE (2008) diFiores Atlas of Histology with Functional Correlations. 12th Edition,Lippin- cott W. & Wilkins, USA.

C:5-DIVERSITY AND DISTRIBUTION OF CHORDATA

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Protochordata and Origin of Chordates

General characters of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata; Dipleurula concept and the Echinoderm theory of origin of chordates.

UNIT-II: Introduction to Vertebrata and Agnatha

Advanced features of vertebrates over Protochordata; General characters and classification of cyclostomes up to class; Structural peculiarities and affinities of Petromyzon and Myxine.

UNIT-III: Pisces and Amphibia

General characters of Chondrichthyes and Osteichthyes and classification up to order; Migration; Osmoregulation and Parental care in fishes; Scales in fishes; Origin of Tetrapoda (Evolution of terrestrial ectotherms); General characters and classification up to order and Parental care in Amphibians.

UNIT-IV: Reptilia and Aves

General characters and classification up to order; Skull in Reptilia; Affinities of Sphenodon; Poison apparatus and Biting mechanism in snakes; General characters and classification up to order; Principles and aerodynamics of flight, Flight adaptations; Archaeopteryx- a connecting link and Migration in birds.

UNIT-V: Mammals and Zoogeography

General characters and classification up to order; Affinities of Prototheria and Metatheria; Dentition in mammals; Adaptive radiation with reference to locomotory appendages; Zoogeographical realms; Theories pertaining to distribution of animals and Distribution of vertebrates in differentrealms.

PRACTICAL

Protochordata

1. Balanoglossus, Herdmania, Branchiostoma and Colonial Urochordata.
2. Sections of Balanoglossus through proboscis and branchiogenitalregions.
3. Sections of Amphioxus through pharyngeal, intestinal and caudalregions.
4. Permanent slide of spicules of Herdmania.

Agnatha

5. Petromyzon and Myxine.

Fishes

6. Sphyrna, Pristis,Trygon, Torpedo, Chimaera, Notopterus, Mystus, Heteropneustes, Hippocampus, Exocoetus, Echeneis, Anguilla, Tetrodon, Diodon, Anabas andFlat fish.

Amphibia

7. Ichthyophis/Ureotyphlus, Necturus, Duttaphrynus, Polypedates, Hyla, Alytes and Salamandra.

Reptiles

8. Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Draco, Ophiosaurus,Bungarus, Vipera, Naja, Hydrophis, Zamenis and Crocodylus.
9. Key for Identification of poisonous and non-poisonous snakes.

Aves

10. Study of six common birds from different orders.
11. Types of beaks and claws.
12. Types of feathers.

Mammalia

13. Sorex, Bat (Insectivorous and Frugivorous), Funambulus, Loris, Herpestesand Hemiechenis.

Recommended Books

1. Agarwal VK (2011) Zoology for degree students. S. Chand, NewDelhi.
2. Arora MP (2006) Chordata-1. 1st Edition. Himalaya Publishing House, New Delhi.
3. Hall BK and Hallgrimsson B (2008) Strickberger's Evolution. 4th Edition. Jones and Bartlett Publishers Inc., USA.
4. Jordan EL and Verma PS (1963) Chordate Zoology. Revised Edition. S. Chand, NewDelhi.
5. Young JZ (2004) The Life of Vertebrates. 3rd Edition. Oxford University Press, USA.

C:6-PHYSIOLOGYCONTROLLING AND COORDINATING SYSTEM

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Tissues and Glands, Bone and cartilage

Structure, location, function and classification of Epithelial tissue, Connective tissue, Muscular tissue, Nervous tissue; Types of glands and their functions; Structure and types of bones and cartilages; Ossification, bone growth and resorption.

UNIT-II: Nervous System

Structure of neuron, resting membrane potential; Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; types of synapsis, Synaptic transmission; Neuromuscular junction; Reflex action and its types, Reflex arc and Physiology of hearing and vision.

UNIT-III: Muscle

Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor Unit, summation and tetanus.

UNIT-IV: Reproductive System

Histology of male and female reproductive systems; Puberty; Physiology of reproduction of male and female; Methods of contraception (depicted through flow chart).

UNIT-V: Endocrine System

Functional Histology of endocrine glands – pineal, pituitary, thyroid, parathyroid, thymus, pancreas, adrenals; Hormones secreted by them and their mechanism of action; Gonadal hormones; Classification of hormones; Regulation of their secretion; Mode of hormone action; Signal transduction pathways utilized by steroidal and non-steroidal hormones; Hypothalamus (neuroendocrine gland), principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system and Placental hormones.

PRACTICAL

1. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerkreflex).
2. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nervecells.
3. Examination of sections of mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid.

Recommended Books

1. Arey LB (1974)Human Histology. 4th Edition. W.B. Saunders, USA.

2. Chatterjee CC (2008) Human Physiology. Vol. I and II. Medical Allied Agency, Kolkata.
3. GuytonAC and Hall JE (2006) Textbook of Medical Physiology. 9th Edition. W.B. Saunders Company, Philadelphia.
4. Tortora GJ and Derrickson B (2012) Principles of Anatomy & Physiology. 13th Edition John Wiley and sons, USA.
5. Victor PE (2008)diFiores Atlas of Histology with Functional Correlations. 12th Edition, Lippincott W. and Wilkins, USA.

C:7-COMPARATIVE ANATOMY OF VERTEBRATES

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Integumentary System and Skeletal System

Structure, functions and derivatives of integument; Axial and appendicular skeletons; Jaw suspensorium in vertebrates.

UNIT-II: Digestive and Respiratory System

Alimentary canal and associated glands; Skin, gills, lungs and air sacs and Accessory respiratory organs in fishes.

UNIT-III: Circulatory System

General plan of circulation; Evolution of heart and aortic arches.

UNIT-IV: Urinogenital System

Succession of kidney; Evolution of urinogenital ducts and Types of mammalian uteri.

UNIT-V: Nervous System and Sense Organs

Comparative account of brain; Autonomic nervous system; Spinal Nerves; Spinal cord; Cranial nerves in Mammals; Classification of receptors; visual receptors, chemoreceptors and mechanoreceptors.

PRACTICAL

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs.
2. Disarticulated skeleton of Frog, Varanus, Fowl and Rabbit.
3. Carapace and plastron of turtle or tortoise.
4. Mammalian skulls (One herbivorous and one carnivorous animal).

Recommended Books

1. Hilderbrand M and Gaslow GE. Analysis of Vertebrate Structure. John Wiley and Sons., USA.
2. Kardong KV (2005) Vertebrates Comparative Anatomy, Function and Evolution. 4th Edition. McGraw-Hill Higher Education, New York.
3. Kent GC and Carr RK (2000) Comparative Anatomy of the Vertebrates. 9th Edition. The McGraw-Hill Companies, New York.
4. Weichert CK and William Presch (1970) Elements of Chordate Anatomy. Tata McGraw Hill, New York.

C:8-BIOCHEMISTRY OF METABOLIC PROCESSES

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Biomolecules

Structures and properties of important mono-, di- and polysaccharides; Fatty acids, triglycerides and steroids; and amino acids and proteins.

UNIT-II: Carbohydrate Metabolism

Glycolysis; Citric acid cycle; pentose phosphate pathway; Gluconeogenesis; Shuttle systems (Malate-aspartate shuttle, Glycerol 3-phosphate shuttle); Glycogenolysis; Glycogenesis.

UNIT-III: Lipid Metabolism

β-oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid and Ketogenesis and its regulation.

UNIT-IV: Protein Metabolism

Catabolism of amino acids: Transamination, Deamination; Urea cycle; Fate of C-skeleton of Gluco-genic and Ketogenic amino acids.

UNIT-V: Enzymes and Oxidative Phosphorylation

Kinetics and Mechanism of action of enzymes; Inhibition of enzyme action; Allosteric enzymes; Oxidative phosphorylation in mitochondria; Respiratory chain, ATP synthase, Inhibitors and Uncou-plers.

PRACTICAL

1. Identification of unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose).
2. Colour tests of functional groups in protein solutions.
3. Action of salivary amylase under optimum conditions.
4. Effect of pH on the action of salivary amylase.
5. Effect of temperature on the action of salivary amylase.
6. Estimation of total protein in given solutions by Lowrys method.

Recommended Books

1. Berg JM, Tymoczko JL and Stryer L (2007) Biochemistry. 6th Edition, W.H. Freeman and Co., New York.
2. Cox MM and Nelson DL (2008)Lehninger Principles of Biochemistry. 5th Edition. W.H. Freeman and Co., New York.
3. Devesena T (2014) Enzymology. 2nd Edition. Oxford University Press, UK.
4. Hames BD and Hooper NM (2000) Instant Notes in Biochemistry. 2nd Edition. BIOS Scientific Publishers Ltd., U.K.
5. Murray RK, Bender DA, Botham KM, Kennelly PJ, Rodwell VW and Well PA (2009) Harpers Illustrated Biochemistry. 28th Edition. International Edition. The McGraw-Hill Companies Inc., New York.

C:9-CELL BIOLOGY

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Cells and Plasma Membrane

Prokaryotic and Eukaryotic cells; Mycoplasma;Virus, Viroids, Virionsand Prions; Various models

of plasma membrane; Transport across membranes; Cell junctions: Occluding junctions (Tight junctions), Anchoring junctions (desmosomes), Communicating junctions (gap junctions) and Plasmodesmata.

UNIT-II: Endomembrane System, Mitochondria and Peroxisomes

The Endoplasmic Reticulum; Golgi apparatus; Mechanism of vesicular transport; Lysosomes; Structure and function of mitochondria: Chemi-osmotic hypothesis; Semiautonomous nature of mitochondria; Endosymbiotic hypothesis and Peroxisomes.

UNIT-III: Cytoskeleton and Nucleus

Structure and functions of intermediate filament, microtubules and microfilaments; Ultra structure of nucleus; Nuclear envelope: Structure of nuclear pore complex; Chromosomal DNA and its packaging; Structure and function of Nucleolus.

UNIT-IV: Cell Cycle and Cell Signaling

Cell cycle, Regulation of cell cycle; Signaling molecules and their receptors.

UNIT-V: Apoptosis and Cancer

Extrinsic (Death Receptor) Pathway and Intrinsic (Mitochondrial) Pathway; Growth and development of tumors and Metastasis.

PRACTICAL

1. Gram's staining technique for visualization of prokaryotic cells.
2. Study various stages of mitosis from permanent slides.
3. Study various stages of meiosis from permanent slides.
4. Study the presence of Barr body in human female blood cells/cheek cells. (Preparation of permanent slides).
5. Cytochemical demonstration (Preparation of permanent slides).

(i) DNA by Feulgen reaction.

(ii) Mucopolysaccharides by PAS reaction.

(iii) Proteins by Mercurobromophenol blue.

(iv) DNA and RNA by Methyl Green Pyronin.

(In practical examination, 05 marks should be of permanent slide submission; one mark each for DNA, PAS, Proteins, MGP and Barr body slide.)

Recommended Books

1. Becker WM, Kleinsmith LJ, Hardin J and Bertoni G P (2009) The World of the Cell. 7th Edition. Pearson Benjamin Cummings Publishing, San Francisco.
2. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008) Molecular Biology of the Cell. 5th Edition. Garland publishing Inc., New York.
3. Cooper GM and Hausman RE (2009) The Cell: A Molecular Approach. 5th Edition. ASM Press, Washington D.C.
4. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology. 8thEdition. Lippin- cott Williams and Wilkins, Philadelphia.
5. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley and Sons. Inc., USA.

C:10-PRINCIPLES OF GENETICS

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Mendelian Genetics and its Extension

Principles of inheritance; Incomplete dominance and co-dominance; Multiple alleles, Lethal alleles; Epistasis; Pleiotropy; Sex-linked inheritance.

UNIT-II: Linkage, Crossing Over and Chromosomal Mapping

Linkage and crossing over; Cytological basis of crossing over; Molecular mechanisms of crossing over; Recombination frequency as a measure of linkage intensity; Two factor and three factor crosses; Interference and coincidence and Somatic cell hybridization.

UNIT-III: Mutations

Gene mutations; Chromosomal mutations: Deletion, duplication, inversion, translocation; Aneuploidy and polyploidy; Induced versus spontaneous mutations; Backward and forward mutations; Suppressor mutations; Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method, attached X method and DNA repair mechanisms.

UNIT-IV: Sex Determination and Quantitative Genetics

Chromosomal mechanisms of sex determination; Sex-linked, sex-influenced and sex limited characters; Polygenic inheritance and Transgressive variation.

UNIT-V: Extra-chromosomal Inheritance

Criteria for extra-chromosomal inheritance; Antibiotic resistance in Chlamydomonas; Mitochondrial mutations and Maternal effects.

PRACICAL

1. To study the Mendelian laws and gene interactions and their verification by Chi square analyses using seeds/beads/Drosophila.
2. Identification of various mutants of Drosophila.
3. To calculate allelic frequencies by Hardy-Weinberg Law.
4. Linkage maps based on data from crosses of Drosophila.
5. Study of human karyotype (normal and abnormal).
6. Pedigree analysis of some human inherited traits.
7. Preparation of polytene chromosomes from larva of Chironomous/Drosophila.
8. To study mutagenicity in Salmonella/E. coli by Ames test.

Recommended Books

1. Gardner EJ, Simmons MJ, Snustad DP (2008) Principles of Genetics. 8th Edition. Wiley India.
2. Griffiths AJF, Wessler SR, Lewontin RC and Carroll SB. Introduction to Genetic Analysis. 9th Edition. W. H. Freeman and Co., NewYork.
3. Klug WS, Cummings MR, Spencer CA and Palladino MA (2012) Concepts of Genetics. 10th Edition. Pearson Edsucation, Inc., USA.
4. Russell PJ (2009) Genetics- A Molecular Approach. 3rd Edition. Benjamin Cummings, USA.
5. Snustad DP and Simmons MJ (2012) Principles of Genetics. 6th Edition. John Wiley and Sons Inc., USA.
6. Verma PS and AgarwalVK (2010) Genetics. 9th Edition. S. Chand, New Delhi.

C:11-DEVELOPMENTAL BIOLOGY

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Introduction

History and basic concepts: Epigenesis, preformation, Mosaic and regulative development; Discovery of induction; Cell-Cell interaction; Pattern formation; Differentiation and growth; Differential gene expression; Cytoplasmic determinants and asymmetric cell division.

UNIT-II: Early Embryonic Development

Gametogenesis (Spermatogenesis, Oogenesis); Types of eggs; Egg membranes; Fertilization: Changes in gametes, monospermy and polyspermy; Planes and patterns of cleavage; Early development of frog and chick up to gastrulation; Fate maps; Embryonic induction and organizers.

UNIT-III: Late Embryonic Development

Fate of germ layers; Extra-embryonic membranes in birds; Implantation of embryo in humans and Placenta (Structure, types and functions of placenta).

UNIT-IV: Post Embryonic Development

Metamorphosis: Changes, hormonal regulations in amphibians; Regeneration: Modes of regeneration (epimorphosis, morphallaxis and compensatory regeneration); Ageing: Concepts and models.

UNIT-V: Implications of Developmental Biology

Teratogenesis: Teratogenic agents and their effects on embryonic development; *in vitro* Fertilization; Stem cell culture and Amniocentesis.

PRACTICAL

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages).
2. Study of whole mounts of developmental stages of chick through permanent slides:Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation(Hamilton and Hamburger stages).
3. Study of developmental stages (above mentioned) by raising chick embryo in the laboratory.
4. Study of the developmental stages and life cycle of Drosophila from stock culture.
5. Study of different types of placenta.
6. Project report on Drosophila culture/chick embryo development.

Recommended Books

1. Balinsky BI and Fabian BC (1981) An Introduction to Embryology. 5th Edition. International Thompson Computer Press.
2. Gilbert SF (2010) Developmental Biology. 9th Edition. Sinauer Associates, Inc., USA.
3. Kalthoff (2008) Analysis of Biological Development. 2nd Edition. McGraw-Hill, New York.
4. Wolpert L, Beddington R, Jessell T, Lawrence P, Meyerowitz E and Smith J (2002) Principles of Development. 1st Edition, Oxford University Press, New York.

C:12-MOLECULAR BIOLOGY

(Credits:6, Theory-4, Practical-2)
Lectures: 60 (Theory:40, Practical:20)
Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Nucleic Acids and DNA Replication

Salient features of DNA double helix; Watson and Crick model of DNA; DNA denaturation and renaturation; DNA topology - linking number and DNA topoisomerases; Cot curves; Structure of RNA, tRNA and DNA and RNA associated proteins; DNA Replication in prokaryotes and eukaryotes; Mechanism of DNA replication; Role of proteins and enzymes in replication; Licensing factors; Semiconservative, bidirectional and semi-discontinuous replication; RNA priming; Replication of circular and linear ds-DNA and replication of telomeres.

UNIT-II: Transcription

RNA polymerase and transcription Unit; Mechanism of transcription in prokaryotes and Eukaryotes; Synthesis of rRNA and mRNA; Transcription factors and regulation of transcription.

UNIT-III: Translation

Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation.

UNIT-IV: Post Transcriptional Modifications and Processing of Eukaryotic RNA Structure of globin mRNA; Split genes: concept of introns and exons, splicing mechanism, alterna- tive splicing, exon shuffling, and RNA editing.

UNIT-V: Gene Regulation andRegulatory RNAs

Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from lac operon and trpoperon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencers elements; Gene silencing, Genetic imprinting; Ribo-switches, RNA interference, miRNA and siRNA.

PRACTICAL

1. Study of DNA replication using Photographs or slides and special cases, e.g., Polytenyusing permanent slides of polytene chromosomes.
2. Preparation of liquid culture medium (LB) and raise culture of $E.\ coli$.
3. Estimation of the growth kinetics of $E.\ coli$ by turbidity method.
4. Preparation of solid culture medium (LB) and growth of E. coli by spreading and streaking.
5. Demonstration of antibiotic sensitivity/resistance of E. coli to antibiotic pressure and interpretation of results.
6. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A260 measurement).
7. Quantitative estimation of RNA using Orcinol reaction.

Recommended Books

1. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell. 7th Edition. Pearson Benjamin Cummings Publishing, San Francisco.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter (2008)Molecular Biology of the Cell, 4th Edition.Garland publishing Inc., New York.
3. Cooper GM and Hausman RE (2007) The Cell: A Molecular Approach. 4th Edition, ASM Press, USA.
4. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology. 8th Edition;Lippin- cott Williams and Wilkins, Philadelphia.

5. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments. 6th Edition; John Wiley and Sons. Inc., USA.

C:13-IMMUNOLOGY

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Immune System and Immunity

Historical perspective of Immunology, Early theories of Immunology, Haematopoiesis, Cells and organs of the Immune system; Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity and Immune dysfunctions.

UNIT-II: Antigens

Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T -Cell epitopes.

UNIT-III: Immunoglobulins

Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions,Immunoassays, Polyclonal sera, Monoclonal antibodies and Hybridoma technology.

UNIT-IV: Major Histocompatibility Complex and Complement System

Structure and functions of endogenous and exogenous pathway of antigen presentation; Components and pathways of complement activation.

UNIT-V: Cytokines, Hypersensitivity and Vaccines

Properties and functions of cytokines; Cytokine-based therapies; Gell and Coombs classification and Brief description of various types of hypersensitivities; Types of vaccines: Recombinant vaccines and DNA vaccines.

PARCTICAL

1. Demonstration of lymphoid organs.
2. Ouchterlonys double immuno-diffusion method.
3. Determination of ABO blood group.
4. Preparation of single cell suspension of splenocytes from chick spleen, cell counting and viability test.
5. ELISA/ dot Elisa (using kit).
6. Principles, experimental set up and applications of immuno-electrophoresis, RIA, F.

Recommended Books

1. Abbas KA and Lechtman HA (2003) Cellular and Molecular Immunology. 5th Edition. Saunders Publication, Philadelphia.
2. David M, Jonathan B, David RB and Ivan R (2006) Immunology. 7th Edition. Elsevier Publica- tion, USA .
3. Kindt TJ, Goldsby RA, Osborne BA and Kuby J (2006) Immunology. 6th Edition. W.H. Freeman and Company, New York.

C:14-EVOLUTIONARY BIOLOGY

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: History of Life, theories of Evolution and Extinction

Chemogeny, Biogeny, RNA World, Major Events in History of Life; Lamarckism; Darwinism; Neo-Darwinism; Background of extinction, Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail) and Role of extinction in evolution.

UNIT-II: Evidences of Evolution

Fossils and its types; Dating of fossils, Phylogeny of horse and human; Molecular evidences (Globin gene families as an example) and Molecular clock concept.

UNIT-III: Processes of Evolutionary Change

Organic variations; Isolating mechanisms; Natural selection (Industrial melanism, Pesticide/Antibiotic resistance); Types of natural selection (Directional, Stabilizing, Disruptive), Sexual Selection and Artificial selection.

UNIT-IV: Principles of population genetics

Concept of gene pool, Gene frequencies equilibrium frequency (Hardy-Weinberg equilibrium), Shift in gene frequency without selection Genetic drift, Mutation pressure and Gene flow and Shifts in gene frequencies with selection.

UNIT-V: Species Concept and Evolution above species level

Biological concept of species (Advantages and Limitations); Sibling species, Polymorphic species, Polytypic species, Ring species; Modes of speciation (Allopatric, Sympatric); Macro-evolutionary Principles (Darwins Finches); Convergence, Divergence and Parallelism.

PRACTICAL

1. Study of fossil evidences from plaster cast models and pictures.
2. Study of homology and analogy from suitable specimens/ pictures.
3. Demonstration of changing allele frequencies with and without selection.
4. Construction of cladogram based on morphological characteristics.
5. Construction of phylogenetic tree with bioinformatics tools (Clustal X and Phylip).
6. Interpretation of phylogenetic trees.

Recommended Books

1. Barton NH, Briggs DEG, Eisen JA, Goldstein DB and Patel NH (2007) Evolution. Cold Spring Harbour Laboratory Press.
2. Campbell NA and Reece JB (2011) Biology. 9th Edition. Pearson Education Inc., NewYork.
3. Douglas JF (1997) Evolutionary Biology. Sinauer Associates,USA.
4. Hall BK and Hallgrimsson B (2008) Evolution. 4th Edition. Jones and Bartlett Publishers,USA.
5. Pevsner J (2009) Bioinformatics and Functional Genomics. 2nd Edition. Wiley-Blackwell, USA.
6. Ridley M (2004) Evolution. 3rd Edition. Blackwell Publishing, USA.

DISCIPLINE SPECIFIC ELECTIVE

DSE:1-ANIMAL BEHAVIOUR

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Introduction and Mechanisms of Behaviour

Origin and history of Ethology; Brief profiles of Karl von Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen; Proximate and ultimate behavior; Objective of behaviour, Behaviour as a basis of evolution; Behaviour as a discipline of science; Innate behaviour, Instinct, Stimulus filtering, Sign stimuli and Code breakers.

UNIT-II: Patterns of Behaviour

Reflexes: Types of reflexes, reflex path, characteristics of reflexes (latency, after discharge, summation, fatigue, inhibition) and its comparison with complex behavior.

Orientation: Primary and secondary orientation; kinesis-orthokinesis, klinokinesis; taxistropotaxis and klinotaxis and menotaxis (light compass orientation) and mnemotaxis.

Learning: Associative learning, classical and operant conditioning, Habituation and Imprinting.

UNIT-III: Social Behaviour

Insects society; Honey bee: Society organization, polyethism, foraging, round dance, waggledance, Experiments to prove distance and direction component of dance, learning ability in honey bee, formation of new hive/queen; Reciprocal altruism, Hamiltons rule and inclusive fitness with suitable examples.

UNIT-IV: Sexual Behaviour

Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry),Inter-sexual selection (female choice), Infanticide, Consequences of mate choice for female fitness, Sexual conflict for male versus female parental care and Courtship behaviour in three spine stickleback.

UNIT-V: Biological Clocks

Circadian rhythm, Tidal rhythm, Lunar rhythm, Advantages of biological clocks, Jet lag and Entrainment.

PRACTICAL

1. To study different types of animal behaviour such as habituation, social life, courtship behaviour in insects, and parental care from short videos/movies and prepare a short report.
2. To study nests and nesting habits of the birds and social insects.
3. To study the behavioural responses of wood lice to dry condition.
4. To study behavioural responses of wood lice in response to humid condition.
5. To study geotaxis behaviour in earthworm.
6. To study the phototaxis behaviour in insect larvae.
7. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.

Recommended Books

1. David McF. Animal Behaviour. Pitman Publishing Limited, London, UK.
2. John A (2001)Animal Behaviour. 7th Edition. Sinauer Associate Inc., USA.
3. Manning A and Dawkins MS. An Introduction to Animal Behaviour. Cambridge University Press, USA.
4. Paul WS and John A (2013) Exploring Animal Behaviour. 6th Edition.Sinauer Associate Inc., Massachusetts, USA.

DSE:2-ECONOMIC ZOOLOGY

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Bee-keeping and Bee Economy (Apiculture)

Varieties of honey bees and Bee pasturage; Setting up an apiary: Langstroths/Newton's hive, bee veil, brood and storage chambers, iron frames and comb sheets, drone excluder, rearing equipments, handling of bees, artificial diet; Diseases of honey bee, American and European Foulbrood, and their management; Honey extraction techniques; Physicochemical analysis of honey; Other benefi- cial products from bee; Visit to an apiculture institute and honey processing Units.

UNIT-II: Silk and Silk Production (Sericulture)

Different types of silk and silkworms in India; Rearing of Bombyx mori, Rearing racks andtrays, disinfectants, rearing appliances, black boxing, Chawki rearing, bed cleaning, mountages, harvesting of cocoons; Silkworm diseases: Pebrine, Flacherie, Grasserie, Muscardine and Aspergillosis, and their management; Silkworm pests and parasites: Uzi fly, Dermestid beetles and their management; Silk reeling techniques and Quality assessment of silkfibre.

UNIT-III: Aquaculture I

Brood stock management; Induced breeding of fish; Management of hatchery of fish; Management of nursery, rearing and stocking ponds; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish; Fishery by-products.

UNIT-IV: Aquaculture II

Prawn farming; Culture of crab; Pearl culture and Culture of air breathing fishes.

UNIT-V: Dairy and Poultry Farming

Introduction; Indigenous and exotic breeds; Rearing, housing, feed and rationing; Commercial im- portance of dairy and poultry farming; Varietal improvement techniques; Diseases and their man- agement; Dairy or poultry farm management and business plan; Visit to any dairy farm or Poultry farm.

* Submission of report on anyone field visits mentioned above.

PRACTICAL

1. Study of different types of bees (Queens, Drones and Worker bees).
2. Study of different types of silk moths.
3. Study of different types of pearls.
4. Study of different types of fish diseases.
5. Identification of different types of scales in fishes.
6. Study of different types of fins.
7. Study of different modified structures of fishes (Saw of sawfish, Hammer of hammer head fish, tail of sharks etc.)
8. Identification of various types of natural silks.

Recommended Books

1. Dhyan Singh Bisht, Apiculture, ICAR Publication.
2. Dunham RA (2004) Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publi- cations, U.K.
3. Hafez ESE (1962) Reproduction in Farm Animals. Lea and Fabiger Publishers.
4. Knobil E and Neill JD (2006) The Physiology of Reproduction. Vol. 2. Elsevier Publishers, USA.
5. Prost PJ (1962) Apiculture. Oxford and IBH, New Delhi.

6. Singh S. Beekeeping in India, Indian council of Agricultural Research, New Delhi.
7. Srivastava CBL (1999) Fishery Science and Indian Fisheries. Kitab Mahal publications, India.

DSE:3-MICROBIOLOGY

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I:

History of Microbiology; Microbial World Characterization, Classification and identification of microbes.

UNIT-II:

Prokaryotes: General morphology and classification of bacteria, their characters and economic importance; Gram-positive and Gram-negative bacteria.

UNIT-III:

Eukaryotes: General morphology of Protista and Fungi classification and economic importance.

UNIT-IV:

Viruses: structure, genome, replication cycle; Epidemiology of infectious diseases with reference of human hosts Bacterial (Tuberculosis), Viral (Hepatitis), Protozoan (Amoebiasis) and Fungal (any one) disease.

UNIT-V:

Microbe interactions-Immune Responses-Antibiotics and other chemotherapeutic agents; Applied microbiology in the fields of food, agriculture, industry and environment.

PRATICAL

1. Cleaning of glasswares, sterilisation principle and methods - moist heat - dry heat and filtration methods.
2. Media preparation: Liquid media, Solid media, Agar slants, Agar plates. Basal, enriched, selective media preparation - quality control of media, growth supporting properties, sterility check of media.
3. Pure culture techniques: Streak plate, pour plate and decimal dilution.
4. Cultural characteristics of microorganisms: Growth on different media, growth characteristics and description and demonstration of pigment production.
5. Staining techniques: Smear preparation, simple staining, Grams staining, Acidfast staining and staining for meta chromatic granules.
6. Morphology of microorganisms.
7. Antibiotic sensitivity testing: Disc diffusion test - Quality control with standard strains.
8. Physiology characteristics: IMViC test, H2S, Oxidase, catalase, urease test, Carbohydrate fermentation, Maintenance of pure culture, Paraffin method, Stab culture and maintenance of mold culture.

Recommended Books

1. Ahsan J and Sinha SP (2010) A Hand book on Economic Zoology. S Chand, NewDelhi.
2. Arora DR and Arora B (2001) Medical Parasitology.2nd Edition.CBS Publications and Distributers.
3. Atwal AS (1993) Agricultural Pests of India and South East Asia. Kalyani Publishers, Ludhiana.
4. Dubey RC and Maheshwari DK (2013) A Textbook of Microbiology. S. Chand, New Delhi.
5. Dunham RA (2004) Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications.
6. Pelczar MJ, Chan ECS and Krieg NR (1993) Microbiology.5th Edition, Tata McGraw Hill Pub- lishing Co.Ltd.

7. Pradhan, S (1983) Insect Pests of Crops. National Book Trust of India, New Delhi.
8. Shukla, G.S. and Upadhya, V.B. (2013) Economic Zoology. 5th Edition, Rastogi Publications, Meerut.

DSE:4-PROJECT WORK

(Credits:6, Max. Marks:100)

SKILL ENHANCEMENT COURSES(SEC)

SEC:1-COMMUNICATIVE ENGLISH & ENGLISH WRITING SKILL

(Compulsory)

(Credits: 02) Theory: 20 Classes (1hr duration)

SEC:2-PUBLIC HEALTH AND HYGIENE

(Credits:2)
Lectures:30, Max. Marks:50

UNIT-I:

Scope of Public health and Hygiene; nutrition and health; classification of foods; Nutritional deficiencies; Vitamin deficiencies.

UNIT-II:

Pollution: water pollution, air pollution, soil pollution, noise pollution, thermal pollution and radioactive pollution.

UNIT-III:

Environment and Health hazards; Environmental degradation and health hazards due to pollutants.

UNIT-IV:

Communicable diseases and their control measures such as Measles, Polio, Chikungunya, Rabies, Plague, Leprosy and AIDS.

UNIT-V:

Non-Communicable diseases and their preventive measures such as Hypertension, Coronary Heart diseases, Stroke, Diabetes, Obesity and Mental ill-health.

Recommended Books

1. Arora DR and Arora B (2001) Medical Parasitology.2nd Edition.CBS Publications and Distributers.
2. Dubey RC and Maheshwari DK (2013) A text book of Microbiology. S. Chand, New Delhi.
3. Pelczar MJ, Chan ECS and Krieg NR (1993) Microbiology.5th Edition. Tata McGraw Hill Publishing Co. Ltd.

GENERIC ELECTIVE PAPERS(GE)

Credits: 06 each)

GE-1: ANIMAL DIVERSITY (NON-CHORDATE), PHYSIOLOGY AND ENDOCRINOLOGY

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

General characteristics and classification up to classes and study of types mentioned

UNIT-I:

Protozoa: Paramecium with reference to structure and reproduction.
Porifera: Structure of Sycon and Canal system in sponges.
Cnidaria: Structure, reproduction and life cycle of Aurelia.

UNIT-II:

Platyhelminthes: Structure, reproduction and life cycle of Fasciola.
Nemathelminthes: Structure, reproduction and life cycle of Ascaris.
Annelida: Structure, digestion and excretion of Hirudinaria.

UNIT-III:

Arthropoda: External morphology, digestive and excretory system of Paleamon.

Mollusca: Morphology and respiration of Pila.

Echimodermata: Morphology and water vascular system of Asterias.

UNIT-IV: Mammalian Physiology

Digestion, Respiration, Transport of respiratory gases, Structure of heart and cardiac cycle, Composition and clotting of blood, Blood group, Structure of neuron and transmission of nerve impulse, Structure of skeletal muscle and muscle contraction.

UNIT-V: Endocrinology

Structure and function of Pituitary, Thyroid and Gonads.

Note: Classification to be followed from " Barnes RD (1982) Invertebrate Zoology. 5th Edition."

PRACTICAL

Experiment (Physiology) Estimation of heamoglobin concentration in man, Estimation of casein in milk, Estimation of lipid in any given sample.
Endocrinology slides as mentioned in syllabus Museum Specimens and slides Slides: Morphology of Paramecium, Binary fission and Conjugation in Paramecium. Section through Sycon, Spicules and Gemmules of sponge, Ephyra larva.
Museum specimens: Spongilla, Sycon, Gorgonia, Physallia, Porpita, Penatulla, Nereis, Aphrodite, Sacculina, Eupagurus, Chiton, Aplysia, Octopus, Starfish, sea-Urchin, sea Cucumber.

Recommended Books

1. Arora MP (2006) Non-Chordata-I. 1st edition. Himalaya Publishing House, New Delhi.
2. Arora MP (2008) Non-Chordata-II. 1st edition. Himalaya Publishing House, New Delhi.

3. Barnes RD (1982) Invertebrate Zoology. 6th Edition. Holt Saunders International Edition.
4. Barnes RSK, Calow P, Olive PJW, Golding DW & Spicer JI (2002) The Invertebrates: A New Synthesis. 3rd Edition. Blackwell Science, USA.
5. Barrington EJW (1979) Invertebrate Structure and Functions. 2nd Edition. ELBS and Nelson.
6. Boradale LA and Potts EA (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
7. Jordan EL and Verma PS (1963) Invertebrate Zoology. Revised Edition. S. Chand, New Delhi.
8. A text book of medical Physiology. Guyton and Hall.
9. Human physiology. Chatterjee.
10. Principle of Anatomy and Physiology.Tortora and Derrickson.
11. A book of Physiology and Functional Histology, A K berry.
12. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.

GE-2: ANIMAL DIVERSITY (PROTOCHORDATA, CHORDATA), DEVELOPMENTAL BIOLOGY AND IMMUNOLOGY

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Protochordata and Origin of Chordates

General characters of Hemichordata, Urochordata and Cephalochordata; Structure, Digestive system, Respiratory and reproduction in Balanoglossus, Herdmania and Amphioxus.

UNIT-II: Pisces and Amphibia

General characters of Chondrichthyes and Osteichthyes and classification up to order; Digestive and reproductive system in Scoliodon General characters and classification of amphibian up to order, Circulatory and Nervous system (Brain and Cranial nerves).

UNIT-III: Reptilia, Aves and Mammals

Urinogenital system of Calotes; Respiratory system of Pigeon and Flight adaptation in Birds; Digestive and Nervous System (Brain and Cranial nerves) of rabbit.

UNIT-IV: Developmental Biology

Gametogenesis, structure of gametes, Mechanism of fertilization, Types of Cleavage, Development of Amphioxus and frog up to formation of three germ layers.

UNIT-V: Immunology

Innate and acquired immunity, Antigens, structure and function of immunoglobulins, Antign- Antibody interaction, Vaccines.

PRACTICAL

Immunology: Blood Grouping

Museum specimens: Balanoglossus, Herdmania, Amphioxus, Exocoetus, Hippocampus, An- abas, Ambystoma, Axolotl larva, Polypedates, Icthyophis, Draco, Chelone, Trionyx, Hemidactylus, Varanus, Chamaeleon, Sea snake, Cobra, Viper, Krait, Pigeon, Crow, Bat, Rat.

Slides: Sections through Balanoglossus and Amphioxus; Tissue sections through Liver, Pancreas; Embryological slides of frog.

Bones: Amphibia and mammals.

Recommended Books

1. Agarwal VK (2011) Zoology for degree students. S. Chand, NewDelhi.
2. Arora MP (2006) Chordata-1. 1st Edition. Himalaya Publishing House, New Delhi.
3. Hall BK and Hallgrimsson B (2008) Strickbergers Evolution. 4th Edition. Jones and Bartlett Publishers Inc., USA.
4. Jordan EL and Verma PS (1963) Chordate Zoology. Revised Edition.S. Chand, New Delhi.
5. Young JZ (2004) The Life of Vertebrates. 3rd Edition. Oxford University Press, USA.
6. Kindt TJ, Goldsby RA, Osborne BA, Immunology.
7. Gilbert SF, Developmental Biology.

GE-3: FOOD, NUTRITION AND HEALTH

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I:

Food; Diet; Nutrient; Vitamins; Disorders due to deficiency of vitamins; Synthetic foods and drinkss.

UNIT-II:

Functions of food; Components of food; Nutrients (Macro and micronutrients): their biochemical role and dietary sources; Food groups and the concept of a balanced diet; Causes of food spoilage; Food adulteration; Nutrition through the life cycle- Physiological considerations, nutrient needs and dietary pattern for various groupsadults, pregnant and nursing mothers, infants, preschool and school children, adolescents and elderly.

UNIT-III:

Nutritional Biochemistry Carbohydrates, Lipids, Proteins - Definition, Classification, Structure and properties Significance of acid value, iodine value and saponification value of lipids; Essential and Non-essential amino acids; Enzymes- Definition, Classification, Properties; Coenzymes Vitamins- Fat-soluble and Water-soluble vitamins; their Structure and properties Minerals- Iron, calcium, phosphorus, iodine, selenium and zinc and their properties.

UNIT-IV:

Introduction to health- Definition and concept of health; Major nutritional deficiency Diseases: Protein Energy Malnutrition; Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary or lifestyle modifications. Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome (AIDS); Common ailments- cold, cough, fevers, diarrhoea, constipation: their causes and dietary treatment.

UNIT-V:

Food hygiene, Potable water- sources and methods of purification, Food and Water Borne Infections.

PRACTICAL

1. To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric.
2. To determine absorbed oil content in fried foods.
3. Estimation of lactose in milk.
4. Ascorbic acid estimation in food by titrimetry.
5. Estimation of calcium in foods by titrimetry.

6. Preparation of temporary mounts of various stored grain pests.
7. Project- Undertake computer aided diet analysis and nutrition counselling for different age groups. OR Identify nutrient rich sources of foods, their seasonal availability and price; study ofNutritionla- belling on selected foods.

Recommended Books

1. Bamji MS, Rao NP and Reddy V (2009) Text Book of Human Nutrition. Oxford & IBH Publishing Co. Pvt Ltd.
2. Jain P et al. (2007) Poshan vaswasthya ke mool siddhant (Hindi). 1st Ed. Acadamic Pratibha.
3. Lakra P and Singh MD (2008) Text book of Nutrition and Health. 1st Edition. Academic Excellence.
4. Manay MS, Shadaksharaswamy (1998) Food-Facts and Principles. New Age International (P) Ltd.
5. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.
6. Mudambi SR and Rajagopal MV (2007) Fundamentals of Foods, Nutrition and Diet Therapy.5th Edition. New Age International Publishers.
7. Srilakshmi B (2002) Nutrition Science. New Age International (P) Ltd.
8. Srilakshmi B (2007) Food Science. 4th Edition. New Age International (P) Ltd.
9. Swaminathan M (1986) Handbook of Foods and Nutrition.5th Edition. BAPPCO.
10. Wardlaw GM, Hampl JS (2007) Perspectives in Nutrition. 7th Edition. McGraw Hill.

GE-4: BIOTECHNOLOGY: MICROBES TO ANIMALS

(Credits:6, Theory-4, Practical-2) Lectures: 60 (Theory:40, Practical:20) Max. Marks:100 (Theory:70, Practical:30)

UNIT-I: Introduction

Concept and scope of Biotechnology; Importance of biotechnology and Application of biotechnology.

UNIT-II: Techniques in Gene Manipulation

Restriction and modifying enzymes, Cloning vectors and Expression vectors, Transformation tech- niques, Identification of recombinants, Construction and screening of DNA libraries; Molecular anal- ysis of DNA, RNA and proteins (i.e., Southern, Northern and Western blotting),DNA sequencing (Sangers method and automation), Polymerase Chain Reaction, Microarrays, DNA fingerprinting and RAPD.

UNIT-III: Microbes in Biotechnology

Growth kinetics of microbes, Applications of microbes in industry (Concept of primary and secondary metabolites, Fermentation/Bioreactors, Downstream processing), Bioremediation and Biosensing. **UNIT-IV: Transgenic Animal**

Production of transgenic animals: Retroviral method, DNA microinjection method, embryonic stem cell method, nuclear transplantation; Applications of transgenic animals; Knockout mice; Transgenic livestock and Transgenic fish.

UNIT-V: Biotechnology and Human Welfare

Animal cell technology: Concept of expressing cloned genes in mammalian cells, Recombinant DNA in health (Recombinant insulin and human growth hormone), Production of recombinant vaccines, Gene therapy: in vitro, in-vivo and ex-vivo. Ethical issues concerning: Transgenesis, Bio safety and Intellectual Property Rights.

PRACTICAL

1. Isolation of genomic DNA from E. coli and analyze it using agarose gel electrophoresis.
2. Isolation of plasmid DNA (pUC 18/19) and analyse it using agarose gel electrophoresis.
3. Transformation of E. coli (pUC 18/19) and calculation of transformation efficiency.
4. Restriction digestion of lambda (λ) DNA using EcoR1 and Hind III.
5. DNA ligation (lambda DNA EcoR1/Hind III digested).
6. Construction of restriction digestion maps from data provided.
7. Study of Southern blot hybridization and PCR; Analysis of DNA fingerprinting (Dry Lab).
8. Project on Animal Cell Culture.

Recommended Books

1. Beauchamp TI and Childress JF (2008) Principles of Biomedical Ethics.6th Edition. Oxford University Press, USA.
2. Brown TA (1998) Molecular Biology Labfax II: Gene Cloning and DNA Analysis. 2nd Edition. Academic Press, USA.
3. Glick BR and Pasternak JJ and Patten CL (2009) Molecular Biotechnology-Principles and Applications of Recombinant DNA. 4th Edition. ASM press, Washington, USA.
4. Griffiths AJF, Miller JH, Suzuki DT, Lewontin RC and Gelbart WM (2009) An Introduction to Genetic Analysis. 9th Edition. W.H. Freeman and Co., USA.
5. Snustad DP and Simmons MJ (2009) Principles of Genetics.5th Edition, John Wiley and Sons Inc., USA.
6. Watson JD, Myers RM, Caudy A and Witkowski JK (2007) Recombinant DNA-Genes and Genomes- A Short Course. 3rd Edition, Freeman and Co., USA.