



# Solapur University, Solapur

## B. Sc.-III (Chemistry) CREDIT-GRADING SYSTEM Syllabus- 2016-2017

### General Structure

#### Theory Examination:

- Structure of B.Sc. course under faculty of science has total 06 semesters for 3 years.
- B.Sc.-III comprises of total two semesters (Sem-V and Sem-VI).

Each semester will have Five theory papers (one compulsory English and four Chemistry papers) of 70 marks each (University external examination) and 30 marks for each paper (Internal examination)

The duration of each University theory paper examination will be of 2 hr. and 30 min.

Each theory paper has 30 marks for internal examination. There will be 15 marks unit test and 15 marks home assignment

- At the end of academic year i.e. semester - VI the practical examination will be conducted.

The Weightage of practical is of 280 marks for University external practical examination and 120 i.e (30\*4) marks for internal practical examination.

**There will be Four theory papers in chemistry of 70 marks for each semester. There titles and marks distribution are as under (Excluding English).**

Semester	Paper No.	Title of Paper	Lectures/ Practicals per week	Total Marks			Total Credit
				Univ. Exam	Internal Exam	Total	
<b>Semester -V</b>	VII	Physical Chemistry	3	70	30	100	3
	VIII	Inorganic Chemistry	3	70	30	100	3
	IX	Organic Chemistry	3	70	30	100	3
	X	Analytical and Industrial Physical Chemistry	3	70	30	100	3
<b>Semester -VI</b>	XI	Physical Chemistry	3	70	30	100	3
	XII	Inorganic Chemistry	3	70	30	100	3
	XIII	Organic Chemistry	3	70	30	100	3
	XIV	Analytical and Industrial Organic Chemistry	3	70	30	100	3
Theory				560	240	800	24
Practical's			20	280	120	400	20
<b>Total B.Sc.-III</b>				<b>840</b>	<b>360</b>	<b>1200</b>	<b>44</b>

### Practical Course

**Practical Examination will be held at the end of the year.**

#### A) Distribution of marks :

- **Continuous Internal Assessment for chemistry:**

- 1) Practical paper has  $30 \times 4 = 120$  marks for internal examination.
- 2) Practical paper has 280 marks for external university practical examination.
- 3) There will be three practical's, one from each Physical, Inorganic and Organic practical work.
- 4) The mark distribution of 280 marks for external university practical examination is as follows.

Q. 1 Physical Chemistry experiment	: 90 marks
Q. 2 Inorganic Chemistry experiment	: 100 marks
Q. 3 Organic Chemistry experiment	: 90 marks

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Total marks: 280 marks

**Duration of practical examination is Three days, six and half hours per day**

**All answer sheets should be collected at the end of examination.**

### Practical Marks Distribution

- **Physical Chemistry experiment: 90 marks**

- a) Instrumental : 30
- b) Non-instrumental : 40
- c) Journal : 10
- d) Oral : 10

- **Inorganic Chemistry experiment: 100 marks**

- a) Gravimetric analysis : 35
- b) Volumetric analysis : 25
- c) Preparation : 20
- d) Journal : 10
- e) Oral : 10

- **Organic Chemistry experiment: 90 marks**

- a) Organic Mixture Separation and analysis: 35
- b) Volumetric analysis : 25

Or

- c) Preparation : 25
- d) Derivative : 10
- e) Journal : 10
- f) Oral : 10

**CHEMISTRY: Syllabus for B.Sc.-III as per CGPA pattern****Theory****N. B.**

- i.) Figures shown in bracket indicates the total number of contact hours required for the respective topics
- ii) The question paper should cover the entire syllabus. Marks allotted should be in proportion to the number of contact hours allotted to respective topics.
- iii) All topics should be dealt with S.I units.
- iv) Use of scientific calculator is allowed.
- v) Industrial tour is prescribed.
- vi) Values required for spectral problems should be provided in the question paper.

**SEMESTER –V****PAPER-VII: PHYSICAL CHEMISTRY****Total Credits: 3****Contact hrs: 45****1. Phase Equilibria.****[10]**

- 1.1 Introduction
- 1.2 Gibbs phase rule : Phase rule equation and explanation of terms involved in the equation.
- 1.3 Phase diagram, true and metastable equilibria.
- 1.4 One component systems : (i) Water system (ii) Sulphur system with explanation for polymorphism.
- 1.5 Two component systems : (i) Eutectic system : (Ag - Pb system); Desilverisation of lead, (ii) Formation of compound with congruent melting point (FeCl<sub>3</sub> - H<sub>2</sub>O)

**2. Electromotive force.****[23]****(Convention : Reduction potentials to be used)**

- 2.1 Introduction
- 2.2 Thermodynamics of electrode potentials, Nernst equation for electrode and cell potentials in terms of activities.
- 2.3 Types of electrodes : Description in terms of construction, representation, half cell reaction and emf equation for,
  - i) Metal - metal ion electrode. ii ) Amalgam electrode.
  - iii) Metal - insoluble salt electrode. iv) Gas - electrode.
  - v) Oxidation - Reduction electrode.
- 2.4 i) Reversible and Irreversible cells.
  - ii) Chemical cells without transference.
  - iii) Concentration cells
    - a. Electrode concentration cell
      - I) Reversible to cation
      - II) Reversible to anion
    - b. Electrolyte concentration cells without transference
- 2.5 Equilibrium constant from cell emf, Determination of the thermodynamic parameters

such as  $\Delta G$ ,  $\Delta H$  and  $\Delta S$ .

2.6 Applications of emf measurements :

- i) Determination of pH of solution using Hydrogen electrode.
- ii) Solubility and solubility product of sparingly soluble salts (based on concentration cell).

2.7 Numerical problems.

### 3. Photochemistry.

[12]

3.1 Introduction

3.2 Difference between thermal and photochemical processes.

3.3 Laws of photochemistry : Grotthus - Draper law, Lambert law, Lambert - Beer's law (with derivation), Stark - Einstein law.

3.4 Quantum yield, Reasons for high quantum yield (e.g.  $H_2 - Cl_2$ ) and low quantum yield. ( e.g. Decomposition of HI and HBr).

3.5 Photosensitized reactions - Dissociation of  $H_2$ , Photosynthesis.

3.6 Photodimerisation of anthracene.

3.7 Jablonski diagram depicting various processes occurring in the excited state :

Qualitative description of fluorescence and phosphorescence.

3.8 Chemiluminescence.

3.9 Numerical problems.

### **Reference Books:**

1. Physical Chemistry by G. M. Barrow, International student Edition, Mc Graw Hill.
2. University General Chemistry by C.N.R. Rao, Macmillan.
3. Physical Chemistry by, R. A. Alberty, Wiley Eastern Ltd.
4. The Elements of Physical Chemistry by P. W. Atkins, Oxford.
5. Principles of Physical Chemistry by S. H. Maron, C. H. Prutton, 4th Edition.
6. Fundamentals of Photochemistry by K.K. Rohatgi-Mukerjee.
7. Principles of Physical Chemistry by Puri, Sharma, Pathania, Shobhanlal Naginchand and Company, Jalandar.
8. Text Book of Physical Chemistry by S. Glasstone, Macmillan India Ltd.
9. Elements of Physical Chemistry by D. Lewis and S. Glassture (Macmillan).
10. Principles of Physical Chemistry by Maron and Lando (Amerind).
11. An Introduction to Electrochemistry by S. Glasstone.
12. Physical Chemistry by W. J. Moore.
13. Essentials of Physical Chemistry, Bahl and Tuli (S. Chand).

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**PAPER -VIII: INORGANIC CHEMISTRY****Total Credits: 3**  
**Contact hrs: 45****1. Metal Ligand Bonding in Transition Metal Complexes [13]****I Crystal Field Theory (CFT).**

- 1) Introduction - What is CFT?
- 2) Basic concept of CFT.
- 3) Formation of complexes with Crystal field splitting of 'd' orbitals
  - I. Shapes of d orbitals and their electron density region
  - II. Formation of octahedral Complex with Crystal field splitting of 'd' orbitals  
e.g. High spin and low spin octahedral complexes of Co(III).-  $[\text{CoF}_6]^{3-}$ ,  $[\text{Co}(\text{NH}_3)_6]^{3+}$ .
  - III. Formation of tetrahedral Complex with Crystal field splitting of 'd' orbitals  
e.g.  $[\text{CoCl}_4]^{2-}$
  - IV. Formation of square planer Complex with Crystal field splitting of 'd' orbitals  
e.g.  $[\text{Co}(\text{CN})_4]^{2-}$
- 4) Jahn - Teller distortion.
- 5) Factors affecting the Crystal - field splitting.
- 6) Crystal field stabilization energy ( $\Delta$ ): Calculation for octahedral complexes only.
- 7) Applications and limitations of CFT.

**II Molecular Orbital Theory (MOT).**

1. Introduction.
2. Basic concept
3. Symmetry classes of atomic orbitals
4. Formation of octahedral complex
  - a) Assumptions
  - b) M.O. energy level diagram for hypothetical octahedral complex.
5. Examples: octahedral complexes with sigma bonding only such as-  
e.g.  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ ,  $[\text{FeF}_6]^{3-}$ ,  $[\text{Fe}(\text{CN})_6]^{3-}$ ,  $[\text{CoF}_6]^{3-}$ ,  $[\text{Co}(\text{NH}_3)_6]^{3+}$ ,  $[\text{Ni}(\text{NH}_3)_6]^{2+}$
6. Applications and limitations of MOT.
7. Comparison between CFT and MOT.

**2. Nuclear Chemistry [12]**

- 1 Nuclear reaction and energetic of nuclear reactions.
- 2 Classification of nuclear reactions and Types of nuclear reactions-
  - i) Artificial transmutation.
  - ii) Artificial radioactivity.
  - iii) Projectile capture reaction.
  - iv) Projectile capture - particle emission reaction.
  - v) Nuclear fission.
  - vi) Nuclear fusion.
- 3) Use of Uranium, Thorium and Plutonium for:
  - a. Nuclear reactor
  - b. Atomic Bomb.

- 4) Applications of radioisotopes as tracers.
- i) Chemical investigation - Esterification.
  - ii) Structural determination - Phosphorus pentachloride.
  - iii) Analytical Chemistry - isotopic dilution method for determination of volume of blood.
  - iv) Age determination - Dating by  $C^{14}$ .

### 3. Bioinorganic Chemistry.

[08]

- 1) Essential and trace elements in biological process.
  - i) Essential elements
    - a) Macro / major elements
    - b) Micro/trace/minor elements
  - ii) Non-essential elements
- 2) Metalloporphyrins with special reference to haemoglobin and myoglobin.
  - i) Structure of Haemoglobin (Hb)
  - ii) Structure of Myoglobin (Mb)
  - iii) Function of Haemoglobin (Hb) and Myoglobin (Mb) as Oxygen transport form lungs to tissues
  - iv) Function of Haemoglobin as Carry back  $CO_2$  to lungs
  - v) Co-operativity
  - vi) Oxygen binding curve
  - vii) Difference between Haemoglobin (Hb) and Myoglobin (Mb)
- 3) Role of alkali and alkaline earth metal ions with special reference to  $Na^+$ ,  $K^+$  and  $Ca^{2+}$ .
  - i) Role of  $Na^+$  and  $K^+$
  - ii) Role of  $Ca^{2+}$

### 4) Inorganic Polymers.

[08]

- 1) Introduction.
- 2) Basic concept and definition.
  - i) polymer
  - ii) Monomer
  - iii) Polymerization
  - iv) copolymer
  - v) degree of polymerization
- 3) Classification of polymers on the basis of -
  - a) origin
  - b) composition
  - c) properties
  - d) use
- 4) Comparison between organic and inorganic polymers.
- 5) Polymer back bone.
- 6) Homoatomic polymer containing - Phosphorus.
- 7) Heteroatomic polymers –
  - (i) Silicones
  - (ii) Phosphonitrilic compounds

(iii) Fluorocarbons.

## 5. Nanotechnology

[04]

1. Introduction
2. Properties of nanoparticles
3. Applications of nanoparticles

### **Reference Books :**

1. Concise Inorganic Chemistry (ELBS, 5th Edition) - J. D. Lee.
2. Inorganic Chemistry (ELBS, 3rd Edition) D. F. Shriver, P. W. Atkins, C. H. Lang Ford, Oxford University Press, 2nd Edition.
3. Inorganic Chemistry (Harper International, 3rd edition) J. E. Huheey Harper and Row.
4. Basic Inorganic Chemistry : Cotton and Wilkinson.
5. Advanced Inorganic Chemistry (4th Edn.) Cotton and Wilkinson.
6. Concepts and Models of Inorganic Chemistry : Douglas and Mc. Daniel. 3rd Edition. John Wiley publication.
7. Fundamental concepts of Inorganic Chemistry by E. S. Gilreath.
8. Structural principles in inorganic compounds. W. E. Addison.
9. T. B. of Inorganic analysis - A. I. Vogel.
10. Theoretical principles of Inorganic Chemistry - G. S. Manku.
11. Theoretical Inorganic Chemistry by Day and Selbine.
12. Co-ordination compounds S F A Kettle.
13. Modern Aspects of Inorganic Chemistry. E. Sharpe.
14. New guide to Modern Valence Theory by G. I. Brown.
15. Essentials of Nuclear Chemistry by H. J. Arnikar.
16. Organometallic Chemistry by R. C. Mahotra A. Sing, Wiley Eastern Ltd. New Delhi.
17. Inorganic Chemistry by A. G. Sharpe, Addison - Wisley Longman - Inc.
18. Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vallabh Publication. Pitampur Delhi.
19. Text book of Inorganic Chemistry by K. N. Upadhyaya Vikas Publishing House - New Delhi.
20. Progress in inorganic polymer by Laport and Leigh.
21. Co-ordination compounds by Baselo and Pearson.
22. Organometallic Chemistry by P. L. Pauson.
23. Advanced inorganic chemistry, Vol. I and II Satyaprakash, G. D. Tuli, S. K. Basu and Madan (S Chand)
24. Selected Topics in inorganic chemistry by W U Malic, G. D. Tuli, R. D. Madan. (S. Chand)
25. Industrial chemistry part I and II by A. K. De
26. Industrial chemistry by B. K. Sharma
27. Nanomaterials and nanostructure, Laura Castlow, April Feter (Dominant Publisher, 2007)
28. Nansocale materials in Chemistry K,J, Kalbunde Wiley Interscience (2001)
29. Introduction to Nansocience and Nanotechnology K.K. Chattopadhyaya, A.N. Banerjee, PHI Learning Pvt. Ltd. New Delhi, 2009.
30. Introduction to Nanotechonology – Charles P. Poole Jr., Frank J Owens, Wiley Student Edition 2008.
31. Nanotechonology – A Future Techonology with Futures BPB Publication New Delhi.

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## Paper – IX: Organic Chemistry

**Total Credits: 3**  
**Contact hrs: 45**

### 1 Spectroscopic Methods.

[20]

#### 1.1. Infrared Spectroscopy :

- 1.1.1 Introduction,
- 1.1.2 Principle of IR spectroscopy,
- 1.1.3 Double beam IR spectrophotometer- Schematic diagram.
- 1.1.4 Fundamental modes of vibration,
- 1.1.5 Types of vibration
- 1.1.6 Hooke's law,
- 1.1.7 factors affecting values of vibrational frequencies,
- 1.1.8 conditions for absorption of radiation and selection rule,
- 1.1.9 fundamental group regions of IR spectrum,
- 1.1.10 Functional group region, Finger print region,
- 1.1.11 characteristic absorption of various functional groups,
- 1.1.12 Applications of IR spectroscopy – Determination of structure, Identification of functional groups spectral problems based on IR

#### 1.2 NMR Spectroscopy.

- 1.2.1 Introduction
- 1.2.2. Proton magnetic resonance (  $^1\text{H}$  ) spectroscopy (PMR).
- 1.2.3 Principles of PMR spectroscopy.
- 1.2.4 Magnetic and non-magnetic nuclei.
- 1.2.5. Theory of PMR spectroscopy - spinning nuclei, magnetic moment and magnetic field, precessional motion of nuclei without mathematical details, nuclear resonance.
- 1.2.6 NMR - Instrument. Schematic diagram.
- 1.2.7. Shielding and deshielding.
- 1.2.8. Chemical shift, measurement of chemical shift, by delta scale and tau scale.
- 1.2.9. TMS as reference. Advantages of TMS.
- 1.2.10. Peak area (integration)
- 1.2.11. Spin - spin splitting ( $n + 1$  rule).
- 1.2.12. Definition of coupling constant (J value) of first order coupling.
- 1.2.13. PMR spectra of ethanol, ethyl bromide, acetaldehyde, 1, 1, 2 - tribromoethane, ethyl acetate, acetophenone, benzaldehyde, propanoic acid and benzoic acid
- 1.2.14. Problems pertaining to the structure elucidation of simple organic compounds using PMR spectroscopic data (supporting IR and UV data to be given).

#### 1.3 Mass spectroscopy.

- 1.3.1 Introduction
- 1.3.2 Theory of mass spectroscopy
- 1.3.3 Mass spectrometer - schematic diagram
- 1.3.4 Formation of ions by ionization
- 1.3.5 Types of ions with at least one example.
- 1.3.6. Applications of mass spectroscopy.
  - i) Determination of molecular weight.
  - ii) Determination of molecular formula

**2. Stereochemistry.**

[07]

2.1 Introduction.

2.2 Baeyer's strain theory.

2.3 Theory of strainless rings.

2.4 Conformation and stability of cyclohexane and monosubstituted cyclohexanes , methyl cyclohexane.

2.5 Locking of conformation in t-butyl cyclohexane.

2.6 Stereoselective and stereospecific reactions :

i) Stereochemistry of addition of halogens to alkenes : syn and anti addition.

Example - Addition of bromine to 2-butene. (mechanism not expected)

ii) Stereochemistry of elimination reaction : syn and anti elimination Example -

Dehydrohalogenation of 1-bromo -1, 2 - diphenylpropane. (Mechanism not expected)

**3. Name reactions.**

[10]

Mechanism of following reactions :

3.1 Stobbe condensation.

3.2 Oppenauer oxidation.

3.3 Meerwein Ponndorf Verley reduction.

3.4 Reformatsky reaction

3.5 Wagner - Meerwein Rearrangement.

3.6 Hofmann rearrangement reaction.

3.7 Wittig reaction.

3.8 Related problems.

**4. Organic synthesis via Enolates**

[08]

4.1 Introduction - Reactive methylene group.

4.2 Ethyl acetoacetate - synthesis by Claisen condensation, acidity of methylene hydrogen (salt formation), Keto-enol tautomerism, synthetic applications - Synthesis of alkyl and dialkyl derivatives, monobasic, dibasic and  $\alpha$ -  $\beta$ - unsaturated acid, heterocyclic compound.

4.3 Diethyl malonate - Synthesis, acidity of methylene hydrogen (salt formation).

Synthetic applications - Synthesis of alkyl and dialkyl derivatives, monobasic , dibasic acid,  $\alpha$ -  $\beta$ - unsaturated acid,  $\alpha$ -amino acid and heterocyclic compound.**Reference Books :**

- 1) Organic Chemistry - Cram D. J. and Hammond G.S. McGraw Hill book Company New York.
- 2) Organic Chemistry - Finar I. L. The English Language Book Society, London.
- 3) A Guide Book to mechanism in Organic Chemistry - Peter Sykes Longman Green and Co. Ltd. London 6th Edition.
- 4) Organic Chemistry - R. T. Morrison and R. N. Boyd Prentice Hall of India private limited New Delhi. 6th Edition.
- 5) Text book of organic Chemistry - Furguson L. N. D. Van Nostrand Company Indian Edition, Affiliated East West press private Ltd. New Delhi.
- 6) Organic Chemistry Vol. I, II and III - S. M. Mukharji, S. P. Singh, R. P. Kapoor Wiley Estern, Limited, New Delhi.

- 7) A text book of organic Chemistry - K. S. Tewari, S. N. Mehrotra, N. K. Vishnoi  
Vikas Publishing House Private Ltd. New Delhi.
- 8) A text book of Organic Chemistry - Arun Bahl and B. S. Bahl S. Chand and  
Company Ltd. 6th Edition.
- 9) Heterocyclic Chemistry Synthesis, Reactions and Mechanism - Raj K. Bansal  
Wiley Easter Ltd. New Delhi.
- 10) Reaction Mechanism and reagents in Organic Chemistry - G. R. Chatwal Himalaya  
Publishing House New Delhi.
- 11) Stereochemistry conformation and mechanism - P. S. Kalsi, New Age International  
Publishers 4th Edition.
- 12) Organic Chemistry Volume I and II - I. L. Finar ELBS with Longman 6th Edition.
- 13) Organic Chemistry Volume I and II - William Kemp ELBS with Macmillan 3rd Edition.
- 14) Advanced Organic Chemistry - Jerry March Wiley Eastern Ltd.
- 15) Spectroscopy of Organic compounds - P. S. Kalsi.
- 16) Organic Chemistry - Fieser and Fieser.
- 17) Principles of Organic Chemistry - English and Cassidy.
- 18) Elementary Organic Absorption Spectroscopy - Y. R. Sharma.
- 19) Spectroscopy - V. M. Parikh.
- 20) Stereochemistry of Carbon Chemistry - Eliel.
- 21) Principles of Organic Chemistry - M. K. Jain.
- 22) Organic Chemistry by Clayden, Greeves, Warren and Wothers Oxford press.
- 23) Organic Chemistry - A Comprehensive degree text and source book by Hanes  
Baeyers and Wolfgang Walter Albion Chemical Science Series.
- 24) Reactions, Rearrangements and reagents - S.N.Sanyal Bharati Bhawan publishers and  
Distributors Patna.

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**PAPER-X : ANALYTICAL AND INDUSTRIAL PHYSICAL CHEMISTRY****Total Credits: 3**  
**Contact hrs: 45****1. Colorimetry. [08]**

1.1 Introduction

1.2 General discussion of theory of colorimetry : Lambert law, Beer's law (Derivation not expected), Terms used in Colorimetry, Application of Beer's law, Deviation from Beer's law.

1.3 Classification of methods of 'colour' measurement or comparison, Photoelectric photometer method - single cell photo-electric colorimeter.

**2. Potentiometry [10]**

2.1 Introduction.

2.2 Detail study of calomel, quinhydrone and glass electrodes and their use in determination of pH. .

2.3 Potentiometric titrations : Classical and analytical methods for locating end points,

i) Acid - Base titrations.

ii) Redox - titrations.

iii) Precipitation titrations.

2.4 Advantages of potentiometric titrations,

2.5 Basic circuit of direct reading potentiometer.

**3 Electroplating [08]**

3.1 Introduction.

3.2 Electrolysis, Faraday's laws, Cathode current efficiency.

3.3 Basic principles of electroplating, cleaning of articles.

3.4 Electroplating of Nickel and Chromium.

3.5 Anodising.

**4 Flame photometry [09]**

4.1 General principles.

4.2 Instrumentation : Block diagram, Burners: Total consumption burner, premix or laminar-flow burner, Lundergraph burner,

Mirrors, Slits, Monochromators, Filters and Detectors.

4.3 Applications in qualitative and quantitative analysis.

4.4 Limitations of flame photometry.

**5. Conductometry: [10]**

5.1 Measurement of conductance by Wheatstone bridge, Basic circuit of D.C. Wheatstone

bridge, use of alternating current,

conductivity water, Different types of conductivity cells, cell constant and its determination.

Experimental determination of specific, equivalent and molecular conductance's.

5.2 Conductometric acid-base titrations

i. Strong acid against strong base

ii. Strong acid against weak base

iii. Weak acid against strong base.

iv. Weak acid against weak base.

### 5.3 Advantages of conductometric titrations

#### **Reference Books :**

1. Text book of Quantitative Inorganic Analysis - By A. I. Vogel (ELBS and Longman 3rd Edition).
2. Instrumental methods of Chemical analysis by Willard, Merit and Dean.
3. Instrumental methods of Chemical analysis by Chatwal and Anand (Himalaya Publication).
4. Principles of electroplating and eletroforming by Blum and Hogaboom, Mac Graw - Hill Book Co. 3rd Edn.
5. Vogel's text book of Quantitative Inorganic Analysis by Basssett and Denny etc. ELBS and Longman 4th Edition.
6. Principles of Physical Chemistry by Puri, Sharma, Pathania, Shobhanlal Naginchand and Company, Jalandar.
7. Text Book of Physical Chemistry by S. Glasstone, Macmillan India Ltd.
8. Elements of Physical Chemistry by D. Lewis and S. Glasstone (Macmillan).
9. Principles of Physical Chemistry by Maron and Lando (Amerind).
10. An Introduction to Electrochemistry by S. Glasstone.
11. Physical Chemistry by W. J. Moore.
12. Essentials of Physical Chemistry, Bahl and Tuli (S. Chand).

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**SEMESTER-VI****PAPER- XI: PHYSICAL CHEMISTRY****Total Credits: 3  
Contact hrs: 45****1. Spectroscopy. [10]**

1.1 Introduction

1.2 Electromagnetic radiation.

1.3 Electromagnetic spectrum, Energy level diagram.

1.4 Rotational spectra of diatomic molecules : Rigid rotor model; moment of inertia (derivation not expected); energy levels of rigid rotor, selection rule; spectral intensity; distribution using population distribution (Maxwell - Boltzman distribution), determination of bond length; isotope effect. Interaction of radiation with rotating molecule.

1.5 Vibrational spectra of diatomic molecules : Simple Harmonic oscillator model, Vibrational energies of diatomic molecules, Determination of force constant, overtones. Interaction of radiation with vibrating molecules.

1.6 Numerical problems.

**2. Solutions. [09]**

2.1 Introduction

2.2 Ideal solutions, Raoult's law, vapour pressure of ideal and non ideal solutions of miscible liquids.

2.3 Vapour pressure and boiling point diagrams of miscible liquids.

Type I : Systems with intermediate total vapour pressure.

(i.e. System in which B.P. increases regularly - Zeotropic)

Type II : Systems with a maximum in the total vapour pressure.

(i.e. System with a B.P. minimum - Azeotropic)

Type III : Systems with a minimum in the total vapour pressure.

(i.e. System with a B.P. Maximum - Azeotropic)

Distillation of miscible liquid pairs.

2.4 Solubility of partially miscible liquids.

(i) Maximum solution temperature type : Phenol - water system.

(ii) Minimum solution temperature type : Triethyl amine - water system.

(iii) Maximum and minimum solution temperature type : Nicotine - water system.

**3. Thermodynamics. [13]**

3.1 Introduction

3.2 Free energy : Gibbs function (G) and Helmholtz function (A), Criteria for thermodynamic equilibrium and spontaneity.

3.3 Relation between  $\Delta G$  and  $\Delta H$  : Gibbs Helmholtz equation.

3.4 Phase equilibria : Clapeyron - Clausius equation.

3.5 Thermodynamic derivation of law of mass action, van't - Hoff isotherm and isochore.

3.6 Fugacity and activity concepts.

3.7 Numerical problems.

**4. Chemical Kinetics****[13]**

4.1 Introduction, simultaneous reactions such as opposing reactions, side reactions, consecutive reactions and chain reactions

[Derivations of rate Equations for these reactions are not expected.]

4.2 Effect of temperature on the rate of reaction.

1. Temperature coefficient
2. Arrhenius equation
3. Energy of activation

4.3 Theories of reaction rate :

1. Collision theory and
2. Transition state theory

4.4 Third order reaction with equal concentration of all reactants, their characteristics and examples

4.5 Numerical problems.

***Reference Books :***

1. Principles of Physical Chemistry by Maron and Pruton 4<sup>th</sup> edition.
2. Principles of Physical Chemistry by Puri, Sharma, Pathania, Shobhanlal Naginchand and Company, Jalandar.
3. Text Book of Physical Chemistry by S. Glasstone, Macmillan India Ltd.
4. Elements of Physical Chemistry by D. Lewis and S. Glasstone (Macmillan).
5. Principles of Physical Chemistry by Maron and Lando (Amerind).
6. Thermodynamics for chemists by S Glasstone.
7. Physical Chemistry by W. J. Moore.
8. Essentials of Physical Chemistry, Bahl and Tuli (S. Chand).
9. Basic Chemical Thermodynamics by V V Rao (Macmillan)
10. An introduction to chemical thermodynamics by R. R. Mishra and R. P. Rastogi.
11. Fundamentals of molecular spectroscopy by C. N. Banwell and McCash- Tata McGraw Hill

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**PAPER-XII: INORGANIC CHEMISTRY****Total Credits: 3****Contact hrs: 45****1) Study of F-block Elements [11]**

## 1.1 Lanthanides :-

- I) Introduction
- II) Electronic configuration
- III) Occurrence
- IV) Separation of Lanthanides
  - i) Bulk separation methods
  - ii) Individual separation of lanthanides- Mention names of methods only; In detail Ion exchange method.

## 1.2 Actinides :-

- I) Introduction
- II) Electronic configuration
- III) General Methods of preparation –
  - a. Neutron-capture followed by  $\beta$ -decay
  - b. Accelerated projectile bombardment method
  - c. Heavy-Ion Bombardment method

## 1.3 IUPAC Nomenclature of the super Heavy Elements with atomic numbers (Z) greater than 100.

**2) Metals and Semiconductors. [11]**

## 2.1 Introduction.

## 2.2 Properties of metallic solids.

## 2.3 Theories of bonding in metal.

- a) Free electron theory.
- b) Molecular orbital theory (Band theory).

## 2.4 Classification of solids as conductor, insulators and semiconductors on the basis of band theory.

## 2.5 Semiconductors:

- a) Types of semiconductors - intrinsic and extrinsic semiconductors.
- b) Applications of semiconductors.

## 2.6 Superconductors :

- a) Ceramic superconductors - Preparation and structures of mixed oxide  $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$
- b) Applications of superconductors.

**3) Structural Chemistry. [11]**

## 3.1 Structural study of following compounds.

- i) Diborane.
- ii) Borazine.
- iii) Xenon compounds  $\rightarrow \text{XeF}_2, \text{XeF}_6, \text{XeO}_4$  (w.r.t. VBT only.)

## 3.2 Structural study of Oxides Of Sulphur and Phosphorous:

- I Oxides of Sulphur :  $\text{SO}_2$ , and  $\text{SO}_3$ ;
- II Oxides of Phosphorous :  $\text{P}_4\text{O}_6$  and  $\text{P}_4\text{O}_{10}$



**4) Corrosion and Passivity.****[07]**

## 4.1 Corrosion :-

- A) Introduction, with types of corrosion.
- B) Electrochemical theory of corrosion.
- C) Factors affecting the corrosion.
  - i) Position of metal in emf series.
  - ii) Purity of metal.
  - iii) Effect of moisture.
  - iv) Effect of oxygen.
  - v) Hydrogen over voltage.
- D) Methods of protection of metals from corrosion.

## 4.2 Passivity :-

- A) Definition.
- B) Types of passivity.
- C) Oxide film theory.
- D) Application of passivity.

**5. Organometallic Chemistry.****[05]**

## 5.1 Introduction - Definition,

## 5.2 Nomenclature of organometallic compounds.

## 5.3 Synthesis and structural study of alkyl and aryl compounds of Li, Be and Al.

## 5.4 Mononuclear carbonyl and nature of bonding in simple metal carbonyls.

**Reference Books :**

1. Concise Inorganic Chemistry (ELBS, 5th Edition) - J. D. Lee.
2. Inorganic Chemistry (ELBS, 3rd Edition) D. F. Shriver, P. W. Atkins, C. H. Lang Ford, Oxford University Press, 2nd Edition.
3. Inorganic Chemistry (Harper International, 3rd edition) J. E. Huheey Harper and Row.
4. Basic Inorganic Chemistry : Cotton and Wilkinson.
5. Advanced Inorganic Chemistry (4th Edn.) Cotton and Wilkinson.
6. Concepts and Models of Inorganic Chemistry : Douglas and Mc. Daniel. 3rd Edition. John Wiley publication.
7. Fundamental concepts of Inorganic Chemistry by E. S. Gilreath.
8. Structural principles in inorganic compounds. W. E. Addison.
9. T. B. of Inorganic analysis - A. I. Vogel.
10. Theoretical principles of Inorganic Chemistry - G. S. Manku.
11. Theoretical Inorganic Chemistry by Day and Selbine.
12. Co-ordination compounds S F A Kettle.
13. Modern Aspects of Inorganic Chemistry. E. Sharpe.
14. New guide to Modern Valence Theory by G. I. Brown.
15. Essentials of Nuclear Chemistry by H. J. Arnikar.
16. Organometallic Chemistry by R. C. Mahrotra A. Sing, Wiley Eastern Ltd. New Delhi.
17. Inorganic Chemistry by A. G. Sharpe, Addison - Wisley Longman - Inc.
18. Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vallabh Publication. Pitampur Delhi.
19. Text book of Inorganic Chemistry by K. N. Upadhyaya Vikas Publishing House – New Delhi.

20. Progress in inorganic polymer by Laport and Leigh.
21. Co-ordination compounds by Baselo and Pearson.
22. Organometallic Chemistry by P. L. Pauson.
23. Advanced inorganic chemistry, Vol. I and II Satyaprakash, G. D. Tuli, S. K. Basu and Madan
24. Selected Topics in inorganic chemistry by W U Malic, G. D. Tuli, R. D. Madan. (S. Chand)
25. Industial chemistry part I and II by A. K. De
26. Industrial chemistry by B. K. Sharma

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**Paper - XIII : Organic Chemistry****Total Credits: 3****Contact hrs: 45****1 Heterocyclic compounds****[09]**

1.1 Introduction and classification.

1.2 Pyrrole.

1.2.1 Methods of synthesis :

i) From acetylene.

ii) From furan.

iii) From succinamide.

1.2.2 Physical properties.

1.2.3 Reactivity of pyrrole :

i) Basic character.

ii) Acidic character.

iii) Electrophilic substitution with general mechanism.

1.2.4 Chemical reactions :

i) Reduction.

ii) Oxidation.

iii) Nitration, sulphonation and halogenation.

iv) Friedel Craft's reaction.

v) Coupling reaction.

1.3 Pyridine.

1.3.1 Methods of synthesis.

i) From acetylene and hydrogen cyanide.

ii) From piperidine.

1.3.2 Physical properties.

1.3.3 Chemical reactions

i) Basic character

ii) Electrophilic substitution(nitration, sulphonation and bromination) reactions

iii) Nucleophilic substitution - General mechanism, Reactions with sodamide, sodium hydroxide and n-Butyl lithium.

1.4 Quinoline

1.4.1 Synthesis - Skraup's synthesis

1.4.2 Physical properties.

1.4.3 Reactions of quinoline :

i) Electrophilic substitution reactions - Nitration and sulphonation.

ii) Nucleophilic substitution reactions - Reactions with sodamide, alkylation and arylation.

iii) Reduction.

**2. Carbohydrates****[11]**

2.1 Introduction.

2.2 Classification and nomenclature.

2.3 Monosaccharide D-glucose - Open chain structure.

2.4 Chain lengthening of Aldoses - Kiliani synthesis.

2.5 Chain shortening of Aldoses - Weerman's reaction.

2.6 Interconversion of glucose and fructose.

2.7 Configuration of D-glucose from D-arabinose.

- 2.8 Objections against open chain structure of D-glucose.  
 2.9 Muta-rotation with mechanism.  
 2.10 Ring structure of D-glucose - Determination of size of ring by,  
 i) Methylation method.  
 ii) Periodic acid treatment method.  
 iv) X - ray analysis.  
 2.11 Disaccharides - Introduction, sucrose and lactose - Sources, structural formulae and uses.  
 2.12 Polysaccharides - Introduction starch, - Sources, structural formulae and uses.

### 3. Vitamins and Hormones

[07]

- 3.1 General idea of vitamins, structure and synthesis of vitamin A  
 3.2 General idea of hormones, structure and synthesis of Adrenaline and Thyroxin

### 4. Pharmaceuticals

[07]

- 4.1 Introduction.  
 4.2 Qualities of ideal drug.  
 4.3 Methods of classification of drugs - Classification based on the therapeutical action.  
 4.4 Brief idea of pencillin-G ( constitution, synthesis not expected)  
 4.5 Synthesis and uses of the following drugs :  
 i) Antimalerials - Paludrin.  
 ii) Antituberculars - Isoniazide and Ethambutol.  
 iii) C. N. S. drugs - Phenobarbitone.  
 iv) Antidiabetics - Tolbutamide.  
 v) Antiinflammatory drugs - Ibuprofen.  
 vi) Antibiotic - Chloromycetin.

### 5 Synthetic dyes.

[07]

- 5.1 Introduction, Qualities of good dye.  
 5.2. Classification based on constitution and methods of applications.  
 5.3 Witt's theory - Colour and constitution.  
 5.4 Synthesis of Orange IV, Malechite green, phenolphthalein.

### 6 Agrochemicals.

[04]

- 6.1 General idea of agrochemicals including pyrethroides.  
 6.2 Synthesis and uses of the following agrochemicals :  
 i) Indole-3-acetic acid.  
 ii) Monocrotophos.  
 iii) Methoxychlor.  
 iv) Ethophan.  
 v) Carbaryl.

**Reference Books :**

- 1) Organic Chemistry - Cram D. J. and Hammond G.S. McGraw Hill book Company New York.
- 2) Organic Chemistry - Finar I. L. The English Language Book Society, London.
- 3) A Guide Book to mechanism in Organic Chemistry - Peter Sykes Longman Green and Co. Ltd. London 6th Edition.
- 4) Organic Chemistry - R. T. Morrison and R. N. Boyd Prentice Hall of India private limited New Delhi. 6th Edition.
- 5) Text book of organic Chemistry - Furguson L. N. D. Van Nostrand Company Indian Edition, Affiliated East West press private Ltd. New Delhi.
- 6) Organic Chemistry Vol. I, II and III - S. M. Mukharji, S. P. Singh, R. P. Kapoor Wiley Eastern, Limited, New Delhi.
- 7) A text book of organic Chemistry - K. S. Tewari, S. N. Mehrotra, N. K. Vishnoi Vikas Publishing House Private Ltd. New Delhi.
- 8) A text book of Organic Chemistry - Arun Bahl and B. S. Bahl S. Chand and Company Ltd. 6th Edition.
- 9) Heterocyclic Chemistry Synthesis, Reactions and Mechanism - Raj K. Bansal Wiley Easter Ltd. New Delhi.
- 10) Reaction Mechanism and reagents in Organic Chemistry - G. R. Chatwal Himalaya Publishing House New Delhi.
- 11) Organic Chemistry Volume I and II - I. L. Finar ELBS with Longman 6th Edition.
- 12) Organic Chemistry Volume I and II - William Kemp ELBS with Macmillion 3rd Edition.
- 13) Advanced Organic Chemistry - Jerry March Wiley Eastern Ltd.
- 14) Spectroscopy of Organic compounds - P. S. Kalsi.
- 15) Organic Chemistry - Fieser and Fieser.
- 16) Principles of Organic Chemistry - English and Cassidy.
- 17) Chemicals for crop improvement and pest management - Green, Hartly and West.
- 18) Chemistry of pesticides - K. H. Buchel (T. W.).
- 19) Medical Chemistry - Burger.
- 20) Principles of Organic Chemistry - M. K. Jain.
- 21) Organic Chemistry by Clayden, Greeves, Warren and Wothers Oxford press.
- 22) Organic Chemistry - A Comprehensive degree text and source book by Hanes Baeyers and Wolfgang Walter Albion Chemical Science Series.
- 23) Reactions, Rearrangements and reagents - S.N.Sanyl Bharati Bhawan publishers and Distributors Patna.
- 24) Synthetic Organic Chemistry-Kamlesh Bansal.
- 25) Synthetic Organic Chemistry-Gurudeep Chatwal.

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**Paper-XIV: Analytical and Industrial Organic Chemistry****Total Credits: 3****Contact hrs: 45****1. Soaps and Detergents. [08]**

## 1.1 Soap

- i) Raw materials.
- ii) Types of soaps.
- iii) Manufacture of soap - Hot process.
- iv) Cleansing action of soaps.

## 1.2 Detergents

- i) Raw materials.
- ii) Types of detergents - Cationic, anionic, amphoteric, neutral detergents.
- iii) Preparation of teepol and deriphat.

## 1.3 Comparison between soaps and detergents.

**2. Synthetic polymers. [08]**

## 2.1 Introduction.

## 2.2 Classification :

- i) According to origin, composition, method of preparation and general physical properties.

- ii) Classification based upon structure.

## 2.3 Process of addition polymerisation - free radical polymerisation of alkenes and Dienes.

## 2.4 Ionic polymerisation.

## 2.5 Ziegler - Natta polymerisation.

## 2.6 Methods of preparation and uses of :

- i) Polythene. ii) Polystyrene
- iii) PVC. iv) Phenol formaldehyde resin.
- v) Urea formaldehyde resin vi) Poly urethane

## 2.7 Natural rubber : General idea and vulcanisation.

## 2.8 Synthetic rubbers : Synthesis and uses of -

- i) Polychloroprene, ii) Buna rubber - Buna N and Buna S.

**3. Sugar and Alcohol Industry [09]**

## 3.1 Manufacture of raw cane sugar.

## 3.2 Refining of raw sugar.

## 3.3 White sugar.

## 3.4 By-products of sugar industry.

## 3.4.1 Manufacture of ethyl alcohol from molasses

## 3.4.2 Rectified spirit, Denatured spirit absolute alcohol and power alcohol.

## 3.4.3 By-products of alcohol industry.

**4. Textile chemistry [07]**

## 4.1 Introduction, classification of fibers.

## 4.2 Sizing: object of sizing, sizing ingredients and their functions.

## 4.3 General idea of processes like singeing, desizing, scouring.

- 4.4 Bleaching: i) Brief study of the outline of the process of bleaching cotton and synthetic material.
- 4.5 Dyeing : Study of dyeing of cellulosic material and synthetic fibers with dyes like direct,vat, reactive and disperse dyes.

### 5. Green Chemistry.

[04]

- 5.1 Introduction - Twelve principles of green chemistry.
- 5.2 Zeolites - Friedel Craft's alkylation and acylation, oxidation of benzene to phenol and benzoquinone, Reduction of benzoquinone to hydroquinone.
- 5.3 Biocatalytic reaction - Hydroxylation and oxidation using enzymes.
- 5.4 Introduction to microwave assisted reactions.

### 6 Chromatography.

[09]

- 6.1 Introduction.
- 6.2 General principles.
- 6.3 Classification.
- 6.4 Study of following chromatographic techniques with reference to principle, methodology and applications.
- i) Paper chromatography.
  - ii) Column chromatography.
  - iii) Thin layer chromatography.
  - iv) Gas chromatography

### **Reference) Books :**

1. Basic Concepts of Analytical Chemistry - S. M. Khopkar, Wiley Eastern Ltd., Bombay.
  2. Industrial Chemistry - R. K. Das, Asia Publishing, Mumbai.
  3. Text Book of Quantitative Organic Analysis - A. I. Vogel, Pearson Edn. Delhi.
  4. Quantitative Organic Chemistry - A. I. Vogel, Pearson Edn. Delhi.
  5. Hand Book of Organic Analysis - H. T. Clarke, Arnold Heinemann Pub. Delhi.
  6. Advanced Organic Chemistry - B. S. Bahl and Arun Bahl, S. Chand Comp. Delhi.
  7. Riegel's Handbook of Industrial Chemistry - J. A. Kent, Van. Nostrard, London.
  8. Chemical Process Industries - Shreve and Brinic - Ostin, Magraw Hill, New York.
  9. Analytical Chemistry- Walton.
  10. Biotechnology and Applied Microbiology - Alani and Moo-Young.
  11. Immobilize Biocatalysis - Joy Wleser.
  12. Introduction to Polymer Chemistry - Raymond B. Seymour.
  13. Polymer Science - V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar Willey Eastern Limited.
  14. Advances in Green Chemistry : Chemical synthesis using MW-irradiation by R. S. Varma.
  15. Green Chemistry : Environment Friendly alternatives - Rashmi Sanghi and M. M. Srivastava (Eds) (c) 2003 Narosa Publishing House, New Delhi, India.
  16. Textile science - J. T. Marsh
  17. A book of textile chemistry - A. J Hall, (Butterworths group)
  18. Sizing - D..B. Ajagaonkar
  19. Bleaching - Dr. V. A. Shenai
  20. Dyeing - Dr. V. A. Shenai
-

## Practicals

- N. B. i. Use of Analytical / Chainometric / Electronic / Single pan balance is allowed.  
ii. Use of Scientific calculator is allowed.

### Physical Chemistry

#### I) Non instrumental Experiments( Any Five ) :

1. To determine the equilibrium constant of the reaction,  $KI + I_2 = KI_3$  by the distribution method.
2. To determine the partition coefficient of  $CH_3COOH$  between  $H_2O$  and  $CCl_4$ .
3. Critical Solution Temperature.  
To determine the CST for phenol – water system.
4. The study of energy of activation of first order reaction i.e. hydrolysis of methyl acetate in presence of 0.5 N HCl.
5. The study of energy of activation of first order reaction i.e. hydrolysis of methyl acetate in presence of 0.5 N  $H_2SO_4$ .
6. The study of energy of activation of second order reaction i.e. reaction between  $K_2S_2O_8$  and KI (Equal concentrations).
7. The study of energy of activation of second order reaction i.e. reaction between  $K_2S_2O_8$  and KI (Unequal concentrations).
8. To study the hydrolysis of methyl acetate by using its two concentrations in presence of 0.5 N HCl and hence find velocity constant of the reaction.
9. To study the effect of addition of electrolyte (KCl) on the reaction between  $K_2S_2O_8$  and KI (Equal concentrations).

#### II. Instrumental experiments

##### A. Potentiometry (Any Three).

1. Titration of strong acid with strong alkali.
2. Preparation of buffer solution and determination of their pH (Any five buffer solutions), - Theoretical calculation of pH values by using Henderson's equation.
3. Determination of standard electrode potential of  $Zn/Zn^{++}$ ,  $Cu/Cu^{++}$ ,  $Ag/Ag^+$  (Any two).
4. Determination of solubility and solubility product of AgCl.
5. Titration of ferrous ammonium sulphate using  $K_2Cr_2O_7$  solution and to calculate redox potential of  $Fe^{++}$ ,  $Fe^{+++}$  system

##### B. Conductometry ( any three ).

1. Titration of weak acid with strong alkali.
2. Titration of a mixture of weak acid and strong acid with strong alkali.
3. To study the effect of substituent on dissociation constant of weak acid with respect to acetic acid and monochloroacetic acid (cell constant to be given).
4. To determine the velocity constant of hydrolysis of ethyl acetate by NaOH solution by conductometric method.

##### C. Refractometry.

1. To determine the percentage composition of unknown mixture by (i) graphical method and (ii) by composition law (Densities of pure liquids A & B be given).
2. To determine the molar refractivity of methyl acetate, ethyl acetate, n-hexane and



carbon tetrachloride and calculate the refraction equivalents of C, H and Cl atoms.

**D. Colorimetry (Any Two).**

1. To verify Lambert - Beer's law using  $\text{CuSO}_4$  solution.
2. To estimate of  $\text{Fe}^{+++}$  ions by thiocyanate method.
3. To estimate  $\text{Fe}^{+++}$  ions using salicylic acid by colorimetric titration.

**E. pH - metry (Any One).**

1. To determine the dissociation constant of monobasic acid (Acetic acid).
2. To determine the dissociation constant of dibasic acid (Malonic acid).

**Reference Books :**

1. Findlay's Practical Physical Chemistry (Longman)
2. Advanced Practical Physical Chemistry by J. B. Yadav, Goel publishing house.
3. Practical Physical Chemistry by B. D. Khosla, V. C. Garg (R. Chand and Co.)
4. Systematic experimental Physical Chemistry by Rajbhoj, Chandekar (Anjali Publicaiton)
5. Practical Physical Chemistry : Nandkumari, Kothari and Lavande.
6. Practical Physical Chemistry by Gurtu (S. Chand).

## Inorganic Chemistry

### I. Gravimetric Estimations (G).

N. B. : Any two experiments from G1 to G3 and any two experiments from G4 to G7

G1. Gravimetric estimation of iron as ferric oxide from the given solution containing ferrous ammonium sulphate, copper sulphate and free sulphuric acid.

G2. Gravimetric estimation of zinc as zinc pyrophosphate from the given solution containing zinc sulphate, ferrous ammonium sulphate and free sulphuric acid.

G3. Gravimetric estimation of barium as barium sulphate from the given solution containing barium chloride, ferric chloride and free hydrochloric acid.

G4. Gravimetric estimation of manganese as manganese ammonium phosphate from the given solution containing manganese sulphate, copper sulphate and free sulphuric acid.

G5. Gravimetric estimation of barium as barium chromate from the given solution containing barium chloride, ferric chloride and free hydrochloric acid.

G6. Gravimetric estimation of Aluminium as Aluminium oxinate i.e.

tris (8-hydroxyquinolino) aluminate (III) from a given solution containing potash alum, copper sulphate and free sulphuric acid.

G7. Gravimetric estimation of nickel as bis (dimethylglyoximato) nickel (II) from the given solution containing nickel sulphate, ferrous ammonium sulphate and free sulphuric acid.

[For the gravimetric experiments, stock solution should be given in the range of 10 to 15 cm and asked to dilute to 100 cm (or the stock solution should be given in the range of 20 to 30 cm and asked to dilute to 250 cm ). Use 50 cm of this diluted solution for estimation.]

### II. Inorganic Preparations (P) : (any five).

N. B. - Calculations of % yield is expected.

P1. Preparation of sodium cuprous thiosulphate.

P2. Preparation of potassium trioxalato ferrate (III).

P3. Preparation of potassium trioxalatoaluminum (III).

P4. Preparation of tris (ethylene diamine)nickel (II) thiosulphate.

P5. Preparation of sodium hexanitrocobaltate (III).

P6. Preparation of ammonium diamminetetra thiocyanatochromate(III) (Reineck's salt).

P7. Preparation of chloropentaamminecobalt (III) chloride.

P8. Preparation of hexamminenickel (II) chloride.

P9. Preparation of tris(thiourea)cuprous(I) sulphate.

### III) Titrimetric Estimations :

#### A) Percentage Purity (any three)

V1. Determination of percentage purity of ferrous ammonium sulphate.

V2. Determination of percentage purity of tetramminecopper (II) sulphate.

V3. Determination of percentage purity of potassium trioxalatoaluminum(III).

V4. Determination of percentage purity of potassium trioxalato ferrate (III).

#### B) Analysis of Commercial Sample ( any three).

V5. Determination of percentage of magnesium in the given sample of talcum powder.

V6. Determination of amount of aluminium in the given solution of potash alum.

V7. Determination of titrable acidity in the given sample of milk or lassi.

V8. Determination of Chemical Oxygen Demand of the given sample of industrial effluent by dichromate method.

V9. Determination of percentage purity of boric acid using supplied sodium hydroxide (Standard succinic or oxalic acid solution to be prepared to standardise the given sodium hydroxide solution.)

**C) Ion exchange method** (any two).

V10. Determination of amount of sodium present in the given solution of common salt using cation exchange resin (By Acid Base titration).

V11. Determination of amount of magnesium in the given solution containing ( $Mg^{++}$  and  $Zn^{++}$ ) using anion exchange resin and standard solution of EDTA.

V12. Determination of amount of zinc in the given solution containing ( $Mg^{++}$  and  $Zn^{++}$ ) using anion exchange resin and standard solution of EDTA.

**Reference Books:**

1. A text book of quantitative Inorganic Analysis - A. I. Vogel.
2. Text book of Quantitative Inorganic Analysis - Kolthoff and Sandell.
3. Experimental Inorganic Chemistry - Palmer W. G.
4. Advanced Practical Inorganic Chemistry - Adams and Raynor.
5. Handbook of Preparation Inorganic Chemistry. Vol. 1 and 11 - Brauer.
6. Manual in Dairy Chemistry - I.C.A.R. Sub-Committee on Dairy Education.
7. Chemical methods for environmental analysis - R. Ramesh and M. Anbu.

## Organic Chemistry

### I) Qualitative analysis

Separation of binary mixture and Identification of its components. 5g of mixture is to be given for separation.

At least **08 mixtures** are to be separated.

Nature 1) Solid - Solid : 4 mixtures

2) Solid - Liquid : 2 mixtures

3) Liquid - Liquid : 2 mixtures

1) Solid - Solid Mixtures :

One mixture from each the following types should be given :

i) Acid + Phenol ii) Acid + Base

iii) Acid + Neutral iv) Phenol + Base

v) Phenol + Neutral vi) Base + Neutral

2) Solid - Liquid Mixtures

One mixtures of type Neutral + Neutral and One mixture of type Acid + Neutral should be given.

3) Liquid - Liquid Mixtures

One mixture of type Neutral + Neutral and One mixture of type Base + Neutral should be given.

Following compounds should be used for preparation of mixtures:

Acids : Benzoic acid, Phthalic acid, Salicylic acid, Cinnamic acid, Aspirin, Oxalic acid.

Phenols:  $\alpha$ -naphthol,  $\beta$ -naphthol

Bases : o -nitroaniline, m-nitroaniline, p-nitroaniline, aniline, o-toluidine and N, N-dimethyl aniline.

Neutrals : Naphthalene, acetanilide, m-dinitrobenzene, chloroform, carbon tetrachloride, acetone, nitrobenzene, ethyl acetate, ethyl benzoate, acetophenone, bromobenzene, urea and thiourea.

### II) Quantitative analysis : (Any four)

**Organic estimations :**

1) Estimation of sucrose

2) Estimation of nitro group

3) Saponification value of oil.

4) Estimation of formaldehyde from given formalin solution.

5) Estimation of acid and ester present in the given mixture of acid and ester.

6) Estimation of acid and amide from the mixture of acid and amide.

### III) Organic Preparations : with following – (any four)

N.B.: a) Calculation of percentage practical yield.

b) Recrystallisation of crude product and its melting point.

c) The purity of the product may be confirmed by TLC.

1) Preparation of m-nitroaniline from m-dinitrobenzene.

2) Preparation of aspirin from salicylic acid .

3) Preparation of nerolin from  $\beta$ -naphthol

4) Preparation of p-iodonitrobenzene from p-nitroaniline.

5) Preparation of benzene azo -  $\beta$  - naphthol.

6) Preparation of benzoic acid from cinnamic acid.

### IV Preparation of Derivatives :

N.B.:During practical course, name of the organic compound should not to be given.

- 1) Bromo derivative of aniline and cinnamic acid.
- 2) Nitro derivative of salicylic acid and nitrobenzene.
- 3) Benzoyl derivative of  $\beta$ -naphthol and aniline.
- 4) Picrate derivative of anthracene and  $\beta$ -naphthol.
- 5) Oxalate and nitro derivatives of urea.
- 6) Anhydride derivative of phthalic acid.
- 7) Oxime derivatives of Ketones : Acetone and acetophenone.
- 8) 2 : 4 DNP of acetophenone.

**Reference Books :**

1. Practical Organic Chemistry by A. I. Vogel.
  2. Hand book of Organic qualitative analysis by H. T. Clarke.
  3. A laboratory Hand Book of Organic qualitative analysis and separation by V. S. Kulkarni. Dastane Ramchandra & Co.
  4. Practical Organic Chemistry by F. G. Mann and B. C. Saunders. Low - priced Text Book. ELBS. Longman.
  5. Experiments in General Chemistry by C. N. R. Rao. Affiliated East-West Press Pvt. Ltd. Delhi.
  6. Advanced Practical Organic Chemistry by N. K. Vishnoi. Vikas Publishing House Private Limited.
  7. Comprehensive Practical Organic Chemistry Qualitative Analysis by V. K. Ahluwalia, Sunita Dhingra. University Press. Distributor - Orient Longman Ltd.
  8. Comprehensive Practical Organic Chemistry Preparation and Quantitative Analysis by V.K.Ahluwalia, Renu Aggarwal. University Press.Distributor-Orient Longmann Ltd.
  9. Practical Chemistry - Physical - Inorganic - Organic and Viva - voce by Balwant Rai Satija. Allied Publishers Private Limited.30
  10. College Practical Chemistry by H. N. Patel, S. R. Jakali, H. P. Subhedar, Miss. S. P. Turakhia. Himalaya Publishing House, Mumbai.
  11. College Practical Chemistry by Patel, Jakali, Mohandas, Israney Turakhia. Himalaya Publishing House, Mumbai.
  12. Practice of thin layer chromatography by Joseph C. Touchstone, Murrell F. Dobbins. A Wiley - Interscience Publication John-Wiley & Sons.
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**Solapur University, Solapur.**  
**Syllabus for**  
**B.Sc.-III( MATHEMATICS)**  
**CGPA pattern Syllabus w.e.f. June 2016**

Structure of the revised course:

**SEMESTER-V**

**(I) Theory Papers**

<b>Paper</b>	<b>Title of the Paper</b>	<b>Marks</b>
<b>VII</b>	<b>Algebra-II</b>	<b>70+30 = 100</b>
<b>VIII</b>	<b>Complex Analysis</b>	<b>70+30 = 100</b>
<b>IX</b>	<b>Integral Calculus</b>	<b>70+30 = 100</b>
<b>X</b>	<b>Partial Differential Equations</b>	<b>70+30 = 100</b>

**SEMESTER-VI**

**(I) Theory Papers**

<b>Paper</b>	<b>Title of the Paper</b>	<b>Marks</b>
<b>XI</b>	<b>Metric Spaces</b>	<b>70+30 = 100</b>
<b>XII</b>	<b>Numerical Analysis</b>	<b>70+30 = 100</b>
<b>XIII</b>	<b>Integral Transform</b>	<b>70+30 = 100</b>
<b>XIV</b>	<b>Programming in C</b>	<b>70+30 = 100</b>

**(II) Numerical Technique Laboratory[NTL]**

<b>NTL No.</b>	<b>Topic</b>	<b>Marks</b>
<b>NTL-III(A)</b>	<b>S-I:Algebra-II[6] S-II : Metric Space [6]+Seminar</b>	<b>70+30 = 100</b>
<b>NTL-III(B)</b>	<b>S-I :Complex Analysis[6] S-II: Numerical Analysis[6] +Project</b>	<b>70+30 = 100</b>
<b>NTL-III(C)</b>	<b>S-I :Integral Calculus [6] S-II: Integral Transform[6]+Study Tour</b>	<b>70+30 = 100</b>
<b>NTL-III(D)</b>	<b>S-I: Partial Differential Equation[6] S-II: Programming in C [6]+Viva Vocae</b>	<b>70+30 = 100</b>

**Note :** [ ] Number inside bracket indicates **number of assignments**.

**In Numerical Technique Laboratory: NTL -III(A) – III(D) [ Project/  
Seminar / Study Tour/Viva Vocae / Book Review ]**

**Project :** Biography of One Mathematician or One Mathematics Topic ( which is not included in the syllabus upto B.Sc. -III Mathematics) about Five Pages. **05 Marks**

**Book Review :** Any Mathematics Book except Text Book **05 Marks**

**Seminar:** Any topic in mathematics. **05 Marks**

**Book Review:** Mathematics Book other than text book **05 Marks**

**Study Tour:** Visit to any Industry / Research Institution / Educational Institution. **05 Marks**

**Viva Voce :** Viva voce on Project, Seminar, Book review and Study Tour. **05 Marks**

**(Free internet should be availed for collection of Material for Project, Seminar. )**

**Instructions:**

1. Each Theory Paper is allotted 45 periods per semester.
2. All **Numerical Technique Laboratory [NTL]** (similar to Practicals) will be conducted in the batch as a whole Class.
3. Total evaluation of B.Sc. III (**1200 Marks**).



- [Theory papers (800 Marks)  
+ [Practicals NT L- III(A) to III(D) (400 Marks)]
4. The annual **Numerical Technique Laboratory** [ NTL - III(A) to III(D)] will carry **50 Marks** each.
- 5. Department of Mathematics should provide FIVE computers per batch of TEN students.**

### Nature of question Paper

#### Semester –V Theory Papers IX, X, XI and XII and

#### Semester –VI Theory Papers XIII, XIV, XV and XVI

#### Theory Paper [Marks 70]

- |   |          |
|---|----------|
| Q. 1: Multiple Choice Questions (Fourteen)              | Marks 14 |
| Q. 2 : Attempt any SEVEN out of EIGHT (each of 2 Marks) | Marks 14 |
| Q. 3:(A) Attempt any TWO out of Four (each of 5 Marks)  |          |
| (B) Compulsory (Mark 4)                                 | Marks 14 |
| Q. 4: Attempt any TWO out of THREE ( each of 07 Marks)  | Marks 14 |
| Q. 5: Attempt any TWO out of THREE ( each of 07 Marks)  |          |

OR

- |  |          |
|--|----------|
| Attempt any ONE out of TWO ( each of 14 Marks) | Marks 14 |
|--|----------|

#### Nature of paper for Numerical Technique Laboratory )

(For NLT- III(A) to NLT- III(D) )

#### Section-I

- |  |          |
|--|----------|
| I) Attempt THREE out of SIX (each of 10 marks) | Marks 30 |
| OR Attempt SIX out of EIGHT (each of 05 Marks) |          |

#### Section-II

- |   |          |
|---|----------|
| II) Attempt THREE out of SIX (each of 10 marks)         | Marks 30 |
| OR Attempt SIX out of EIGHT (each of 05 Marks)          |          |
| III) Seminar/Project/Study Tour/Viva-vocae/ Book Review | Marks 05 |
| III) Journal  | Marks 05 |

**Total Marks 70**

**SEMESTER-V**  
**Paper-VII :Algebra - II**

**Unit -1 : Introduction to Rings** [10]

- 1.1. Definitions and Examples
- 1.2. Integral Domains. Subrings
- 1.3. Fields
- 1.4. Isomorphism. Characteristic

**Unit –2 : Quotient Rings** [05]

- 4.1. Homomorphisms of Rings. Ideals
- 4.2. Quotient Rings

**Unit–3: Vector spaces** [10]

Vector spaces, Subspaces, Linear combination and system of linear equation, Linear dependence and independence, Basis and dimensions

**Unit-4 : Linear transformation and matrices** [15]

Linear transformation, Null spaces and ranges, Matrix representation of linear transformation, Composition of linear transformation and Matrix multiplication, Invertibility and isomorphism.

**Unit- 5 : Inner product space** [05]

Inner products and Norms

**Recommended books ( Scope of Syllabus):**

**Modern Algebra-An Introduction**, by John R. Durbin, John Wiley & Sons, Inc. Fifth Edition

Unit – 1 : Chapter-VI: Art. 24,25,26,27

Unit – 2 : Chapter-IX:Art.38, 39

**Linear Algebra** Fourth Edition by Stephen H. Friedberg, Arnold J. Insel  
Lawrence E. Spence Prentice Hall of India New Delhi (EEE)

Unit-3: Chapter-I (Vector spaces): Art. 1.2 to 1.6

Unit-4 :Chapter-II (Linear transformation and matrices): Art. 2.1 to 2.4

Unit-5:Chapter-VI (Inner product space) Art. 6.1.

**Reference Books:**

1. A First Course In Abstract Algebra J. B. Fraleigh Pearson Education 7th edition
2. University Algebra N.S. Gopalkrishnan
3. Fundamentals of Abstract Algebra D. S. Malik & N. Mordeson & M. K. Sen Mc. Graw Hill International Edition.

4. Linear Algebra by Vivek Sahai & Vikas Bist Narosa Publishing House
5. Topics In Algebra John Wiley & Sons by I. N. Herstein
6. Abstract Algebra by K.S.Bhamri and Khanna Vijay

### **Paper-VIII Complex Analysis**

#### **Unit -1 : Analytic Functions** **[10]**

Complex Differentiation, Limits and Continuity, Differentiability, Necessary and Sufficient condition of analytic function, Method of constructing a regular function and analytic function, Simple method of constructing analytic function, Polar form of Cauchy-Riemann Equations.

#### **Unit -2 : Complex Integration** **[20]**

Introduction, Some basic definitions, Complex integral, Reduction of complex integrals to real integrals, Some properties of complex Integrals, An Estimation of a complex integral, Line integrals as functions of arcs, Cauchy's Fundamental Theorem(Theorem –I), Cauchy Goursat Theorem[Statement Only], Cauchy's Integral formula[Statement only], its consequences and examples, Derivative and higher order derivatives of an analytic function [Statement(s) only] and examples, Expansions of Analytic functions as power series ( Taylor's, Maclaurin's and Laurent's Series [ Statement only]) and its examples, The zeros of an analytic function, Different Types of Singularities, Some Theorems on Poles and other Singularities(Theorem –I to IV only) and its examples, The point at infinity

#### **Unit -3: Calculus of Residues** **[15]**

Residue at simple pole, Residue at a Pole of order greater than unity, Residue at infinity, Cauchy's Residue Theorem. Evaluation of Definite integrals,

Integration round the unit circle. Evaluation of  $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta$ .

#### **Recommended Book ( Scope of Syllabus):**

#### **1. Functions of Complex Variable by J. N. Sharma Revised by Dr. Shanti Swarup, (38 Edition) Krishna Prakashan Media Ltd., Meerut.**

Chapter -2 (Analytic Functions): 1 to 7

Chapter-6 (Complex Integration): 1 to 8, 9(Statement Only),

19(Theorem-1, Theorem – II (Statements only),

20, 21,22 [Theorems I to IV only], 23.24 .

Chapter -7 ( Calculus of Residues ): 1 to 6.

## Paper –IX: Integral Calculus

### Unit 1: Improper Integrals :

Convergence of Improper integrals of the first kind, Test of convergence of a (Positive integrand), Necessary and sufficient condition for the convergence of improper integrals, Comparison of two integrals, A practical comparison test, Useful comparison integrals, Two useful tests,  $f(x)$  not necessarily positive General test for convergence, Absolute and conditionally convergence, Convergence of improper integrals of the second kind, Convergence at infinity(Integrand being positive), Comparison of two integrals, A useful comparison integrals, General test( for convergence at infinity and  $f(x)$  may be positive or negative), Cauchy's test for convergence, Absolute and conditionally convergence of improper integrals of second kind, Test for the absolute convergence of the integral of a product, Abel's test, Dirchilet's test.. (20)

### Unit 2 .Beta and Gamma function :

Definition, Properties, Transformations of Gamma function and Beta function and relation between them, Some Important deductions, Duplication Formula. (15)

### Unit 3. Multiple integrals :

Double Integrals, Cartesian and polar, Applications of Double Integration ( Area of region and Volume of a Solid only), Change of order of integration, Change of Variables. (10)

### Recommended Book

#### Paper-VII (Integral Calculus )

**Elements of Real Analysis by Shantinakaran, M.D. Raisinghanian by S. Chand(8 th Edition)**

Unit 1 : 16.1 to 16.18.

**Integral Calculas by Shanti Narayan and P.K.Mittal S.Chand  
Publication Revised Edition 2005.**

Unit 2 : 7.1,7.2,7.3,7.4, 7.5.

Unit 3: 12.2,12.3,12.4,12.5.

### Reference books:-

1. N. Piskunov, Differential and Integral Calculus, Peace Publishers, Moscow
2. P. N. Wartikar and J. N. Wartikar, A Text Book of Applied Mathematics, Vol. I, Poona Vidyarthi Griha Prakashan, Poona 30.
3. Tom M. Apostol, Calculus Vol I and II, Wiley Publication.
4. Mathematical Analysis by S. C. Malik and Savita Arora.

## **Paper-X : Partial Differential Equations**

### **Unit-1: Linear partial differential equation of order one [15]**

- 1.1 Derivation of partial differential equation of arbitrary constants
- 1.2 Derivation of partial differential equation of arbitrary functions.
- 1.3 Lagrange's Method of solving linear partial differential equation of order one. Namely  $Pp + Qq = R$  Working rule for solving  $Pp + Qq = R$  by Lagrange's Method.
- 1.4 Integral surface passing through a given curve

### **Unit-2: Non Linear partial differential equation of order one [15]**

- 2.1 Solution of first order partial differential equation Charpit's Method.
- 2.2 Special methods of solution applicable to certain Standard form I, II, III, IV.

### **Unit-3: Linear partial differential equation with constant Coefficient [10]**

- 3.1 Homogeneous and Non Homogeneous linear partial differential equation with constant Coefficient working rule for finding C.F. method of finding particular integral (P.I).
- 3.2 Short method when  $f(x, y)$  is  $\emptyset(ax + by)$  and  $x^m y^n$ ,

### **Recommended Book (Scope of syllabus) :**

#### **1. Ordinary and partial differential equation by M. D.Raisinghania, S. Chand Co. [ PART – III ]**

Unit – 1 :Chapter-1 : 1.1, 1.2, 1.2a, 1.2b, 1.3, 1.4, 1.5, 1.5a, 1.5b, 1.5c, 1.5d, 1.6

Unit – 2 :Chapter-2 : 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10,

Unit – 3 :Chapter-3: 3.1, 3.2, 3.3, 3.4, 3.4A, 3.4B, 3.5, 3.6, 3.6A, 3.6B, 3.7, 3.8, 3.9,3.10

### **Reference Books :**

1. Elements of partial differential equation IAN Sneddon (International students edition by Mc Graw Hill Book )
2. Differential equation  
Sharma & Gupta (Krishna Prakashan Media (P)Ltd. Meerut)
3. Partial differential equation J. M. Kar.

# SEMESTER-VI

## Paper – XI :Metric Spaces

### Unit – 1 :Limits and metric Spaces [15]

- 1.1 The class  $l^2$  (Schwartz, Minkowski inequality)
- 1.2 Limit of a function on the real line
- 1.3 Metric spaces
- 1.4 Limits in metric spaces

### Unit-2 : Continuous functions on metric spaces [15]

- 2.1 Functions continuous at a point on the real line
- 2.2 Reformulation
- 2.3 Functions continuous on a metric space
- 2.4 Open sets
- 2.5 Closed sets

### Unit-3 : Completeness and Compactness [15]

- 3.1 More about open sets
- 3.2 Bounded sets and totally bounded sets
- 3.3 Complete metric spaces
- 3.4 Compact metric spaces
- 3.5 Continuous functions on compact metric spaces

### Recommended Book ( Scope of Syllabus):

#### Scope :

**Methods of real analysis by R.R. Goldberg John Wiley & Sons 1976.**

#### Metric Spaces

**Unit – 1:** Limits and metric spaces Art: 3.10, 4.1 to 4.3

**Unit -2:** Continuous functions on metric spaces Art: 5.1 to 5.5

**Unit -3 :** Completeness and Compactness Art: 6.1, 6.3.6.4, 6.5, 6.6

#### Reference books

1. A first course in mathematical analysis by D. Somasundaram & B. Choudhary Narosa Publishing House.
2. Mathematical Analysis second edition by S. C. Malik & Savita Arora.
3. Principles of Mathematical analysis by Rudin W. McGraw-Hill, New York.
4. A Course of Mathematical Analysis by Shanti Narayan S. Chand & Company New Delhi.

## Paper –XII: Numerical Analysis

- Unit- 1 : Finite Differences** [10]
- 1.1.Introduction
  - 1.2. Finite differences,
  - 1.3.Differences of a Polynomial
  - 1.4. Relation between the operators
- Unit-2 : Interpolation** [15]
- 2.1.Introduction
  - 2.2. Newton’s forward interpolation formula
  - 2.3. Newton’s backward interpolation formula
  - 2.4. Central difference interpolation formula
  - 2.5. Gauss’s forward interpolation formula
  - 2.6. Gauss’s backward interpolation formula
  - 2.7. Stirling’s formula
  - 2.8. Interpolation with unequal Intervals
  - 2.9. Lagrange’s Interpolation Formula
- Unit- 3 : Numerical Differentiation and Integration** [10]
- 3.1.Numerical differentiation
  - 3.2. Formula for derivatives
  - 3.3. Maxima and minima of a tabulated function
  - 3.4. Numerical Integration
  - 3.5. Quadrature formulae(Trapezoidal rule, Simpson’s 1/3 Rule and Simpson’s 3/8 th rule)
- Unit- 4 : Difference Equations** [10]
- 4.1.Introduction
  - 4.2. Definitions
  - 4.3. Formation of difference equations
  - 4.4. Linear difference equation
  - 4.5. Rules for finding the Complementary function
  - 4.6. Rules for finding the Particular Integral
  - 4.7. Difference equations reducible to linear form

### **Recommended book ( Scope of Syllabus):**

**Numerical Methods in Engineering & Science with Programs in C and C++** Ninth Edition by B. S. Grewal Khanna Publishers New Delhi

Chapter-6. (Finite differences): Art. 1,2,3,7

Chapter-7 (Interpolation ): Art. 1,2,3,4,5, 6,7, 11,12

Chapter-8 (Numerical Differentiation and Integration) Art.1, 2, 3, 4, 5(except IV and V)

Chapter-9 (Difference Equations) Art. 1 to 7

**Reference books:-**

1. Numerical Analysis and Programming in C by Pundir and Pundir(Pragati Prakashan)
2. Linear Algebra And Its Application Gilbert Strang International Student Edition
3. Topics In Algebra John Wiley & Sons by I. N. Herstein
4. Hoffman & Kunj
5. K. B.Datta Matrix & Linear Algebra Prentice Hall of India Pvt. Ltd.New Delhi 2000
6. S. Kumarsen Linear Algebra A Geometric Approach Prentice Hall of India 2002.

**Paper –XIII : Integral Transforms**

**Unit 1: Laplace Transform. [15]**

Integral Transform (Definition) ,Laplace Transform (Definition ), Linearity property of Laplace Transform ,Piecewise continuous functions ,Existence of Laplace Transform, Functions of exponential order ,function of class A ,First Translation or Shifting Theorem,Second Translation or Shifting Theorem,Change of Scale Property ,Laplace Transform of the derivatives of  $F(t)$ , Laplace Transform of the  $n^{th}$  order derivatives of  $F(t)$ ,Initial value theorem, Final value theorem, Laplace Transform of Integrals,Multiplication by  $t$  , Multiplication by  $t^n$ , Division by  $t$ , Evaluation of Integrals ,periodic functions.

**Unit 2: The Inverse Laplace Transform. [15]**

Inverse Laplace Transform, Null Function, Linearity property, Table of Inverse Laplace Transform, First Translation or Shifting Theorem, Second Translation or Shifting Theorem,Change of Scale Property, Use of partial fraction ,Inverse Laplace Transform of the derivatives , Inverse Laplace Transform of Integrals, Multiplication by powers of  $p$ , Division by powers of  $p$ , Convolution(definition), Convolution theorem, Heaviside's expansion formula, Beta function.



**Unit 3: Applications of Laplace Transforms. [15]**

Ordinary Differential equations with constant coefficients, Ordinary Differential equations with variable coefficients, Simultaneous ordinary differential equations, Partial differential equations..

**Recommended Book for Paper –XIII (Integral Transform) :**

**Integral Transform by Vasistha A.R.,Gupta R.K.,Krishna Prakashan Media Pvt.Ltd.11 , Shivaji Road,Meerut India.**

**Unit 1:** 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14, 1.15, 1.16, 1.17, 1.18, 1.19, 1.20, 1.21.

**Unit 2:** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.13, 2.14, 2.15, 2.16,2.17.

**Unit 3 :** 3.1, 3.2.3.3,3.4

**Reference Books:**

1. Rainville E.D. *The Laplace Transform*
2. Dr.J.R.Goyel and K.P.Gupta *Integral Transform Pragati prakashan Meerut.*
3. Sharma and Gupta, *Differential equation ,Krishna Prakashan Media co.,Meerut*

**Paper-XIV : Programming in C**

**Unit – 1 : Overview of C [4]**

- 1.1 Introduction
- 1.2 Importance of C
- 1.3 Sample C programs
- 1.4 Basic structure of C programs
- 1.5 Programming style
- 1.6 Executing a C program
- 1.7 Points to remember

**Unit – 2 : Constants, Variables and Data Types [6]**

- 2.1 Introduction
- 2.2 Character set
- 2.3 C Token
- 2.4 Constants
- 2.5 Keywords and Identifiers
- 2.6 Variables
- 2.7 Data Types

- 2.8 Declaration of variables
- 2.9 Assigning values to variables
- 2.10 Defining symbolic constants

**Unit – 3 : Operators and Expressions** [9]

- 3.1 Introduction
- 3.2 Arithmetic operators
- 3.3 Relational operators
- 3.4 Logical operators
- 3.5 Assignment Operators
- 3.6 Increments and decrement operators
- 3.7 Conditional operators
- 3.8 Bit-wise operators
- 3.9 Special operators
- 3.10 Arithmetic expressions
- 3.11 Evaluation of expressions
- 3.12 Precedence of arithmetic operators
- 3.13 Some computational problems
- 3.14 Type conversions in expressions
- 3.15 Operators precedence and associativity
- 3.16 Mathematical functions

**Unit –4: Managing Input and Output Operators** [4]

- 4.1 Introduction
- 4.2 Reading a character
- 4.3 Writing a character
- 4.4 Formatted input
- 4.5 Formatted output

**Unit -5: Decision Making and Branching** [6]

- 5.1 Introduction
- 5.2 Decision making with IF statement
- 5.3 Simple IF statement
- 5.4 The IF...ELSE Statement
- 5.5 Nesting of IF...ELSE Statement
- 5.6 The ELSE...IF ladder
- 5.7 The SWITCH statement
- 5.8 The ?: operator
- 5.9 The GOTO statement

**Unit -6 Decision Making and Looping** [4]

- 6.1 Introduction
- 6.2 The WHILE statement
- 6.3 The DO statement
- 6.4 The FOR statement
- 6.5 Jumps in loops

**Unit – 7 : Arrays** [3]

- 7.1 Introduction
- 7.2 One dimensional arrays
- 7.3 Two dimensional arrays
- 7.4 Initialising two dimensional arrays
- 7.5 Multidimensional arrays

**Unit – 8 : User-defined Functions** [4]

- 8.1 Introduction
- 8.2 Need for user-defined functions
- 8.3 A multifunction program
- 8.4 The form of C Functions
- 8.5 Return values and their types

**Recommended Book ( Scope of Syllabus):**

**[I] Programs in C by E. Balgurusamy, McGraw Hill, New-Delhi**

**Unit- 1 : 1.1-1.7 Unit- 2 : 2.1 -2.10 Unit- 3 : 3.1-3.16 Unit- 4 : 4.1-4.5**

**Unit- 5 : 5.1 - 5.9 Unit- 6 : 6.1-6.5 Unit- 7 : 7.1 - 7.5 Unit- 8 : 9.1- 9.5**

**Reference books:**

1. Numerical Methods in Engineering & Science with Programs in C and C++ Ninth Edition by B. S. Grewal Khanna Publishers New Delhi.
2. Numerical Analysis and Programming in C by Pundir and Pundir(Pragati Prakashan)
3. A Book on C, Macmillan, by Berry, R.E. and Meekings.
4. C Programming Language: An applied perspective, John Wiley & Sons
5. The C Programming Tutor, Prentice-Hall, by Wortman, L.A. and Sidebottom.
6. C made Easy, Osbone McGraw-Hill by Schildt, H. C.
7. Let us C by Yeshwant Kanetkar BPB Publications, New-Delhi.

8. Programming in C by Schaum's Outline Series, Tata McGraw Hill, EEE.

## **Numerical Technique Laboratory [NTL –III(A) to III(D)]**

**Note: Each assignment is of 1.5 periods [50+25 = 75 minutes]**

### **NTL-III(A)( Algebra - II +Metric Spaces)**

**(Problems on the following topics)**

#### **Section - I : Algebra - II**

**Assignment-1 :** Rings and subrings ,Integral domains and Fields

**Assignment-2 :** Isomorphism and Characteristic.

**Assignment-3 :** Homomorphisms of Rings. Ideals , Quotient Rings

**Assignment-4 :** Subspaces, Linear dependence, independence and basis

**Assignment-5 :** Linear transformation and matrices, Kernel and range

**Assignment-6 :** Inverse and Composite, Inner Product Space

#### **Section – II :Metric Spaces**

**Assignment-7 : Metric Space-I**(Examples on Metric spaces, open set, closed set, boundary set in Metric spaces)

**Assignment-8 : Metric Space-II**(Examples on bounded set, Totally bounded set and Diameter of set in Metric spaces)

**Assignment-9 : Metric Space-III**(Examples on Limit of metric space, Cauchy sequence in Metric spaces)

**Assignment- 10 : Metric Space-IV**(Contraction, Isometry, homeomorphism in Metric spaces)

**Assignment- 11: Metric Space-V**(Examples on cover, open cover, Dense in Metric spaces)

**Assignment- 12: Metric Space-VI**(Examples on completeness and compactness in Metric spaces)

### **NTL -III(B) (Complex Analysis+ Numerical Analysis)**

**(Problems on the following topics)**

#### **Section - I :Complex Analysis**

**Assignment-1 :** Find the regular (analytic) function of which function (Real , Imaginary ,  $u+v$  ,  $u-v$  type).

**Assignment-2 :** Solving the complex intigration Circle , Line and Parabola.

**Assignment-3 :** Obtain the Taylor's and Laurent's series.

**Assignment-4 :** Calculus of residue.

**Assignment-5 :** Integration round the unit circle.

**Assignment-6 :** Evaluation of integral  $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta$ .

## **Section – II :Numerical Analysis**

### **Assignment No.7: Finite Differences**

Examples on Forward, Backward and Central difference formulae, Differences of a Polynomial, Relation between operators, ( Forward( $\Delta$ ), Backward( $\nabla$ ), Central  $\delta$ , Shift (E))

### **Assignment No.8: Interpolation-I**

Examples on Newton's forward , Newton's backward difference formulae, Central difference formulae

### **Assignment No.9: Interpolation – II**

Examples on Gauss's forward and backward difference formulae, Stirling's formula, Lagrange's interpolation formula

### **Assignment No. 10: Numerical Differentiation**

Examples on Numerical differentiation, formula for derivatives and maxima and minima of tabulated function

### **Assignment No. 11: Numerical Integration**

Examples on Numerical integration, Trapezoidal rule, Simpson's 1/3 Rule and Simpson's 3/8 th rule .

### **Assignment No. 12: Difference Equations**

Examples on Formation of difference equations, Linear difference equation, finding the Complementary function, finding the Particular Integral, Difference equations reducible to linear form.

## **NTL -III(C) (Integral Calculus + Integral Transforms)**

### **Section - I : Integral Calculus**

#### **Assignment-1 : Improper Integral - I**

#### **Assignment-2 : Improper Integral - II**

#### **Assignment-3 : Beta and Gamma function - I**

#### **Assignment-4 : Beta and Gamma function -II**

#### **Assignment-5: Multiple integrals - I(Change of order and Change of Variable)**

#### **Assignment-6: Multiple integrals - II(Area and Volume )**

### **Section – II : Integral Transform**

#### **Assignment-7 : Laplace Transforms (Numerical examples )**

#### **Assignment-8 : Inverse Laplace Transform(Numerical Examples)**

**Assignment-9 :Applications of Laplace Transform** Ordinary Differential equations with constant coefficients,

**Assignment-10 : Applications of Laplace Transform** Ordinary Differential equations with variable coefficients.

**Assignment-11 : Applications of Laplace Transform** Simultaneous Ordinary Differential equations.

**Assignment-12 : Applications of Laplace Transform** Partial Differential equations.

**NTL -III(D)( Partial Differential Equation +Programming in C )  
(Problems on the following Topics)**

**Section – I : Partial Differential Equation**

**Assignment-1** : Solve Linear differential equation of first order by arbitrary constant and arbitrary function, Lagrange’s method.

**Assignment-2** : Non linear partial differential equation of order one by Charpit method.

**Assignment-3** : Non linear partial differential equation of standerd form I , II , III & IV.

**Assignment-4** : Find C.F and P.I for Homogeneous linear partial differential equation with constant coefficient.

**Assignment-5** : Find C.F and P.I for Non-Homogeneous linear partial differential equation with constant coefficient.

**Assignment-6** : Find C.F and P.I for equation reducible to linear differential equation with constant coefficient.

**Section – II :Programming in C**

**(Run and write following C programs only )**

**Assignment No.7: Sample Programms – I**

Addition, subtraction, multiplication and division. Area, Volume of a sphere, Temperature Conversion, Simple Interest Calculation, Compound Interest Calculation, Salary Calculation, Bonus and Commission

**Assignment No.8: Sample Programms – II**

Star pattern, Reverse of a given number, Fibbonacci sequence, Factorial,  ${}^n C_r$ ,  ${}^n P_r$ , Roots of the quadratic equation

**Assignment No.9: Sample Programms – III**

Maximum and Minimum, Sum of the series  $1+2+3+\dots+n$ ,  $1^2+2^2+3^2+\dots+n^2$ ,  $1^3+2^3+3^3+\dots+n^3$ ,  $1^2+3^2+\dots+(n-1)^2$ ,  $2^2+4^2+6^2+\dots+(2n)^2$

**Assignment No.10: Sample Programms – IV**

Sine, Cosine, Exponential series

**Assignment No.11: Sample Programs – V**

Ascending and descending data. Matrix addition/Subtraction, Matrix multiplication.

**Assignment No.12: Sample Programs – VI**

Trapezoidal Rule, Simpson’s 1/3 Rule, Simpsons’s 3/8 th Rule.

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# **Solapur University, Solapur**

## **B.Sc. Part III PHYSICS**

**New CGPA Syllabus with effect from June 2016**

**(Theory Course)**

***SEMESTER – V***

**Paper VII: Mathematical Physics & Statistical Physics**

**100 Marks (3 Credits)  
(UA-70, CA-30 Marks)**

**Paper VIII Solid state Physics**

**100 Marks (3 Credits)  
(UA-70, CA-30 Marks)**

**Paper IX: Classical Mechanics**

**100 Marks (3 Credits)  
(UA-70, CA-30 Marks)**

**Paper X: Nuclear Physics**

**100 Marks (3 Credits)  
(UA-70, CA-30 Marks)**

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**Total (A).....400 Marks  
12 Credits**

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# **Solapur University, Solapur**

## **B.Sc. Part III PHYSICS**

**New CGPA Syllabus with effect from June 2016**

**(Theory Course)**

***SEMESTER - VI***

**Paper XI: Electrodynamics**

**100 Marks (3 Credits)  
(UA-70, CA-30 Marks)**

**Paper XII: Materials Science**

**100 Marks (3 Credits)  
(UA-70, CA-30 Marks)**

**Paper XIII: Atomic, Molecular Physics and Quantum Mechanics**

**100 Marks (3 Credits)  
(UA-70, CA-30 Marks)**

**Paper XIV: Electronics & Instrumentation**

**100 Marks (3 Credits)  
(UA-70, CA-30 Marks)**

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**Total (B).....400 Marks  
12 Credits**

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# Solapur University, Solapur

## B.Sc. Part III PHYSICS

New CGPA Syllabus with effect from June 2016

### Practical Course of Semester – V & VI – (C)

ANNUAL - (AT THE END OF SIXTH SEMESTER)

400 Marks 20 Credits

(UA – 280 Marks + CA – 120 Marks)

Group (I to VI) experiments UA (30 \* 6) + CA (20 \* 6) = 180 + 120=300 Marks  
5\*3=15 Credits

Scale down of 20 Marks for CA per Group: -  
(15 Marks for experimental performance and 03 Marks for attendance 02 Marks for Oral)

Scale down of 30 Marks for UA per Group: As per given in the practical slips

Assessment Part of Practical Course.....100 Marks (5 Credits)

1. Journal .....20 Marks  
    Certified Journal.....10 Marks  
    Neatness & Punctuality (5+5).....10 Marks
2. Seminar report & Seminar report.....15 Marks
3. Tour report .....15 Marks  
(Tour of minimum 2-3 Days / Two different industrial visits)
4. Project of at least 4 – 5 experiments length .....50 Marks  
    Theme of the project.....05 Marks  
    Data collection.....05 Marks  
    Workout / Success.....15 Marks  
    Applicability.....10 Marks  
    Report writing.....15 Marks

-----  
Total (C) .....400 Marks  
20 Credits  
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Grand total of B Sc. III Physics: (A) + (B) + (C) = 400 + 400 + 400 =1200 Marks. Whose C redits are (12 + 12 + 20 = 44 Credits)

**NB:**

**During University Practical examination one practical examiner will assess the first three assessment events of the students along with their assessment of experiment from Group I**

**And another examiner will assess the third assessment event of the student along with assessment of experiment from Group V**

## **NATURE FOR COLLEGE ASSESSMENT (CA) OF 30 MARKS**

### **CGPA SEMESTER PATTERN (w e f June 2016)**

**Time: - 1 hrs**

**Total marks: - 20**

**Q.No.1) Select the correct answer from the given alternatives. (05)**

1) .....

a) .....b).....c).....d).....

2) ..... Do .....

3) ..... Do .....

4) ..... Do .....

5) ..... Do .....

**Q.No.2) Answer any one of the following (05)**

1)

2)

**Q.No.3) A) Answer any one of the following (10)**

1)

2)

**AND ASSIGNMENT OF 10 MARKS FOR EACH PAPER**

# Semester V

## Physics Paper VII

### Mathematical physics and Statistical physics

**1. Vector theorems and introduction to partial differential equation. (6)**

1.1 Gauss's theorem.

1.2 Green's theorem

1.3 Stoke's theorem

1.4 Partial differential equation

1.4.1 Degree

1.4.2 Order

1.4.3 Linearity

1.4.4 Homogeneity

1.5 Frobenius method for power series solution of

1.5.1 Legendre differential equation (without solution)

1.5.2 Bessel differential equation (without solution)

1.5.3 Hermite differential equation (with solution)

**2. Orthogonal Curvilinear Coordinates (8)**

2.1 Introduction to Cartesian, Spherical polar and Cylindrical Coordinate system

2.2 Concept of Orthogonal Coordinate system

2.3 Gradient in Orthogonal Coordinate system

2.4 Divergence in Orthogonal Coordinate system

2.5 Curl in Orthogonal Coordinate system

2.6 Laplacian Operator in Orthogonal Coordinate system

2.7 Extension of Orthogonal Coordinate system in Cartesian, Spherical polar and Cylindrical Coordinate system

**3. Basic Concept in Statistical Physics (8)**

- 3.1 Micro and Macro States
- 3.2 Micro canonical and Canonical Ensemble
- 3.3 Phase Space
- 3.4 Accessible microstates
- 3.5 A Priory Probability
- 3.6 Thermodynamic Probability
- 3.7 Probability Distribution
- 3.8 Entropy and Probability

**4. Maxwell Boltzman Statistics (7)**

- 4.1 Maxwell Boltzman Distribution Law
- 4.2 Evaluation of constants  $\alpha$  and  $\beta$
- 4.3 Molecular Speeds
- 4.4 Thermodynamic functions in terms of partition function

**5. Quantum statistics - I (9)**

- 5.1 Bose Einstein Statistics
- 5.2 Bose Einstein Distribution Law
- 5.3 Experimental study of black body radiation
- 5.4 Derivation of Plank's radiation formula
- 5.6 Deduction of Wein's Formula from Plank's radiation formula
- 5.7 Deduction of Rayleigh's Jeans Law from Plank's radiation formula
- 5.8 Deduction of Wein's Displacement Law from Plank's radiation formula
- 5.9 Stefan's Law from Plank's radiation formula

## 6. Quantum Statistics - II

(7)

- 6.1 Fermi Dirac Distribution Law
- 6.2 Application to free electrons in metals
- 6.3 Electron energy Distribution
- 6.4 Fermi Energy
- 6.5 Electronic Specific heat of metals
- 6.6 Comparison of M.B., F.D. and B.E. statistics

### Reference Books: -

1. Theory and problems of vector analysis- Schaum outline series- Murray R, Spiegel
2. Mathematical methods for physics – George Arfken
3. Thermodynamics and statistical physics – Sharma, Sarkar
4. Statistical Mechanics –B.B. Laud
5. Statistical and thermal physics – S. Loknathan
6. Statistical Mechanics – Satya Prakash, J.P. Agrawal
7. Elementary Statistical Mechanics – Kumar, Gupta
8. An approach to Statistical Physics – Debi Prasad Ray

**Semester V**  
**Physics Paper VIII**  
**Solid state Physics**

**1. Crystallography:** **(09)**

1.1 Lattice and Basic

1.2 Unit cell

1.3 Bravais lattices (2-D, 3-D),

1.4 Inter-planer spacing,

1.5 Miller indices,

1.6 Packing fraction and co-ordination number for BCC, SC, FCC & HCP structures.

**2. X- ray Diffraction by Crystals:** **(07)**

2.1 Reciprocal Lattice and its properties,

2.2 Bragg's Law in reciprocal lattice,

2.3 Powder method of X-ray diffraction for crystal structure,

**3. Free electron Theory:** **(8)**

3.1 Free electron model (Drude & Lorentz model).

3.2 Sommerfield's theory.

3.3 Fermi-Dirac distribution.

3.4 Fermi energy, degeneracy and non-degeneracy of metals.

**4. Band theory of solids:** **(08)**

4.1 Origin of energy bands,

4.2 One electron approximation,

4.3 Motion of electron in one dimensional periodic potential (Kronig Penny model),

4.4 Effective mass of electron,

4.5 Difference between metals semiconductors and insulators,

4.6 Hall Effect. And its applications

## **5. Magnetic materials:**

**(7)**

- 5.1 classification of magnetic materials,
  - 5.1.1 Dimagnetic material
  - 5.1.2 Paramagnetic material
  - 5.1.3 Ferromagnetic material
  - 5.1.4 Anti-ferromagnetic material
  - 5.1.5 Ferri-magnetic and ferrites,
- 5.2 Energy loss in the hysteresis,

## **6. Superconductivity:**

**(6)**

- 6.1 Superconductor
- 6.2 Type I and Type II superconductors
- 6.3 Critical temperature,
- 6.4 Effect of magnetic field
- 6.5 Meissner effect,
- 6.6 Application of superconductor

## **Reference Books: -**

- Solid State Physics – S.O. Pillai (wiley eastern Ltd)
- Solid State Physics - A. J. Dekker
- Solid State Physics - Charles Kittel
- Solid State Physics - R.L. Singhal
- Solid State Physics – Saxena and Gupta

**Semester V**  
**Physics Paper – IX**  
**Classical Mechanics**

**1. Mechanics of a particle and system of particles: (7)**

1.1 Mechanics of a particle using vector algebra and vector calculus.

1.2 Conservation theorems for linear momentum, angular momentum and energy of a particle.

1.3 Mechanics of a system of particles, concept of centre of mass.

1.4 Conservation theorems for linear momentum, angular momentum and energy of a system of particles.

1.5 Application of Newton's law of motion - Projectile motion in resistive medium

**2. Lagrangian Formulation: (10)**

2.1 Limitations of Newtonian Formulation

2.2 Introduction of Lagrangian Formulation

2.3 Constraints

2.4 Degrees of freedom

2.5 Generalised coordinates 2.6 Principle of virtual work

2.7 D'Alembert's Principle

2.8 Lagrange's equation from D'Alembert's Principle.

2.9 Application of Lagrange's equation to

i) A particle in space (Cartesian coordinates)

ii) Atwood's Machine and

iii) A bead sliding on uniformly rotating wire

iv) Simple pendulum

v) Simple harmonic Oscillator.



**3. Moving Coordinate systems: (8)**

- 3.1 Moving origin of coordinates
- 3.2 Pseudo forces 8
- 3.3 Rotating coordinate systems
- 3.4 Coriolis force
- 3.5 Foucault's pendulum
- 3.6 Effects of Coriolis force in nature
- 3.7 Effect of Coriolis force on freely falling body.

**4. Techniques of Calculus of Variation: (6)**

- 4.1 Hamilton's principle
- 4.2 Deduction of Lagrange's equations from Hamilton's principle
- 4.3 Applications:
  - i) Shortest distance between two points in a plane
  - ii) Brachistochrone problem
  - iii) Minimum surface of revolution.

**5. Coupled Oscillations: (6)**

- 5.1 Frequencies of coupled oscillatory system
- 5.2 Normal modes and normal coordinates
- 5.3 Energy of coupled oscillations
- 5.4 Energy transfer in coupled oscillatory system.

## **6. Motion of rigid body:**

**(8)**

6.1 Motion of rigid body in space

6.2 Euler's theorem

6.3 Angular momentum and energy

6.4 Euler's equations of motion

6.5 Motion of a symmetric top (without nutation).

### **References:**

1. Classical Mechanics: Herbert Goldstein
2. Classical Mechanics: N. C. Rana and P.S.Joag
3. Introduction to classical Mechanics: R. G. Takawale and P.S. Puranic
4. Classical Mechanical: Gupta, Kumar and Sharma
5. Classical Mechanics: P.V.Panat

# Semester - V

## Physics Paper X

### Nuclear Physics

#### **1. Nuclear structure and properties** **(10)**

- 1.1 Composition of nucleus
- 1.2 Nuclear radius
- 1.3 Nuclear spin
- 1.4 Nuclear magnetic moment
- 1.5 Electric quadrupole moment
- 1.6 Mass defect
- 1.7 Binding energy
- 1.8 Packing fraction
- 1.9 Liquid drop model of nucleus
- 1.10 Semi-empirical mass formula

#### **2. Nuclear reactions** **(6)**

- 2.1 General scheme of nuclear reactions
- 2.2 Q value of nuclear reactions
- 2.3 Threshold energy
- 2.4 Cross section of nuclear reactions (qualitative)
- 2.5 Stripping reactions
- 2.6 Pick-up reactions

#### **3. Particle Accelerators:** **(8)**

- 3.1 Need of accelerator
- 3.2 Cyclotron
- 3.3 Limitations of cyclotron
- 3.4 Phase stable orbit
- 3.5 Synchrocyclotron
- 3.6 Betatron

**4. Nuclear radiation detectors (7)**

- 4.1 Classification of detectors
- 4.2 Geiger Muller counter
  - i. Construction and working
  - ii. Dead time, recovery time and resolving time
  - iii. Self quenching mechanism
- 4.3 Bubble chamber
- 4.4 Scintillation counter
- 4.4 Cloud chamber

**5. Nuclear Energy levels (8)**

- 5.1 Alpha decay-  $\alpha$  disintegration energy
- 5.2  $\alpha$  particle spectra
- 5.3 Nuclear energy levels
- 5.4 Beta decay –Experimental study of  $\beta$  decay 5 .5 Continuous  $\beta$  ray spectrum
- 5.6 Pauli’s neutrino hypothesis
- 5.7 Nuclear energy levels from  $\beta$  decay

**6. Elementary Particles (6)**

- 6.1 Types of interactions
- 6.2 Classification of elementary particles
- 6.3 Properties of particles

**Reference Books:**

- 1. Nuclear Physics : Irving Kaplan ( Addison Wesley )
- 2. Nuclear Physics : S.N. Ghoshal (S.Chand Publising Co.)
- 3. Nuclear Physics : D.C.Tayal (Himalayan Publishing House)
- 4. Nuclear Physics : J.B.Rajam (S.Chand Publising Co.)
- 5. Concepts of Modern Physics : Arthur Beiser ( Tata McGraw Hill Publishing)
- 6. Atomic and Nuclear Physics : N. Subhramanyam & Brijlal(S.Chand Pub. Co.)
- 7. Concepts of Nuclear Physics : B.L.Cohen ( Tata McGraw Hill Publishing)
- 8. Nuclear Physics an introduction: W E Barcham

# Semester VI

## Physics Paper XI

### Electrodynamics

#### 1. Electrostatics and Charged particle dynamics:

(8)

- 1.1 Coulomb's law
- 1.2 Gauss law in differential form
- 1.3 Poisson's and Laplace's equations
- 1.4 Applications of Poisson's and Laplace's equation to spherical systems
- 1.5 Motion of charged particles in constant electric field
- 1.6 Motion of charged particles in constant magnetic field
- 1.7 Motion of charged particles in constant crossed uniform electric and magnetic fields.

#### 2. Time varying fields:

(7)

- 2.1 Electromotive force
- 2.2 Electromagnetic induction-Faraday's law
- 2.3 Lenz's law
- 2.4 Faraday's laws-Integral & Differential forms
- 2.5 Self inductance
- 2.6 Application to - solenoid
- 2.7 Mutual inductance
- 2.8 Application to transformer

#### 3. Maxwell's equations:

(9)

- 3.1 Magnetic Susceptibility and Permeability
- 3.2 Biot - Savart law

- 3.3 Derivation of  $\nabla \cdot \vec{E} = \rho$
- 3.4 Ampere's law
- 3.5 Derivation of  $\nabla \times \vec{B} = \mu_0 \vec{j}$  OR Differential form of Ampere's law.
- 3.6 Displacement current density
- 3.7 Equation of continuity
- 3.8 Maxwell's correction to Ampere's law
- 3.9 Maxwell's equations for time dependent electric and magnetic fields in vacuum
- 3.10 Maxwell's equations for time dependent electric and magnetic fields in material medium.
- 3.11 Physical significance (Integral form) of Maxwell's Equation

#### 4. Electromagnetic waves: (9)

- 4.1 Conservation of energy in electromagnetic field and Poynting's theorem.
- 4.2 Conservation of momentum in electromagnetic fields.
- 4.3 Wave equations for electric and magnetic fields in vacuum
- 4.4 Plane wave solutions, orthogonality of  $\vec{E}$ ,  $\vec{B}$  and propagation vector  $\vec{k}$
- 4.5 Plane E. M. waves in Dielectrics
- 4.6 Plane E. M. waves in conductors, Attenuation of wave in metal (skin depth)

#### 5. Reflection and Refraction of E.M. waves: (7)

- 5.1 Boundary conditions for E. M. field vectors ( $\vec{D}$ ,  $\vec{E}$ ,  $\vec{E}$  &  $\vec{H}$ )
- 5.2 Reflection and refraction of E. M. waves at a boundary of two dielectrics (Normal incidence only)
- 5.3 Total internal reflection.

#### 6. Radiation from Electric Dipole: (5)

- 6.1 Electric dipole
- 6.2 Retarded time and retarded potential
- 6.3 Electric dipole radiation
- 6.4 Radiation reaction for Electric dipole

### **Reference Books:**

1. Introduction to Electrodynamics (second edition) – David J. Griffiths
2. Introduction to Electrodynamics (third edition) – David J. Griffiths
3. Classical Electrodynamics – J. D. Jackson
4. Classical Electrodynamics – S. P. Puri
5. Electrodynamics – B. B. Laud
6. Foundations of Electromagnetic theory – Reitz and Milford

## **Semester VI**

### **Physics Paper XII (Materials Science)**

1. **Materials and their properties:** (8)
  - 1.1 Classification of materials
  - 1.2 Organic, inorganic and biological materials
  - 1.3 Properties of materials

- 1.3.1 Mechanical properties
  - 1.3.2 Thermal properties
  - 1.3.3 Optical properties
  - 1.3.4 Electrical properties
  - 1.3.5 Magnetic properties
2. **Polymer materials:** (12)
- 2.1 Polymers
  - 2.2 Polymerization mechanism
    - 2.2.1 Additional polymerization
    - 2.2.2 Condensation polymerization
    - 2.2.3 Homo-polymer
    - 2.2.4 Co-polymer
  - 2.3 Degree of polymerization
  - 2.4 Defects in the polymers
  - 2.5 Mechanical properties of polymers, deformation, reinforced polymers
  - 2.6 Applications of polymers.
3. **Ceramic Materials:** (6)
- 3.1 Classification of ceramic materials
  - 3.2 Structure of ceramics
  - 3.3 Ceramic possessing
  - 3.4 Properties of Ceramics
  - 3.5 Applications of Ceramics
4. **Composite Materials:** (6)
- 4.1 Fabrication of composites
  - 4.2 Mechanical properties of composites
  - 4.3 Particle-Reinforced Composites
  - 4.4 Fiber-Reinforced composites
  - 4.5 Applications of composites
5. **Nano-structured Materials:** (7)



5.1 Synthesis of nano-structured materials (Different Types with advantages and disadvantages)

5.1.1 Chemical Bath Deposition method (CBD)

5.1.2 Laser Ablation

5.2 Properties of nano-structured materials

5.3 Characterization of nano-structured materials

5.4 Carbon nano tubes (CNT)

5.5 Applications of nano-structured materials

6. **Biomaterials:** (6)

6.1 Bio-mechanism

6.2 Classification of biomaterials

6.3 Processing of biomaterials

6.4 Properties of biomaterials

6.5 Applications of biomaterials

**References:**

1. Material science by S.L. Kakani, Amit Kakani, New age international publishers.
2. Materials science and engineering, V. Raghavan, 5<sup>th</sup> edition, PHI
3. Materials science by R.S. Khurmi, S. Chand
4. Materials science, G.K. Narula, K.S. Narula, V.K. Gupta, Tata McGraw-Hill.
5. Semiconductor physics and devices by S.S. Islam, Oxford university press, 1<sup>st</sup> edition
6. Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials, by Thomas Varghese & K.M. Balakrishna, Atlantic publication
7. Introduction to nanoscience and nanotechnology, by Chattopadhyay K.K., Banerjee A.N., PHI
8. Materials science – V. Rajendran & A. Marikani (TMHI).
9. Elements of material Science & engineering.- I.H.Van Vlack ( 4th Edition.).

## **Semester VI**

### **Physics Paper XIII**

**Atomic Physics, Molecular Physics and Quantum Mechanics**

1. **Atomic Spectra** (6)

1.1 Review of quantum numbers

1.2 Electronic configuration of alkali metals

- 1.3 Spectral notations
- 1.4 Optical spectral series
- 1.5 Doublet fine structure of alkali metals
- 1.6 Spectrum of Sodium
- 1.7 Selection rules
- 1.8 Intensity rules

**2. Effects of Magnetic and Electric fields on Atomic Spectra (6)**

- 2.1 Anomalous Zeeman effect and its explanation from vector atom model
- 2.2 Paschen Back effect
- 2.3 Paschen Back effect in principal series doublet
- 2.4 Selection rules for Paschen Back effect
- 2.5 The Stark effect of hydrogen
- 2.6 Weak field Stark effect in hydrogen
- 2.7 Strong field Stark effect in hydrogen

**3. Molecular Spectra and Raman Effect (10)**

- 3.1 Molecular bond
- 3.2 Rotational energy levels and Rotational spectra
- 3.3 Vibrational energy levels and Vibrational spectra
- 3.4 Vibration-Rotation spectra
- 3.5 Electronic spectra of a diatomic molecule
- 3.6 Franck-Condon principle
- 3.7 Raman effect
- 3.8 Characteristic properties of Raman lines
- 3.9 Classical theory of Raman effect

**4. Quantum Mechanics (5)**

- 4.1 Heisenberg's uncertainty principle (Statement) and its similarity with concept of matter waves

- 4.2 Physical significance of  $\psi$
- 4.3 Time dependent and time independent Schrödinger wave equations
- 4.4 Eigen values and Eigen functions
- 4.5 Probability current density

## **5. Application of Schrodinger's time independent wave equation (10)**

- 5.1 Particle in a Box (one and three dimensional cases), its Eigen values and Eigen functions.
- 5.2 Step Potential (Statement, boundary conditions, Schrodinger's equations in different regions and Discussion of results)
- 5.3 Potential Barrier (Statement, boundary conditions, Schrodinger's equations in different regions and Discussion of results)
- 5.4 Potential Well (Statement, boundary conditions, Schrodinger's equations in different regions and Discussion of results)
- 5.5 Linear Harmonics Oscillator – Eigen values and Eigen functions
- 5.6 Zero point energy

## **6. Operators (8)**

- 6.1 Operators in quantum mechanics
- 6.2 Expectation values and properties
- 6.3 Angular momentum operators
- 6.4 Commutation properties for components  $L_x, L_y, L_z$
- 6.5 Commutation for  $L^2$  and  $L_z$  operators and their Eigen values
- 6.6 Schrodinger's equation for hydrogen atom
- 6.7 Separation of radial and angular parts

**References:**

1. Atomic Spectra – H.E. White
2. Molecular Spectroscopy - Banwell
3. Molecular Spectroscopy – Hertzberg
4. Quantum Mechanics - J. Powell and B. Creassman
5. Introduction to Quantum Mechanics - Pauling and Wilson
6. Elements of Quantum Mechanics - Kamal Singh and S.P. Singh.
7. Perspectives of Modern Physics – Arther Beiser
8. Quantum Mechanics – Chatwal Anand

**Semester VI**  
**Physics Paper XIV**  
**Electronics & Instrumentation**

**1. Operational Amplifier: -****(9)**

1.1 Block diagram of OP-AMP

1.2 Characteristics of OP-AMP

1.3 OP-AMP parameters

1.4 OP-AMP as inverting amplifier

1.5 OP- AMP as non- inverting amplifier

1.6 Applications of OP-AMP

1.6.1 Adder

1.6.2 Subtractor

1.6.3 Differentiator

1.6.4 Integrator

1.6.5 Comparator

1.6.6 Schmitt's trigger

**2. Timer: -**

**(6)**

2.1 Functional Block diagram of IC 555, its Pin connections

2.2 Operating modes

2.2.1 Monostable

2.2.2 Astable

2.3 Applications of timer IC 555 as

2.3.1 Linear ramp generator

2.3.2 Square wave generator

2.3.3 Voltages to frequency converter

**3. Power Electronics: -**

**(10)**

3.1 Four layer PNP device

3.2 SCR construction and working

3.3 Characteristics of SCR,

3.4 Turn ON and Turn OFF methods of SCR,

3.5 Applications of SCR to control the speed of DC motor,

3.6 Construction, working and characteristics of Diac.

3.7 Construction, working and characteristics of Triac

3.8 Applications of Diac and Triac.

#### **4. Display Devices**

(7)

- 4.1 Classification of Displays
- 4.2 Light Emitting Diodes
- 4.3 Liquid Crystal Display and its Important Features
- 4.4 Gas discharge plasma displays
- 4.5 Segmented gas discharge displays
- 4.6 Segmental displays using LEDs

#### **5:- Transducers and Sensors**

(7)

- 5.1 Classifications of Transducers
- 5.2 Characteristics of transducers
- 5.3 Selection criteria for transducer
- 5.4 Temperature Transducers- Resistance temperature detector
- 5.5 Optical transducer- Photo conductors (LDR), Photodiode
- 5.6 Sensor- Dry reed relay
- 5.7 Servomotor sensors

#### **6. Characterization techniques**

(6)

- 6.1 Resolution and Magnification of Electron microscope
- 6.2 Construction, working of SEM
- 6.3 Application of SEM
- 6.4 Construction and working of TEM
- 6.5 Application of TEM
- 6.6. UV-Visible spectroscopy
- 6. Construction and working of ultra-visible (UV) spectroscopy
- 6.8 Applications of ultra-visible (UV) Spectroscopy

**References:**

1. Electronic principles – Malvino & Leech
2. Basic Electronic – Grob
3. Electronic Circuits and devices – Allan Mottershed
4. Linear Op – Amp – Ramakanth Gaikwad
5. Electronic principles – V.K.Mehta
6. Electronic Instrumentation by H.S. Kalsi
7. Nanotechnology Principles & Practices– Sulbha K. Kulkarni
8. Spectroscopy - Y. R. Sharma

## **Group I General Physics**

01. Resonance Pendulum
02. S.T. of a Soap film
03. S.T. by Ferguson's modified method
04.  $\gamma$  and  $\eta$  using Flat Spiral Spring
05.  $\gamma$  by Koenig's method
06. Stefan's fourth power law
07.  $\gamma$  by Cornu's method
08. Logarithmic decrement to determine viscosity of a given liquid
09. Temperature of flame.

10. Motion of Spring and calculate (a) Spring Constant and (b) Value of G
11. Modulus of Rigidity of a Wire by Maxwell's needle.
12. Determine the Young's Modulus of a Wire by Optical Lever Method.

## **Group II**

### **Optics**

01. Cardinal points by turn table
02. Cardinal points by Newton's method
03. Diffraction due to cylindrical obstacle
04. Lloyd's single mirror
05. Diameter of a Lycopodium powder
06. Resolving power of prism
07.  $\mu$  by total internal reflection
08. Elliptically and circularly polarized light
09. Transverse and Spherical aberration of thick lens
- 10) Dispersive Power of a Plane Diffraction Grating.
- 11) Intensity Measurement by using Photo sensor and Laser in diffraction patterns of single and double slits.



12) Diameter of a thin wire by studying the diffraction produced by it

## **Group III**

### **Electricity and Magnetism**

1. Self inductance by Owen's bridge.
2. Earth inductor: Measurement of  $B_H$ ,  $B_V$  and angle of dip ( $\theta$ ).
3. Hysteresis of ferromagnetic material by magnetometer method.
4. High resistance by leakage method
5. Absolute capacitance of condenser by B.G. method
6. Calibration of bridge wire by Foster's bridge method
7. Equivalent conductivity of solution at its infinite dilution..
8. Resistance of moving coil galvanometer by Kelvin's method.
9. Charge sensitivity of ballistic galvanometer
10. Magnetic flux density between pole pieces of an electromagnet with the help of search coil and ballistic galvanometer.

11. Measure the magnetic susceptibility of paramagnetic solution ( $\text{FeCl}_3$ ) by Quincke's method.
12. Hysteresis by BG Method.

## **Group IV**

### **Electronics and Instrumentation**

1. Astable multi vibrator using IC 555
2. OP-AMP as inverting amplifier
3. OP-AMP as comparator –Schmitt's trigger
4. OP-AMP as adder and subtractor
5. SCR firing by UJT
6. RS and JK flip flop
7. FET as VVR
8. Seven Segment Display
9. Study of mono-stable operation of IC 555
10. Characteristics of SCR
11. Build a regulated power supply of 6V by using IC 7805

12. Build a dual power supply by using IC 7805 and 7905..

## **Group –V**

### **Use of computer and internet**

1. To create resume by MS word.
2. Create worksheet of student mark sheet in Excel
3. Create an e-mail address, mail the documents, download the received documents and take its print..
4. Search any research paper or book and download from search engine
5. Create photo album with animations by power point presentation
6. Create mail merge letter (Application letter)
7. Draw graph or chart
8. Create poster of your seminar presentation by power point presentation
9. To make student presentee (Catlog) sheet using MS word.
10. From origin plot graph, calculate slope and make calculations.
11. Word to PDF conversion.

12. Create documents in IEEE format by using mathematical model, mathematical functions, various signs and symbols.

## **Group – VI**

### **Applied Physics**

1. Velocity of sound using CRO and microphone
2. Estimation of efficiency of GM counter
3. Determination of Beta particle range and maximum energy
4. Hall effect
5. Resistivity of semi conducting material by four probe method.
6. Thermo-electric power of thin film
7. Band gap/temperature sensor using semiconductor diode.
8. Study the Seebeck effect and Peltier effect with the help of thermocouple..
9. Temperature sensor (PTCR & NTCR)
10. Determination of yield point and the breaking point of elastic material.
11. Thin film preparation by any chemical method with different preparative parameters.

12. Thin film characterization by XRD technique.

**NATURE OF THEORY QUESTION PAPER FOR UA OF  
CGPA SEMESTER PATTERN (w e f June 2016)**

Time: - 2 hrs 30 min.

Total marks: - 70

**Q.No.1) Select the correct answer from the given alternatives. (14)**

- 1) -----
- a) .....b).....c).....d).....
- 2) ..... ..Do .....
- 3) ..... Do .....
- 4) ..... Do .....
- 5) ..... Do .....
- 6) ..... Do .....
- 7) ..... ..Do .....
- 8) .....Do .....
- 9) .....Do .....
- 10) ..... Do .....
- 11) ..... Do .....
- 12) ..... Do .....
- 13) ..... Do .....
- 14) ..... Do .....

**Q.No.2) Answer any seven of the following (14)**

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)
- 7)
- 8)

**Q.No.3) A) Answer any two of the following (10)**

- 1)
- 2)
- 3)

**B) Write the answer (04)**

**Q.No.4 Solve any two of the following (14)**

- 1)
- 2)
- 3)

**Q.No.5) Solve any one of the following**

**1) Essay type long answer question / Derive an expression (10)**

**Example (04)**

**2) ..... Do .....**

**NB:**

1. At least two numerical based questions should be asked in Question No. 1
2. Question No. 2, 3A and 4 must be included one example to solve.

