



श्री. गावणे.
Imp. document
AMB
30/4/7

SANT GADGE BABA
AMRAVATI UNIVERSITY
AMRAVATI - 444602
(M.S.)

Tel: 2662206, 2662207, 2662208, 2662249, 2662358
website: www.amtuni.com

FAX NO. 0721-2660949, 2662135

GRAM AMUNI

No SGBAU/7-D/6/71/ 317 /07
Date:

20 APR 2007

To,
The Secretary,
Department of Higher Education,
Government of Maharashtra,
Mantralaya Annexe,
Mumbai-32.

Subject: Sanction of Courses under the UGC scheme of "Career Oriented Programme 2006-07-under plan" to the colleges affiliated to the University.

Sir,

Proposals of the colleges for "Introduction of Career Oriented Courses at first-degree level, were recommended by the University to the UGC under the UGC scheme. The UGC has granted permission to the following colleges for Career Oriented Courses at first-degree level and also granted financial assistance for this purpose, copy of which is enclosed herewith for your reference.

Sr. No.	Name of the Colleges	Course Approved by UGC	Fin. Assistance Sanction
1	Vidnyan Mahavidyalaya, Malkapur, Distt. Buldana	Water Quality and Soil Testing	7.00 lakh
2	Late N.A. Deshmukh Arts & Comm. College, Chandurbazar, Distt. Amravati	Computer and information Tech.	7.00 lakh
3	Smt. Kesharbai Lahoti M.V. Amravati	Fashion Designing	5.00 lak
4	Lokmanya Tilak M.V., Wani Distt. Yavatmal	Functional English	5.00 lakh
5	L. B. Aney Mahila M.V., Yavatmal	Fashion Designing	5.00 lakh
6	M. Fule Arts, Commerce & Sitaramaji Choudhari Science College, Warud, Distt. Amravati	Biomedical Laboratory	7.00 lakh
7	Matoshri Vimlabai Deshmukh Mahavidyalaya, Amravati	English Grammar and Communicative Skills	5.00 lakh
8	Nehru Arts & Commerce College, Nerparsopant, Distt. Yavatmal	Accounting & Auditing	5.00 lakh
9	R.A.Arts & Shri M.K.Commerce & Shri S.R.Rathi Science Mahavidyalaya, Washim	E-Commerce	5.00 lakh
10	Swatantra Sainik Late K.R.Innani Mahavidyalaya, Karanaja(Lad), Washim	Taxation	5.00 lakh
11	S.P.M.Late Tatyasaheb Mahajan Arts & Commerce College, Chikhli, Dist. Buldana	E-Commerce	5.00 lakh
12	Smt. R.Sarda Arts & Commerce College, Anjangaon Surji, Distt. Amravati	Translation Proficiency	5.00 lakh
13	Vidya Bharati Mahavidyalaya, Amravati	Insurance	5.00 lakh
14	Smt. Vatsalabai Naik Mahila Mahavidyalaya, Pusad, Dist. Yavatmal	Functional English	5.00 lakh

Contd ..2/...

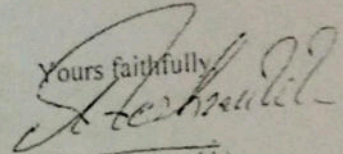
15	Y.D.V.D. Arts & Commerce College, Teosa, Distt. Amravati	Finance Management & Auditing	5.00 lakh
16	Takshashila Mahavidyalaya, Amravati	Communicative Skills in English	5.00 lakh
17	Savitribai Phule Mahila Mahavidyalaya, Washim	Communicative Skills in English	5.00 lakh
18	S.Khandelwal Arts, Science & Commerce College, Akola	Biomedical Instrumentation	7.00 lakh
19	Arts & Science Mahila Mahavidyalaya, Mehkar, Distt. Buldana	Fashion Designing	5.00 lakh
20	Phulsing Naik Mahavidyalaya, Pusad, Distt. Yavatmal	Non-Conventional energy System	7.00 lakh
21	Adarsha Science, J.B.Arts & Commerce Mahavidyalaya, Dhamangaon(Rly.), Distt. Amravati	Web Designing & Office Automation	5.00 lakh
22	B.B.Arts, N.B. Commerce & B.P.Science College, Digras, Distt. Yavatmal	Vermiculture	7.00 lakh
23	Bharatiya Mahavidyalaya, Amravati	Clinical Technology Laboratory	7.00 lakh
24	Bar. R.D. Arts & Smt. I. K. Commerce & N.K.D. Science College, Badnera-Amravati	Sericulture	7.00 lakh
25	Dr. Babasaheb Ambedkar Mahavidyalaya, Amravati	Applied sociology	5.00 lakh
26	G. S. Gawande Arts & Commerce College, Unakhed, Distt. Yavatmal	Agriculture Management	5.00 lakh
27	Ghulam Nabi Azad Arts & Commerce College, Barshitakli, Distt. Akola	Fashion Designing Computer Application	10.00 lakh
28	J.D.Patil Sangludkar Mahavidyalaya, Daryapur, Distt. Amravati	Fresh Water Fish Culture	7.00 lakh
29	K.N. College of Arts, Commerce, Karanja(Lad), Distt. Washim	Banking	5.00 lakh
30	Abasaheb Parvekar Mahavidyalaya, Yavatmal	Communication Skill in English	5.00 lakh
31	Arts & Commerce College, Motala, Distt. Buldana	Accountancy and Auditing	5.00 lakh

32	G. S. Tompe Arts & Commerce Mahavidyalaya, Chandur Bazar, Distt. Amravati	Translation Proficiency Information and Computer Technology	12.00 lakh
33	B. S. Patil Mahavidyalaya, Achalpur, Paratwada, Distt. Amravati	Rural Handicraft	5.00 lakh
✓ 34	R. L. T. College of Science, Akola	Clinical Laboratory Technology	7.00 lakh
35	Shri Shivaji College, Akot, Distt. Akola	E-Commerce	5.00 lakh

The above courses sanctioned by the UGC are permanently on non-grant basis and there is no financial burden on the Government. It is requested to kindly grant permission for introduction of the courses to the said colleges at the earliest, so that the courses could be introduced from this academic session.

Thanking you.

Encl : Copies of the UGC letters.

Yours faithfully

(C. D. Deshmukh)
Registrar

Copy forwarded for information to :

- 1] The Principal ,
- 2] Dy. Registrar (Academic), Sant Gadge Baba Amravati University
- 3] Asstt. Registrar (College), Sant Gadge Baba Amravati University

SANT GADGE BABA AMRAVATI UNIVERSITY

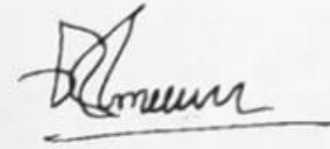
SHORT - TERM CERTIFICATE COURSES EXAMINATION OF SUMMER - 2021

PROGRAMME FOR THEORY Revised

Day	Date	Time	Subject
Tuesday	30-11-2021	09 AM. To 10 AM.	Certificate Course Tally
			Certificate Course Desktop Publishing
			Certificate Course Food & Beverages Services
			Certificate Course Housekeeping
			Certificate Course Textile weaving
			Certificate Course Textile Spinning
			Diploma in Sericulture
			Diploma in Astronomy
		02 PM. To 03 PM.	a) Diploma in Naturopathy & Yoga Therapy Paper-I
			b) Diploma in Naturopathy & Yoga Therapy Paper-II

(Note :- The Schedule is subject to corrections, if any)

The Name of Examination centre is printed on Admission Card of the examinee.



Dr.H. R. Deshmukh

**Director, Board of Examinations and Evaluation
Sant Gadge Baba Amravati University**

AMRAVATI

DATE : 24/11/2021

M.Sc.
Sem-I to IV(Chemistry)

Prospectus No. 2015125

संत गाडगे बाबा अमरावती विद्यापीठ

SANT GADGE BABA AMRAVATI UNIVERSITY

विज्ञान विद्याशाखा
(FACULTY OF SCIENCE)

अभ्यासक्रमिका
विज्ञान पारंगत परिक्षा (रसायनशास्त्र)
सत्र-१ ते सत्र -४

PROSPECTUS
OF
MASTER OF SCIENCE EXAMINATION
IN
CHEMISTRY
Semester -I & III, Winter 2014,
Semester -II & IV, Summer 2015,



2014

Visit us at www.sgbau.ac.in

Price Rs. /-

PUBLISHED BY
Dineshkumar Joshi
Registrar
Sant Gadge Baba
Amravati University
Amravati-444602

-
- © 'या अभ्यासक्रमिकेतील (Prospectus) कोणताही भाग संत गाडगे बाबा अमरावती विद्यापीठाच्या पूर्वानुमती शिवाय कोणासही पुनर्मुद्रित किंवा प्रकाशित करता येणार नाही.'
- © "No part of this prospectus can be reprinted or published without specific permission of Sant Gadge Baba Amravati University"

INDEX

M.Sc.Part-I & Part-II (Semester I to IV) Examinations in Chemistry (Prospectus No.2015125)

Sr.No.	Paper	Page Nos.
1.	Special Note	1
2.	Ordinance No.4 of 2008	3
3.	Direction No.14 of 2009	12
4.	Direction No.26 of 2010	14
5.	Direction No.27 of 2010	37
6.	Direction No.39 of 2011	40
7.	Direction No.25 of 2012	42
8.	Direction No. 7 of 2014	46
9.	Direction No. 8 of 2014	47
10.	Semester I	
I	Inorganic Chemistry	1
II	Organic Chemistry	3
III	Physical Chemistry-I	6
IV	Modern Methods of Separation	8
11.	Semester II	
V	Co-ordination Chemistry	14
VI	Organic Chemistry-II	16
VII	Physical Chemistry-II	19
VIII	Optical Methods and Environmental Chemistry	20
12.	Semester III	
IX	Spectroscopy-I	26
X	Analytical Chemistry-I	29
XI	Special Paper-I Inorganic Chemistry (Bio-inorganic Chemistry)	31
XII	Special Paper-II Inorganic Chemistry (Solid State Chemistry)	33
XI	Special Paper-I Organic Chemistry (Organic Synthesis-I)	36
XII	Special Paper-II Organic Chemistry (Natural Product-I)	38
XI	Special Paper-I Physical Chemistry	40
XII	Special Paper-II Physical Chemistry	41
XI	Special Paper-I Industrial Chemistry (Heat Transfer, Unit Operations and Material Balances)	43
XII	Special Paper-II Industrial Chemistry (Processes Economics And Industrial Management)	45
XI	Special Paper-I Analytical Chemistry (Adv.Separation Tech.)	46
XII	Special Paper-II Analytical Chemistry (Recent Advances in Analytical Chemistry)	49
13.	Semester IV	
XIII	Spectroscopy-II	54
XIV	General Analytical Chemistry	57
XV	Special Paper-III Inorganic Chemistry (Photoinorganic & Organometallic Chemistry)	59
XVI	Special Paper-IV Inorganic Chemistry (Materials Chemistry)	61
XV	Special Paper-III Organic Chemistry (Organic Synthesis: II)	63
XVI	Organic Chemistry (Natural Product-II)	64
XV	Special Paper-III Physical Chemistry	67
XVI	Special Paper-IV Physical Chemistry	68
XV	Special Paper-III (Unit Processes) Industrial Chemistry	69
XVI	Special Paper-IV (Chemical Processes Industries) Industrial Chemistry	72
XV	Special Paper-III Analytical Chemistry (Analysis of Commercial Products)	75
XVI	Special Paper-IV Analytical Chemistry (Applied Analytical Chemistry)	78

Syllabus Prescribed for M.Sc.Part-I, Semester-I (Chemistry)

Paper-I

Inorganic Chemistry

60hrs (4hrs/week). 12hrs/unit

50 Marks

Unit-I A) Stereochemistry and Bonding in Main Group Compound.

6L

VSEPER-Shape of simple inorganic molecules and ions containing lone pairs, Various stereochemical rules and resultant geometry of the compounds of non-transitional elements, Short coming of VSEPR model. Bent rule and energetic of hybridization, some simple reaction of covalently bonded molecules, d-orbital participation by non-metal.

B) Molecular Orbital Theory: 6L

Molecular orbital representation of polyatomic molecules with special reference to C_2H_4 , C_2H_6 and CO and delocalised molecular orbital of ozone, Carbon dioxide, Nitrite, Nitrate and Benzene.

Unit-II 6L

A) Metal ligand Bonding: Splitting of d-orbital in low symmetry environments, Structural effects of orbital splitting. Jahn-Teller effects, tetragonally distorted octahedral complexes. Jahn-Teller distortion in chelate complexes. Thermodynamic effects, crystal field stabilization energies (CFSE's) for octahedral and tetrahedral complexes, correlation of crystal field stabilization energy with the related thermodynamic properties such as lattice energies, enthalpies of hydration, formation constants, stabilization of unusual oxidation states and ionization energies, structure of mineral spinels. Limitations of crystal field theory.

B) Magnetochemistry 6L

Concept of magnetic susceptibility, types of magnetic bodies, Magnetic properties of free ions and transition metal complexes of different geometries, factors affecting the magnetic properties, orbital splitting and magnetic properties, quenching of orbital angular momentum, and effect of ligand field on spin-orbit coupling. Temperature dependence of paramagnetism, High spin-low spin crossover, spin crossover in coordination compounds, spin equilibria, magnetic interactions, ferromagnetism and antiferromagnetism. Anomalous magnetic moments and magnetic exchange coupling. Magnetic properties of polynuclear complexes.

Unit-III **Metallic Cluster:** 12L

Boron hydrides: Classification, nomenclature, structure, bonding and topology of boranes, 4-digit coding (s, t, y, x) numbers for B_2H_6 , B_4H_{10} , B_5H_9 , B_5H_{11} and B_6H_{10} and their utilities. Chemistry of diboranes. Acquaintance with metalloboranes, Carboranes and Metallocarboranes. Metal clusters: Occurrence of metal-metal bonds, binuclear, trinuclear, tetranuclear, and octahedral clusters. Synthesis, properties and bonding, of carbides, sulphur-nitrogen compounds, peroxo compound of boron, carbon and sulphur, oxy acids of nitrogen, Isopoly and Heteropoly acids.

Unit-IV A) Non-aqueous solvent behavior 6L

Inorganic solutes in organic solvents. Solvent system concept. The role of solvents in chemical reactions, effect of physical and chemical properties. Inorganic reactions in the following non-aqueous solvents: Dinitrogen tetroxide, anhydrous sulphuric acid, bromine trifluoride and reaction in molten salts.

B) Metal-Ligand equilibria in solution: 6L

Stability of complex ions in solution. Basic principles, Mathematical function and their interrelationship, trends in stepwise constant, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, statistical, electrostatics, chelate effect and its Thermodynamic origin ($\Delta G, \Delta S, \Delta H$). Uses of stability constants in analytical chemistry, resolving of enantiomorphs. Determination of stability constants by spectrophotometric methods (Job's and Mole ratio), Bjerrum's H metric method, polarographic method and Conductometric method.

Unit-V **Symmetry and Group theory** 12L

Symmetry elements and symmetry operations, symmetry groups or point groups. Schoenflies symbols, point group classification, matrix representation of symmetry operations, identification of point groups ($C_n/C_n v/C_n h/D_n h/Td, Oh$ etc), necessary conditions for any set of elements to form a group, subgroups, classes in a group, and representation of groups. The great orthogonality theorem (without proof) and its importance. Derivation of character tables for $C_2 v, C_3 v$ points groups (construction not required), representation reducible and irreducible, and analysis of reducible representation.

List of Books

- 1) S. F. A. Kettle, J. N. Murrell & S. T. Teddler: Valency Theory
- 2) C. A. Coulson: Valency
- 3) J. E. Huheey :Inorganic Chemistry
- 4) F. A. Cotton & G. Wilkinson: Advanced Inorganic Chemistry 3rd, 5th & 6th Editions.
- 5) A. F. Williams: Theoretical Approach in inorganic chemistry.
- 6) A. Mannas Chanda: Atomic Structure and chemical Bonding
- 7) L. E. Orgel: An Introduction To transition metal chemistry, Ligand field theory, 2nd Edition.
- 8) J. J. Logowski: Modern Inorganic Chemistry
- 9) B. Durrant and P.J. Durrant: Advanced Inorganic Chemistry
- 10) J. C. Bailar: Chemistry of co-ordination compounds.
- 11) W. L. Jolly: Modern Inorganic Chemistry
- 12) R. S. Drago: Physical methods in inorganic chemistry.
- 13) Waddington: Nonaqueous solvents.
- 14) Sisler: Chemistry of nonaqueous solvents.
- 15) A. K. Barnard: Therotical Inorganic Chemistry
- 16) Emeleus and Sharpe: Modern Aspect of Inorganic Chemistry.
- 17) F. A. Cotton: Chemical Applications of Group theory.
- 18) Jones: Elementary Co-ordination chemistry.
- 19) B. N. Figgis: Introduction to Ligand field.
- 20) S. F. A. Kettle: Co-ordination chemistry.
- 21) M.C. Day and J. Selbin: Theoretical Inorganic Chemistry.
- 22) J. Lewin and Wilkins: Modern Co-ordination chemistry.
- 23) Gowariker, Vishwanathan and Sheedar: Polymer science.
- 24) H. H. Jattey and M. Orchin: Symmetry in chemistry.
- 25) D. Schonland: Molecular Symmetry in chemistry.
- 26) L. H. Hall: Group theory and Symmetry in chemistry
- 27) H. H. Jattey and M. Orchin: Symmetry in chemistry
- 28) R.L. Dutta and A. Simal: Elements of magneto chemistry
- 29) Inorganic Chemistry 4th Edition, P. Atkins, Oxford University Press.
- 30) Essential Trends in Inorganic Chemistry, D.M.P. Mingos, Oxford University Press

Semester –I**Paper-II****Organic Chemistry**

60hrs (4hrs/week). 12hrs/unit

50 Marks

- Unit-I: Nature and Bonding in Organic Molecule** 12L
 Delocalized chemical bonding, conjugation, cross-conjugation, resonance, hyper-conjugation, bonding in fullerenes.

Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternat hydrocarbons Huckel's rule, energy level of pi-molecules orbitals, annulenes, anti-aromaticity, homo-aromaticity. Aromatic character and chemistry of cyclopentadiene anion, tropyllium cation, tropene and tropelene.

- Unit-II : Stereochemistry** 12L
 Conformational analysis of cycloalkanes (5 – 8 membered rings), decalines, effect of conformation on reactivity, steric strain due to unavoidable crowding.
 Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, method of resolution, optical purity, enantiotopic and distereotopic atoms, groups and faces, stereospecific and stereoselective synthesis.
 Asymmetrical synthesis, optical activity in absence of chiral carbon (biphenyl, allenes and spiranes). Stereochemistry of the compounds containing N, P and Sulphur.
- Unit-III : Reaction mechanism: Structure and Reactivity** 12L
 Types of mechanism, Types of reaction, thermodynamics and kinetics requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects.
 Effect of Structure on reactivity:-
 Resonance and field effects, Steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation.
- Unit-IV : A) reactive Intermediates:** 12L
 Classical and non-classical carbocations, Carbanions, radical anions and radical cations, Carbenes, nitrenes and arynes. General methods of generation , detection and reactivity of these intermediates. Singlet oxygen, its generation and reactions with organic substrates.
- B) Aliphatic nucleophilic substitution:**
 The SN¹, SN², mixed SN¹, SN² and SET and SNⁱ mechanisms. Nucleophilicity, effect of leaving group, ambient nucleophiles and ambient substrates regioselectivity. The neighbouring group. Participation mechanism, substitution at allylic and vinylic carbon atoms.

Dehydration using DCC, Meyllers synthesis of aldehydes, ketones and acids.

Unit-V: A) Aromatic Nucleophilic Substitution 12L

A general introduction to different mechanisms of aromatic nucleophilic substitution S_NAr , S_N1 , Benzyne and $SRN1$ mechanisms.

Reactivity effect of substrate structure leaving group and attacking nucleophile. The Von Richter, Sommet-Hauser and Smiles rearrangements.

B) Elimination Reactions:

The E_1 , E_2 and E_1CB mechanisms orientation of the double bond. Saytzeff and Hoffman's rule. Effect of substrate structure, attacking base, leaving group and medium. Pyrolytic elimination mechanism and orientation. Cleavage of quaternary ammonium salts. Conversion of vicinal dihalides and nitro compounds to alkenes.

BOOKS SUGGESTED-

- Advanced organic chemistry ~ Reaction mechanism and structure. Jerry March, John Wiley.
- Advanced organic chemistry- F.A. Carey and R.J. Sunberg, Plenum.
- A Guidebook to mechanism in organic chemistry-Peterskyes, Longman.
- Structure and mechanism in organic chemistry-C.K. Gold, Cornell University Press.
- Organic chemistry, R.T. Morrison Boyd. Prentice Hall
- Modern organic chemistry-H.O. House, Benjamin.
- Principal of organic chemistry-R.O.C. Norman and J.M. Coxon, Blackie Academic and Professional.
- Reaction mechanism in organic chemistry-S.M. Mukharji and S.P. Singh, Macmillan.
- Stereochemistry of organic compounds- D. Nasipuri, New age international.
- Stereochemistry of organic compounds- P.s.kalsi, New age international.
- Frontier orbitals and organic chemical reactions-I. Fleming.
- Orbital Symmetry ~ R.E. Lehr & A.P. Marchand.
- Reactive intermediate in organic chemistry-N. S. Isaacs.
- Stereochemistry of carbon compounds- E.L. Eliel.
- Physical organic chemistry-J. Hine.
- Name reaction in organic chemistry ~ Surrey.
- Advanced organic chemistry ~ L.F. Fieser and M. Fieser.
- Vol. I & II organic chemistry - I. L. Finar.

- Modern organic chemistry- J.D. Roberts and M. C. Caserio.
- The search for organic reaction pathways (Longmann), Peter Skyes.
- Organic chemistry 5th Edition (McGraw Hill), Pine.
- Organic chemistry (Willard Grant Press Botcon), John McMurry.
- A Textbook of organic chemistry- R.K. Bansal.
- New trends in green chemistry ~ V.K. Ahluwalia & M. Kidwai, Anamaya publishers New Delhi.
- Organic Chemistry, J. Clayden, Oxford University Press.
- Organic Chemistry, 4th Edition, G Marc Loudon, Oxford University Press.

**Semester I
Paper-III
Physical Chemistry-I**

60 Hours (4-Hours/week) 50 Marks 12 hours/Unit

Unit-I Quantum Chemistry:

- Discussion of solutions of Schrodinger equation to some model systems viz., Particle in a three dimensional box, Harmonic oscillator, Rigid rotor. The variation theorem, linear variation principle. Perturbation theory (first order & non degenerate). Application of variation method & perturbation theory to the Helium atom. 6L.
- Ordinary angular momentum, generalized angular momentum, eigen functions for angular momentum, eigen value of angular momentum. Pauli exclusion principle. Russell-Saunders terms and coupling schemes, Slater-Condon parameters, spin-orbit coupling and Zeeman splitting. Numericals. 6L.

Unit-II Surface Chemistry :

- Adsorption: Freundlich adsorption isotherm, Langmuir adsorption isotherm, Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids, and catalytic activity at surfaces. 6L
- Micelles: micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation & mass models, solubilization, micro emulsion, reverse micelles. Numericals. 6L.

Unit-III Thermodynamics

- Classical Thermodynamics: Partial molar properties. Partial molar free energy, Chemical Potential, Partial molar volume

and Partial molar heat content and their significances. Determination of these quantities. Concept of fugacity and determination of fugacity.

Non-ideal systems: Activity, Activity coefficients, Debye-Huckel theory for Activity coefficient of electrolytic solutions; Determination of Activity & Activity coefficients; ionic strength.. 6L.

- B) Non equilibrium Thermodynamics: Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow for different irreversible processes (e.g. heat flow, chemical reaction, coupled reactions and electrochemical reactions.) Transformations of the generalized fluxes and forces, phenomenological equations. Microscopic reversibility and Onsager's reciprocity relation. Numericals. 6L.

Unit-IV Nuclear chemistry:

- A) Properties of Nucleons & Nuclei: Nuclear size and shape, mechanical effects due to orbiting and spinning of Nucleons, magnetic quantum numbers, Principal and radial quantum numbers, Total angular momentum of the nucleus, Magnetic properties of the nucleus. Net magnetic moments of the nuclei. Numericals. 6L.
- B) Nuclear models: Liquid drop model, shell model, Fermi gas model, collective model and optical model. 6L.

Unit-V Chemical Dynamics:

- A) Theories of reaction rates: Collision theory, collision rates in gases, energy requirement and steric requirement. Dynamics of molecular collisions. Transition state theory: assumptions, Statistical Mechanics and chemical equilibrium, derivations of Eyring equation, Application of transition state theory to reaction between atoms and molecules (e.g. The reaction $H + HBr \rightarrow H_2 + Br$) 6L.
- B) Unimolecular reactions: Lindemann-Christiansen hypothesis and Hinshelwood treatment, Marcus's extension of the RRK treatment. 3L.
- C) Reactions in solution: Solvent effect on reaction rate, Factors determining reaction rate. Numericals. 3L.

List of Books :

- 1) Physical chemistry by P.W. Atkins & dePaula 7th Edition
- 2) Introduction to Quantum chemistry by A.K. Chandra, Tata Mc
- 3) Quantum chemistry by Ira N. Levine.
- 4) Molecular quantum mechanics, Vol. I & II, P.W. Atkins, Oxford university press, 1970.

- 5) Statistical thermodynamics, by T.L.Hill, Addison Wesley, 1060
- 6) Chemical thermodynamics, by F.T.Wall, W.H.Freeman & Co. 1965
- 7) Irreversible thermodynamics, Theory and applications, by K.S.Forland, T. Forland, S.K.Ratje, Jonny Wiley, 1988.
- 8) Chemical Kinetics, by K.J.Laidler, 3rd Edition, Harper and row, 1987.
- 9) Chemical Kinetics-A study of reaction rate in solution, K.Conors, V.C.H.Publication 1990.
- 10) Chemical Kinetics and Dynamics, By J.I.Streinfeld, J.S. Francisco & W.I.Hase, Pritice Hall, 1989.
- 11) Kinetics and Mechanism of Chemical transformation, J.Rajraman, J. Kucriacose, Mc-Million
- 12) Molecular reaction Dynamics and chemical reactivity, R.D.Levine and R.B. Benstin, Oxford University press. 1987.
- 13) Physical Chemistry by Alberty and Silby, Jolly Wiley
- 14) Essential of Quantum Chemistry by Anant Raman.
- 15) Introduction to Relativistic Quantum Chemistry, K.G.Dyall, Oxford University Press.
- 16) Molecular Quantum Mechanics, 4th Edition, P.W. Atkins, Oxford University Press

Semester I

PAPER-IV

Modern Methods of Separation

60hrs(4hrs/week),

12hrs/Unit

50 Marks

Unit-I

12L

Role of Analytical Chemistry: Classification of analytical methods-classical & instrumental. Types of instrumental analysis. Selecting an analytical method. Laboratory Operations and practices. Analytical balances (Semi micro and Micro balances) and their use in analytical chemistry. Techniques of weighing and errors. Volumetric glassware cleaning and calibration of glassware. Principal and Methods of sampling, theory of sampling, pit falls and problems associated with sampling. Techniques of sampling of gases, liquids, solids and particulates. Stoichiometric calculations based on gravimetry and titrimetry analysis of commercial samples. Transmission and storage of samples. Effect of sampling uncertainties samplers' responsibility, sampling hazards.

Unit-II

12L

Statistical Analysis: (Emphasis should be placed on numerical problems) Collection, Treatment and presentation of analytical data. True, standard and observed value. Definition of terms in mean and median. Errors in chemical analysis, classification of errors, nature and origin of errors. Accuracy and precision. Average deviation and standard deviation and its physical significance. Normal distribution curve and its properties. Coefficient of variation. Confidence limit and probability. Probability theorem, probability curves, comparison of analytical results. Tests for rejection of data. T-test, F-test and Q-test. Significant figures and computation rules. Least squares method for deriving calibration graph. Curve fitting, Correlation co-efficient. Limit of detection. Regression analysis and Statistical analysis of Chemical analysis.

Unit-III**Modern method of separation:**

12L

Chromatography: General principles and Classification of various techniques. Study of following chromatographic techniques: Partition Chromatography, Liquid-Liquid Chromatography, Reverse Phase chromatography. Adsorption chromatography. Principles, Techniques and applications of paper, Thin-layer, column, HPLC, Gas Chromatography, size exclusion chromatography and Electro chromatography.

Unit-IV**Ion exchange**

12L

Ion-Exchange Separation: Fundamental properties of ion exchangers. Theory of ion exchange, exchange capacity, screening effect, penetration of electrolytes into ion exchange resins, sorption of complex ions Cation and Anion exchangers, Action of ion exchange resins. Ion-exchange equilibria and ion exchange capacity. Strongly and weakly acidic cation exchangers. Strongly and weakly basic anion exchangers. Liquid ion exchangers, chelation ion exchangers, techniques of ion exchange, use of non aqueous solvents in ion exchange separation, application of ion exchange separation in determination of total salt concentration, removal of interfering ions, separation of anions and metals and application in analytical chemistry. Separation using solvent mixture.

Unit-V**Solvent Extraction**

12L

Solvent Extraction: Basic principles, Classification, Mechanism of extraction. Multiple extraction. Significance of various terms factors favouring solvent extraction,

Extraction equilibria. Quantitative treatment of solvent extraction. Synergetic effects, ion-pair extraction, salting out effect and stripping. Techniques in extraction, application of diketone, hydroxyquinoline, oximes, dithiocarbamates, xanthates, thiols, high molecular weight amines i.e. crown ethers, cryptands and calixarenes. Advantages, applications of synergistic extraction. Separation of nonmetals and metals.

List of Books.

1. Analytical chemistry- Problems and Solution- S. M. Khopkar, New Age International Publication.
2. Day & Underwood: Quantitative Analysis.
3. Findley: Practical Physical Chemistry:
4. A. I. Vogel A Text book of Quantitative Inorganic Chemistry, ELBS, London.
5. Strouts Galfillal: Analytical chemistry
6. Y. Lyalikov: Physicochemical Analysis
7. S. Wilson & P. Jones: Chemical Analysis Vol I
8. Meites and Thomas: Advance Analytical Chemistry. (Mc Graw Hill)
9. H.H. Willard, L.L. Merritt and J.A. Dean: Instrumental Methods of Analysis (Van Nostrand).
10. B. L. Krayner, H. H. Willard. L. Merritt, J. A. Dean & F. A. Settle: Instrumental Methods of Analysis (CBS Publishers, Delhi, 1986)
11. R. D. Brown Instrumental Methods of Chemical Analysis (Mc Graw Hill)
12. L. R. Snyder & C. H. Harvath: An Introduction to Separation Science (Wiley Interscience)
13. F. J. Wicher Robert: Standard Methods Chemical Analysis.
14. G. L. Davis Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, KLN Reddy, C. Sudhakar, Analytical Chemistry.
15. S. M. Khopkar Analytical Chemistry of Macrocyclic and supramolecular and compounds, Narosa publication.
16. R. D. Budhiraja Separation Chemistry, New Age.
17. Kaushik & Kaushik Perspectives in Environmental Studies, New Age
18. R.L. Peesok and L.D. Shield: Modern Methods of Chemical Analysis.
19. Data Analysis for Chemistry, D.B. Hibbert, Oxford University Press.
20. Analytical Chemistry, S.P.J. Higson, , Oxford University Press

Semester I**Organic Chemistry Practical-I**

Total Hours: 90 hrs. (9 Hours per week)

Marks: 100

Unit-I Organic Synthesis

Student is expected to carry out minimum of 8-10 organic preparation (involving two steps) from the following lists.

1. Preparation of Benzanilide from Benzophenone.
2. Preparation of p- nitroaniline from Acetanilide.
3. Preparation of p-Bromoaniline from Acetanilide.
4. Preparation of m-nitroaniline from Nitrobenzene.
5. Preparation of p-Chlorotoulene from p-Toluidine.
6. Preparation of p- nitrobenzoic acid from p-Nitrotoulene.
7. Cannizzaro's reaction with 4-Cholobenzaldehyde as a substrate.
8. Preparation of 2-Phenylindole (Fischer-Indole synthesis).
9. Claisen - Schmidt: Dibenzal acetone from benzaldehyde.
10. Preparation of Anthranilic acid. (Hoffman's bromamide reaction).
11. Diels - Alder reaction: Anthracene + Maleic anhydride.
12. Methyl -orange from Sulphanilic acid.
13. Hydroquinone to 2,5-Dihydroxyacetophenone.
14. Chlorobenzene to 2,4- Dinitrophenylhydrazine.
15. Nitrobenzene to p- Aminophenol.

UNIT-II Quantitative Analysis

Student is expected to carry out following estimations (minimum 6 estimations.)

1. Estimation of Vitamin `C_ Iodometry.
2. Estimation of Phenol by KbrO₃-KBr.
3. Estimation of Amine by Bromate/ Bromide solution.
4. Estimation of Formaldehyde by Iodometry.
5. Estimation of Glucose by Benedict's solution.
6. Estimation of given carbonyl compound by hydrazone formation.
7. Estimation of Aldehyde by Oxidation method.
8. Determination of percentage of number of hydroxyl group in an organic compound by acetylation method.

Practical-I**Organic Chemistry**

Time : 6-8 Hrs.

(One day Examination)

Marks : 100

- (1) Exercise-1 (Organic Synthesis) - 40 Marks
- (2) Exercise-2 (Qualitative Analysis) - 40 Marks

(3) Record

-10 Marks

(4) Viva-Voce

-10 Marks

Semester I**Practical II****Physical Chemistry****Total Hours: 90 hrs.****9 Hours per week****Time: 6 – 8 hrs.****Marks: 50****Use of Computer Programs 5 terms of practicals :**

Treatment of experimental data, X-Y plots, programs with data preferably from physical chemistry practicals. Students will operate two packages I) MS-Word and II) MS-Excel.

Part –A

- 1) To study the surface tension-concentration relationship for solution and determination of surface excess concentration by using Gibbs's adsorption equation.
- 2) To find out the molecular surface energy and the association factor of ethyl alcohol.
- 4) To compare the cleansing power of two samples of detergent by surface tension method.
- 5) To study the effect of concentration of an electrolyte (KCl, NaCl) on solubility of an organic acid.
- 6) To study the kinetics of iodine clock reaction.
- 7) To study the reaction between acetone & iodine in presence of acids.
- 8) To study the decomposition of hydrogen peroxide catalyzed by iodine ion.

Part- B

- 1) To measure refractometrically average polarisability of some common solvents.
- 2) To find out the order of reaction and velocity constant of inversion of cane sugar by acid polarimetrically.
- 3) Polarimetric determination of the specific rotation of camphor in benzene and carbon tetrachloride.
- 4) Determine the rate constant, order of reaction and energy of activation of saponification of ethyl acetate by sodium hydroxide conductometrically.
- 5) To find out degree of dissociation constant of acetic acid and monochloroacetic acid by conductometrically.
- 6) Determination of strength of strong and weak acid in given mixture conductometrically.

- 7) To determine equivalence conductance of strong electrolytes at several concentrations and verification of Debye-Huckel Onsagar principle conductometrically.
- 8) Determination of solubility and solubility product of sparingly soluble salts ($PbSO_4$, $BaSO_4$) conductometrically.
- 9) To find out composition of ferric ion thiocyanate/Nickel and o-phenanthroline complex by Job's method by colorimetrically
- 10) To study the complex formation between ferric and salicylic acid and find the formula and stability constant of the complex colorimetrically.
- 11) To determine the dissociation constant of phenolphthalein colorimetrically
- 12) To determine the dissociation constant of Cu (II) and Fe (III) solution photometrically by titrating it with EDTA

Practical-II

Physical Chemistry

Time : 6-8 Hrs. (One day Examination)	Marks : 100
(1) Exercise-1 (Instrumental)	- 40 Marks
(2) Exercise-2 (Non-Instrumental)	- 40 Marks
(3) Record	- 10 Marks
(4) Viva-Voce	- 10 Marks

List of Books:-

1. Findley's Practical Physical Chemistry, B.P. Levitt Longman.
2. Practical Physical Chemistry, A.M. James and F.F. Prichard Longman.
3. Experimental Physical Chemistry, R.C. Das and B.Behra, Tata McGraw Hill.
4. Advanced Physical Chemistry Experimentals Gurtu-Gurtu Pragati Prakashan
5. Experimental Physical Chemistry, V.D. Athanale and Parul Mathur New age International
6. Advance Practical Physical Chemistry J.B. Yadao Goel Pubs. House.
7. Experimentals in Physical Chemistry by Dr. D.V.Jahagirdhar.
8. Experiments in Physical Chemistry by D.P.Shoemaker.
9. Systematic experimental Physical Chemistry by Dr. T.K. Chandhekar & S.W. Rajbhoj.

Syllabus for Semester II

Paper V

Co-ordination Chemistry

60hrs (4hrs/week). 12hrs/unit

50 Marks

Unit-I

12L

Ligand field theory (LFT), Failure of ionic model of CFT. Experimental evidences in support of metal ligand orbital overlaps, Adjusted crystal field theory (ACFT), Molecular Orbital Theory: Ligand symmetry orbitals, Sigma and pi-molecular orbitals, Qualitative treatment of MOT of Octahedral complexes with sigma bonding and also with sigma and pi bonding. Qualitative MO diagrams and their interpretation of octahedral, tetrahedral and square planer complexes with example. Explanations of charge transfer spectra. Comparison of theories of bonding-VBT, CFT, LFT and MOT.

Unit-II

12L

Electronic spectra:

Spin-orbit (L-S) coupling scheme, calculation of spectral term symbols for ground state and excited states, selection rules, vibronic coupling, electronic spectra of transition metal complexes, charge transfer spectra, band intensities, band energies, band width & shapes, construction and application of Orgel diagrams, Tanabe-Sugano diagrams, spectra of octahedral, tetrahedral and square planar complexes with examples, Jahn-Teller effect, calculation of crystal field parameters ($10Dq$, B , and C) for octahedral Ni (II) and Co(II) complexes from electronic spectra. Spectrochemical series, Nephelauxetic effect and Nephelauxetic series of ligands. Magnetic moment, electronic spectra and structure of complexes.

Unit-III

Reaction Mechanism of Transition Metal complexes -I

12L

Reactivity of metal complexes, ligand replacement reaction: classification of mechanism and energy profile of reaction. Inert and labile complexes, interpretation of lability and inertness of transition metal complexes on the basis of VBT and CFT. Factors affecting the lability of a complex, transition state or activated complex, substrate, attacking reagents electrophilic and nucleophilic, Nature of central atom. Kinetic application of CFT. Kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism,

direct & indirect evidences in favour of conjugate mechanism, anation reaction, reaction without metal ligand bond cleavage, reactions of coordinated ligands. Molecular rearrangement complexes. Geometrical, linkage and optical isomerization reactions. Ligand stereospecificity.

Unit-IV Reaction Mechanism of Transition Metal complexes -II 12L

Substitution reaction in square planer complexes: the trans effect, cis effect, steric effect, solvent effect, effect of leaving group, effect of charge, effect of nucleophile, effect of temperature. Trans effect theories, uses of trans-effect, mechanism of substitution reactions in Pt(II) complexes. Electron transfer reactions. Types of electron transfer reactions, conditions of electron transfer, and mechanism of one-electron transfer reactions, outer sphere and inner sphere mechanisms, two electron transfer reactions-complimentary and non-complimentary reactions. Tunneling effect, cross-reaction, Marcus-Hush theory, bridged activated mechanism. Synthesis of coordination compounds using electron transfer reactions. Photochemical reaction of Chromium and Ruthenium complexes.

Unit-V Metal pi-Complexes: 12L

Metal carbonyls: Structure and bonding, vibrational spectra of metal carbonyls for bonding and structure elucidation, important reaction of metal carbonyls, Metal nitrosyls: Nitrosylating agents for synthesis of metal nitrosyls, vibrational spectra and X-ray diffraction studies of transition metal nitrosyls for bonding and structure elucidation, important reactions of transition metal nitrosyls, structure and bonding. Dinitrogen and dioxygen complexes; Wilkinson's catalyst and Vaska's compound. Fluxional Organometallic compounds (h^2 -olefin, h^3 -allyl and dieny complexes)

List of Books

1. J.E.Huheey :Inorganic Chemistry
2. F.A.Cotton& G. Wilkinson: Advanced Inorganic Chemistry 3rd, 5th & 6th Editions.
3. A.F. Willims: Theoretical Approach in inorganic chemistry.
4. Mannas Chanda: Atomic Structure and chemical Bonding
5. L. E. Orgel: An Introduction To transition metal chemistry, Ligand field theory, 2nd Edition.
6. J. J. Logowski: Modern Inorganic Chemistry

7. B.Durrant and P.J.Durrant: Advanced Inorganic Chemistry
8. J.C. Bailar: Chemistry of co-ordination compounds.
9. W. L. Jolly: Modern Inorganic Chemistry Jones: Elementry Co-ordination chemistry.
10. B. N. Figgis: Introduction to Ligand field.
11. M.C.Day and J.Selbin: Therotical Inorganic Chemistry.
12. J. Lewin and Wilkins: Modern Co-ordination chemistry.
13. Purcell and Kotz: Inorganic Chemistry.
14. D. Banerjea: Co-ordination chemistry, Tata Mc. Graw. Pub.
15. A.F. Wells: Structural inorganic chemistry, 5th Edition, Oxford.
16. S. G. Davies: Organotransition metal chemistry applications to organic synthesis.
17. R. C. Mehrotra: Organometallic chemistry Tata McGraw Hill. Pub.
18. G. S. Manku: Thereotical priciples of inorganic chemistry
19. A. B. P. Lever: Inorganic electronic spectroscopy.
20. R.C.Maurya:Synthesis and charecterisation of novel nitrosyls compounds, Pioneer Pub. Jabalpur 2000.
21. R.H.Crabtree:The Organometallic chemistry of Transition metals, John Wiley.
22. D.N.Styanaryan:Electronic Absorption Spectroscopy and related techniques, University Press.
23. R. S. Drago: Physical methods in inorganic chemistry
24. F.Basolo &G.Pearson: Inorganic Reaction Mechanism
25. Organometallics II & I complexes with transition metal- carbon bonds: Manfred Bochmann- Oxford Press.
26. Advanced Inorganic Chemistry Vol I & II - Satyaprakash, Tuli, Bassu and Madan- S Chand.
27. M.Tsusui,M.Nlevy,M.Ichikwa and K.Mori:Introduction to metal pi-complexe chemistry,Plenum press,NY
28. A.E.Martel;Coordination Chemistry-VolI&II,VNR.

PAPER VI

ORGANIC CHEMISTRY-II

60hrs (4hrs/week). 12hrs/unit

50 Marks

Unit-I : AROMATIC ELECTROPHILLIC SUBSTITUTION 12L
The arenium ion mechanism,orientation and reactivity,energy profile diagrams.The o/p ratio, ipso attack,orientation in benzene ring with more than one substituents, orientation in other ring system. Diazonium coupling, Gatterman-koch reaction, Pechman reaction,Houben -hoesch reaction.

Unit-II: A) ADDITION TO CARBON – CARBON MULTIPLE BOND 12L

Mechanistic and stereochemical aspects of addition reaction involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, Orientation and stereochemistry, Addition to cyclopropanes, Hydrogenation of double bond and triple bonds. Hydrogenation of aromatic rings, hydroboration, Michael reaction.

B) Addition to Carbon-Heteroatom multiple bonds.

Mannich reaction, Lithium-Aluminium Hydride, reduction of carbonyl compounds, nitriles, Reformatsky reaction, Aldol Condensation, Knoevenagel reaction, Perkin Witting, Stobbe reaction, Hydrolysis of esters and amide, ammonolysis of esters.

Unit-III : FREERADICAL REACTION 12L

Type of free radical reactions, free radical substitution mechanism at an aromatic substrate, aliphatic substrate, reactivity at a bridgehead position. Neighbouring group assistance, reactivity for aliphatic and aromatic substrates, reactivity in attacking radicals, effect of solvent on reactivity.

Halogenation at an alkyl carbon, allylic carbon, hydroxylation at an aromatic carbon by means of Fenton's reagent. Oxidation of aldehydes to carboxylic acids. chlorosulphuration (Reed Reaction) Coupling of alkynes and arylation of aromatic compounds by Diazonium salts. Sand Meyer reaction. Free radical rearrangement, Hunsdiecker reaction.

Unit-IV : MECHANISM OF MOLECULAR REARRANGEMENT 12L

Classification and General mechanistic treatment of electrophilic, nucleophilic and free radical molecule rearrangement. Mechanism of the following rearrangement: Wagner-Meerwin, Pinacol-Pinacolone, Tiffeneau-Demjanov ring expansion, Favorski, Wolff, Fritsch-Butenber-Wieland, Curtius Lossen, Beckman, Hoffman, Schmidt rearrangement.

Unit-V : GREEN CHEMISTRY 12L

Designing a green synthesis: Choice of starting material, choice of solvents. Basic principle of green chemistry: Prevention of waste by products, Maximum incorporation of the reactants (starting material and reagents) into the final products. Rearrangements reaction, Addition reaction, substitution, elimination reaction. Prevention or

minimization of hazardous products. Designing of safer chemical. Synthesis involving basic principles of green chemistry, some examples. Synthesis of styrene, Synthesis of urethane, Free radical bromination, Synthesis of paracetamol, Synthesis of Ibuprofen.

BOOKS SUGGESTED-

- Advanced organic chemistry – Reaction mechanism and structure. Jerry March, John Wiley.
- Advanced organic chemistry- F.A. Carey and R.J. Sunberg, Plenum.
- A Guidebook to mechanism in organic chemistry-Peterskies, Longman.
- Structure and mechanism in organic chemistry-C.K. Gold, Cornell University Press.
- Organic chemistry, R.T. Morrison Boyd. Prentice Hall
- Modern organic chemistry-H.O. House, Benjamin.
- Principles of organic chemistry-R.O.C. Norman and J.M. Coxon, Blackie Academic and Professional.
- Reaction mechanism in organic chemistry-S.M. Mukharji and S.P. Singh, Macmillan.
- Stereochemistry of organic compounds- D. Nasipuri, New age international.
- Stereochemistry of organic compounds- P.s.kalsi, New age international.
- Frontier orbitals and organic chemical reactions-I. Fleming.
- Orbital Symmetry – R.E. Lehr & A.P. Marchand.
- Reactive intermediate in organic chemistry-N. S. Isaacs.
- Stereochemistry of carbon compounds- E.L. Eliel.
- Physical organic chemistry-J. Hine.
- Name reaction in organic chemistry – Surrey.
- Advanced organic chemistry – L.F. Fieser and M. Fieser.
- Vol. I & II organic chemistry - I. L. Finar.
- Modern organic chemistry- J.D. Roberts and M. C. Caserio.
- The search for organic reaction pathways (Longman), Peter Skyes.
- Organic chemistry 5th Edition (McGraw Hill), Pine.
- Organic chemistry (Willard Grant Press Botcon), John McMurry.
- A Textbook of organic chemistry- R.K. Bansal.
- New trends in green chemistry – V.K. Ahluwalia & M. Kidwai, Anamaya publishers New Delhi.
- Heterocyclic Chemistry, John Joule, Oxford University Press.

Paper- VII**Physical Chemistry-II**

60 Hours (4-Hours/week)

50 Marks

12 hours/Unit

Unit-I Chemical Dynamics:

- A) Kinetics of Complex reactions: Chain reaction ($H_2 + Br_2 \rightleftharpoons 2 HBr$ thermal and photo chemical reaction), Homogeneous catalysis (acid-base and enzymes), oscillating reactions (Belousov-Zhabotinsky reaction, Lotka-Volterra mechanism, the brusselator and the oregonator). 6L
- B) Fast reactions: General features of fast reactions, Stopped flow method, relaxation method, nuclear magnetic resonance method, flash photolysis. Numericals. 6L

Unit-II Quantum Chemistry:

- A) Molecular orbital theory: Basic ideas, criteria for forming M.O. from A.O., Construction of M.O. 's by LCAO for H_2^+ ion. Calculation of energy levels from wave functions, physical picture of bonding & anti-bonding wave functions, concept of orbitals and their characteristics. 6L
- B) Hybrid orbitals- sp , sp^2 , sp^3 . Calculations of coefficient of A.O. 's used in hybrid orbitals. Huckel theory of conjugated systems, bond order & charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical, cyclo- butadiene. Numericals. 6L

Unit-III Macromolecules:

- A) Definition of macromolecule (Polymer), types of polymers, Random coils, configuration and conformation of macromolecules, electrically conducting molecular wires, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization. The stability of biological polymers. 6L
- B) Number average & mass average molecular mass, molecular mass determination by Osmometry, Viscometry, Ultracentrifugation, Electrophoresis, Size-exclusion chromatography and Light scattering methods. Numericals. 6L

Unit-IV Electrochemistry:

- A) Electrochemistry of solutions: Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Theory of electron transfer processes, electron tunneling. The electrode-solution interface, structure of electrified interface, electric potential at the interface. 6L

- B) The rate of charge transfer, the Butler-Volmer equation, the low overpotential limit, the high overpotential limit, Tafel plot. Voltammetry, concentration polarization, experimental techniques. Corrosion, types of corrosion, corrosion inhibitors, corrosion monitoring and prevention methods. Numericals. 6L

Unit-V Statistical Thermodynamics

- A) Concept of distribution, Thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and micro-canonical ensembles, corresponding distribution laws (using Lagrange 's method of undetermined multipliers). 6L
- B) Partition function- Translational, rotational, vibrational and electronic partition functions, calculations of thermodynamic properties in terms of partition functions. Applications of partition functions. Numericals. 6L

List of Books:

- 1) Physical chemistry by P.W. Atkins & dePaula 7th Edition
- 2) Molecular reaction Dynamics and chemical reactivity, R.D. Levine and R.B. Benstin, Oxford University press. 1987.
- 3) Physical Chemistry by Alberty and Silby, Jolly Wiley
- 4) Adsorption and Catalysis by solids, by D.K. Chakraborti, Wiley Eastern, 1990
- 5) The Theory of Adsorption and catalysis, by A. Clark, Academic press, 1970
- 6) Micells Theoretical and applied aspects, by V. Moroy. Plenum
- 7) Modern Electrochemistry by A.K.N. Raddy
- 8) Theoretical electrochemistry by D.I. Antropov, Mir Publisher 1972
- 9) Electrochemistry by J. Dvorak, J. Koryta, V. Bohackova.
- 10) Introduction to radiation chemistry by J.W.T. Spinks and R.J. Woods

Paper VIII**Optical Methods and Environmental Chemistry**

60hrs(4hrs/week), 12hrs/Unit

50Marks

Unit-I Optical Method

12L

Spectrophotometry and Colorimetry: Interaction of radiations with matters, Fundamental laws of Spectrophotometry. Beer - Lambert 's law and its limitation. Varification of Beer 's law and deviation from Beer 's law. Ringbom 's plot. Photometric titrations. pK value of indicator. Outline of construction and working of the UV-Visible spectrophotometers. (Single and double beam).

Applications of quantitative and qualitative analysis, problems.

Theory, instrumentation and applications of fluorimetry, Nephelometry, turbidimetry, Polarimetry & Refractometry.

Unit-II Flame Emission and atomic spectrometry: 12L

Flame photometry: Elementary theory of flame photometry. Instrumentation and experimental techniques. Interferences, analytical techniques and applications. Atomic absorption spectrometry (AAS): introduction, principles, Advantages of AAS over FES, Instrumentation, Flame atomization. Hollow cathod lamps, interferences and applications. Comparison of atomic absorption with atomic emission methods.

Unit-III WATER POLLUTION 12L

Origin of wastewater, types, water pollutants and their effects. Sources of water pollution, domestic, industrial, agricultural soil and radioactive wastes as sources of pollution. Objective of analysis, parameter for analysis colour, turbidity, total solid, conductivity, acidity, alkalinity, hardness, chloride, sulphate, fluoride, silica, phosphates and different forms of nitrogen. Heavy metal pollution, public health significance of Cadmium, Chromium, Copper, Zinc Lead, Manganese, Mercury and Arsenic. General survey of instrumental techniques for the analysis of heavy metals in aqueous systems. Oxygen content of water and aquatic life. Measurements of DO, BOD, COD and their significance as pollution indicators. Pesticides as water pollutants and analysis. A brief idea of coagulation and flocculation.

Unit-IV AIR POLLUTION 12L

Sources and sinks of gases pollutants, classification of air pollutants, effect of air pollutants on living and non-living things. Sources of air pollution, air quality standards and sampling. Analysis of air pollutants (CO, CO₂, NO_x, SO_x, H₂S, NH₃ and Hydrocarbons and particulates). Green house effect, acid rain, ozone depletion and their consequences on environment. Effects of air pollution, photochemical smog and monitoring of air pollution.

Unit-V Soil Pollution and Pesticide Analysis 12L

Chemistry of soil, soil irrigation by effluents. Agricultural pollution, role of micronutrients in soil, trace element analysis in soil

Pesticides and pollution, Sources of pesticide residue in the environment, classification of pesticides, pesticide degradation by natural forces, effect of pesticide residue on life. Analytical techniques for pesticide residue analysis. DDT problem.

Radiation pollution-Classification and effects of radiation. Effects of ionizing radiation on Man. Effect of nonionizing radiation on life, Radioactivity and nuclear fall out, protection and control from radiation.

List of Books

1. Analytical chemistry- Problems and Solution- S. M. Khopkar, New Age International Publication.
2. Day & Underwood: Quantitative Analysis.
3. Findley: Practical Physical Chemistry:
4. Vogel : A Text book of Quantitative inorganic Chemistry, ELBS, London.
5. Strouts Galfillal: Analytical Y. Lyalikov: Physocochemical Analysis
6. S. M.Khopkar:Basic concept in Analytical Chemistry
7. Meites and Thomas: Advance Analytical Chemistry. (Mc Graw Hill)
8. H.H.Willard ,L.L.Merritt and J.A.Dean: Instrumental Methods of Analysis (Van Nostrand).
9. B. L. Krayner, H. H. Willard. L. Merrit, J. A. Dean & F. A. Settle: Instrumental Methods of Analysis (CBS Publishers, Delhi, 1986)
10. R. D. Brown, Instrumental Methods of Chemical Analysis ,McGraw Hill
11. L. R. Shyder & C. H. Harvath: An Introduction to Separation Science (Wiley Interscience).
12. Environmental Chemistry, S. E. Manahan, Lewis Publishers.
13. Environmental Chemistry, Sharma & Kaur, Krishna publishers.
14. Environmental Chemistry, A. K. De, Wiley Eastern.
15. Environmental Pollution Analysis, S. M. Khopkar, Wiley Eastern.
16. Environmental Toxicology, Ed. J. Rose, Gordon and Breach Science Publication.
17. Elemental Analysis of Airborne Particles, Ed. S. Landberger and M. Creachman, Gordon and breach Science Publication.
18. Atmospheric pollution, W. Buch, McGraw Hill, New York.
19. Fundamentals of Air Pollution, S. J. Williason, Addison ~ Wesley Publishers.
20. Analytical Aspect of Environmental Chemistry, D. F. S. Natush and P. K. Hopke. John Wiley & sons. New York.

21. Analytical chemistry- Problems and Solution- S. M. Khopkar, New Age.
22. Environmental Chemistry, J.W.Vanloon, Oxford University Press.

Semester II

Practical III

Physical Chemistry

Practical Work load (9Hours/week) Duration: 6Hours Marks : 100

Use of Computer Programs 5 terms of practicals.

Treatment of experimental data, X-Y plots, programs with data preferably from physical chemistry practical. Students will operate two packages I) MS-Word and II) MS-Excel.

Part A

- 1) To find out molecular weight of given liquid by steam distillation method.
- 2) To find out the molecular weight of sulphur, alpha-naphthol and biphenyl by freezing point method using naphthalene as a solvent.
- 3) To find out degree of association of benzoic acid in benzene by cryoscopy method.
- 4) To study the effect of temperature on adsorption.
- 5) To determine the viscosity of different mixture benzene, nitrobenzene and also test the validity of Kendall's method.
- 6) Identify and separate given mixture of amino acid by paper chromatography.
- 7) Separation of metal cations (Co, Ni, Zn, Mn) and the Rf value by paper chromatography.
- 8) Separate and identify sugar present in honey by paper chromatography.
- 10) To check up by TLC technique whether the following ink consist of single or multiple mixtures of dyes.

Part-B:

- 1) Determination of pK value of acid-base indicator (methyl red, methylene blue & bromo cresol) by spectrophotometrically.
- 2) Determination of standard electrode potential of Zinc and Copper.
- 3) To find the strength of HCl and Acetic acid in given mixture potentiometrically.
- 4) To find the strength of mixture of halides by titrating it against AgNO_3 solution potentiometrically.
- 5) To determine the hydrolysis constant of aniline chloride by emf method.
- 6) To determine the solubility and solubility product of a sparingly soluble salt potentiometrically.

- 7) To determine the heat of reaction, equilibrium constant and other thermodynamic functions for the reaction $\text{Zn} + \text{Cu}^{2+} = \text{Zn}^{2+} + \text{Cu}$ potentiometrically.
- 8) To titrate ferrous ammonium sulphate solution with potassium dichromate solution potentiometrically using bimetallic electrode pair.
- 9) To determine the dipole moment of given liquid.
- 10) To obtain the phase diagram of ethanol-water-benzene system at room temperature.
- 11) To obtain solubility curve for liquid say water-acetic acid-chloroform system.
- 12) Determination of strength of commercial phosphoric acid/Vinegar by conductometric analysis.

Physical Chemistry Practical

Books Suggested :

- 1) Experimental physical chemistry, R.C. Das and B. Behera, Tata McGraw-Hill
- 2) Advanced physical chemistry J.B. yadao, Goel Pub House
- 3) Experiments in physical Chemistry, D.P. Shormaker, C.W. Garland and J.W. Nibler, Tata McGraw Hill Comp.
- 4) Post graduate physical chemistry, Patel, Turakhia, Kelkar, Himalaya Pub House
- 5) Experiments, in physical chemistry, D.v. Jahagirdar, Himalaya Pub House
- 6) Practical Physical Chemistry, A. Findlay Revised by J.A. Kitehner, Longmans , Green
- 7) Experiments in Physical Chemistry, F. Daniels and J. Williams, Mc Graw Hill.
- 8) Systematic Experimental Physical Chemistry, T.K. Chondekar & S.W. Rajbhoj, Anjali Pub. Aurangabad.
- 9) Advanced Physical Chemistry Experiments, J.N. Gurtu & A. Gurtu, Pragati Prakashan
- 10) Practical Physical Chemistry, A.M. James & P.E. Prichard, Longam Group Ltd.
- 11) Experiments in physical Chemistry, J.M.Wilson, K.J.Newcombe, A.R. Denko, and R.M.W.Richett, Pergamon Press,
- 12) Senior Practical Physical Chemistry, B.D.Khosle and V.S. Garg S.Chand & Comp.

Practical-III
Physical Chemistry

Time : 6-8 Hrs. (One day Examination)	Marks : 100
(1) Exercise-1 (Based on Part-A)	- 40 Marks
(2) Exercise-2 (Based on Part-B)	- 40 Marks
(3) Record	- 10 Marks
(4) Viva-Voce	- 10 Marks

Semester II
Practical IV
Inorganic Chemistry Practicals

Practical Work load 9 Hrs. /Week Marks 50

I] Preparation of inorganic compounds and their characterization by elemental analysis, MW determination, decomposition temperatures and molar conductance studies. (Minimum 6)

1. [VO (acac)₂]
2. *Cis* K [Cr (C₂O₄)₂(H₂O)₂]
3. Na [Cr (NH₃)₂(SCN)₄]
4. Mn (acac)₃
5. K₃ [Fe (C₂O₄)₃]
6. Hg [Co (SCN)₄]
7. [Co (Py)₂Cl₂]
8. TiO (C₉H₈NO)₂(H₂O)₂
9. *Cis* [Co (trine)(NO₂)₂] Cl H₂O
10. [Cu₂ (CH₃COO)₄(H₂O)₂]
11. K₃ [Al (C₂O₄)₃](H₂O)₃
12. Ni (dmg)₂

II] A) Quantitative Analysis of mixture of two cations:

Quantitative analysis of binary mixture of cations involving their chemical separation and separate analysis of one cation by gravimetry and another by volumetric or colorimetric. Certain model examples are given below:

- i) Copper (II) and Nickel (II)
- ii) Copper (II) and Zinc (II)
- iii) Nickel (II) ' Zinc (II)
- iv) Copper (II) ' Iron (III)

B) Analysis of Limestone, Dolomite and Bauxite.

III] Qualitative analysis of radicals

Qualitative analysis of inorganic mixture for a total of five radicals including interfering radicals (not more than one such radical in a mixture), rare earth (not more than two rare earths in a mixture) and combination of cations (minimum 8 mixtures).

Cations: Mercury (I, II), Pb, Ag, Bi (III), Cu (II), Cd (II), As (IV, V), Sb (IV, V), Sn (II, IV), Fe (III), Al (III), Cr (III), Ni (II), Co (II), Mn (II), Zn (II), Barium, Strontium, Calcium and Magnesium.

Interfering radicals: Phosphate, Oxalate, Fluoride and Borate.

Rare Earth: Tl, Mo, W, Se, Ti, Zr, Th, V, U, Ce.

The Practical examination will be based on the Inorganic Chemistry.

Time: 6-8 hours (one day examination)	Marks: 100
I) Exercise -1 (Synthesis/Radicals)	- 40 Marks
II) Exercise-2 (Estimation)	- 40 Marks
III) Record	- 10 Marks
IV) Viva- Voce	- 10 Marks
<hr/>	
Total	- 100 Marks

List of Books-

1. Synthesis and Characterization of Inorganic Compounds, W. L. Jolly, Prentice Hall.
2. Inorganic Experiments, J. Derck Woollins, VCH.
3. Practical Inorganic Chemistry, G. Mairand, B. W. Rockett, Van Nostrand.
4. A Text Book of Quantitative Inorganic Analysis, A. I. Vogel
5. EDTA Titrations. F. Laschka
6. Instrumental Methods of Analysis, Willard, Merit and Dean (CBS, Delhi).
7. Inorganic Synthesis, Jolly
8. Instrumental Methods of Chemical Analysis, Yelri Lalikov
9. Fundamental of Analytical Chemistry, Skoog D.A. & West D.M Holt Rinehart & Winston Inc.
10. Experimental Inorganic Chemistry, W.G.Palmer, Cambridge.

Syllabus for Semester III

Paper IX

Spectroscopy I

60 Hours (Four hours/week) 12 Hrs. / Unit. Max.Marks.50.

Unit-I

- A) Unifying principle: Electromagnetic radiation, interaction of electromagnetic radiation with matter- absorbance emission, transmission, reflection, refraction, dispersion, polarization and scattering. Uncertainty relation and natural line width and line broadening, transition probabilities, results of the dependent perturbation theory, transition moment, selection rule, intensity of spectral lines. Born-oppenheimer approximate, rotational, vibrational and electronic energy level.

B) Microwave spectroscopy: Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non rigid rotor, Stark effect, nuclear and electron spin interaction and effect of external field, applications. 6L

Unit-II A) Ultraviolet and visible spectroscopy : Various electronic transition (185-800nm), Beer-Lambert law, effect of solvent on electronic transition, UV band for carbonyl compounds, unsaturated carbonyl compound, diene, conjugated polyenes. Fisher-Woodward rules for conjugated dienes and carbonyl compounds, UV spectra of aromatic and heterocyclic compounds. Steric effects in biphenyls. 4L

B) Infrared spectroscopy : Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero point energy, force constant and bond strength, anharmonicity, Morse potential energy diagram, vibration of polyatomic molecules, selection rules, normal modes of vibration, group frequencies, overtone band, factors affecting the band position and intensities, far IR region, metal ligand vibrations, Instrumentation and sample handling characteristics. Vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, amines. Detail study of vibrational frequencies of carbonyl compounds, (ketones, aldehydes, esters, amides, acids, acid chlorides and anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent on vibrational frequencies, overtones, combination bands and Fermi resonance. FT-IR, IR of gaseous solids and polyatomic materials. Modes of bonding of ambidentate ligands etc. 8L

Unit-III : Mass spectrometry: Introduction, theory, measurement techniques (EI, CI, FD, FAB) recording of mass spectrum. types of ions, isotopic contribution, fragmentation process, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds of various types, common functional groups, molecular ion, metastable ions, McLafferty rearrangement. Retro-Diels Alder fragmentation, nitrogen rule. High resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structural determination. 12L

Unit-IV Nuclear Magnetic Resonance Spectroscopy: General introduction and definition of nuclear spin, nuclear resonance shielding of magnetic nuclei, chemical shift, factors influencing chemical shift, deshielding, chemical shift values and correlation for protons bonded to carbons (aliphatic, olefinic, aldehydic, aromatic) and other nuclei. (alcohols, phenols, enols, acids, amides, and mercaptans), chemical exchange, effect of deuteration, spin spin coupling (n+1) rule, complex spin spin interaction between two, three, four, and five nuclei (first order spectra) factors affecting coupling constant J classification of spin system like AX, AX₂, ABX, AMX, ABC, A₂B₂ etc. Spin decoupling, basic idea about instrument, mechanics of measurement, Stereochemistry, hindered rotation. 12L

Unit-V A) Karplus curve-variation of J with dihedral angle. Simplification of complex spectra, nuclear magnetic double resonance, contact shift reagent, solvent effects, Fourier transform technique, nuclear Overhauser effect (NOE). Resonance of other nuclei like P, F. Some application including biochemical system, an overview of NMR of metal nuclei with emphasis on ¹⁹⁵Pt and ¹¹⁹Sn NMR. 6L

B) Carbon : ¹³C NMR spectroscopy : General consideration, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl), coupling constants, general idea about two dimensional NMR spectroscopy - COSY, NOESY- DEPT techniques, solid state NMR. 6L

Books suggested

- 1) Spectroscopic identification of organic compound-RM Silverstein, GC Bassler and TC Morrill, John Wiley
- 2) Introduction to NMR spectroscopy-RJ Abraham, J Fisher and Ploftus Wiely
- 3) Application of spectroscopy to organic compound-JR Dyer, Printice Hall
- 4) Organic spectroscopy-William Kemp, ELB with McMillan
- 5) Spectroscopy of organic molecule-PS Kalsi, Wiley, Esterna, New Delhi
- 6) Organic spectroscopy-RT Morrison, and RN Boyd
- 7) Practical NMR spectroscopy-ML Martin, JJ Delpenck, and DJ Martyin
- 8) Spectroscopic methods in organic chemistry-DH Willson, I Fleming
- 9) Fundamentals of molecular spectroscopy-CN Banwell
- 10) Spectroscopy in organic chemistry-CNR Rao and JR Ferraro
- 11) Photoelectron spectroscopy-Baber and Betteridge

- 12) Electron spin resonance spectroscopy-J Wertz and JR Bolten
- 13) NMR Basic principle and application-H Guntur
- 14) Interpretation of NMR spectra-Roy H Bible
- 15) Interpretation of IR spectra-NB Coulthop
- 16) Electron spin resonance theory and applications-W gordy
- 17) - Mass spectrometry organic chemical applications ,JH Banyon

Semester III

Paper X

Analytical Chemistry-I

Thermal & Electroanalytical Methods

Total Lectures: 60Hours, 4Hours per week, 12Hours/unit Total Marks: 50

- Unit-I : Thermal methods of Analysis: 12L**
 Introduction of different thermal methods, Thermogravimetry TG and DTG, Static thermogravimetry, quasistatic Thermogravimetry and dynamic thermogravimetry, Instrumentation, Factors affecting thermograms, Applications of thermogravimetry, Differential thermal analysis (DTA), DTA curves, Factors affecting DTA curves, instrumentation, applications of DTA. Simple numerical problems.
 Differential Scanning Colorimetry(DSC): Introduction, Instrumentation, DSC-curves, factors affecting DSC curves and applications. Thermometric Titrations; Introduction, apparatus, theory and applications.
- Unit-II : Electroanalytical Methods 12L**
 Conductometry: Principal of analysis, measurement of conductance, analytical applications of conductometry, conductometric titrations. High frequency titrations. Types of cells used, instrumentation and applications. Problems. Electrogravimery: Theory of electrolysis, electrode reactions, over voltage, characteristics of deposits and completion of deposition, separation of metals.
 Coulometry: Principal, coulometry at constant potential, coulometry at constant current, coulometric method of analysis, instrumentation, coulometric titrations. Advantages of coulometric titrations. Applications of coulometric titrations

- Unit-III : Electroanalytical Techniques 12L**
 Potentiometry & pH Metry: Potentiometry, Indicator electrodes: hydrogen electrode, quinhydrone electrode, antimony electrode and glass electrode, Reference electrodes, Bimetallic electrode, Theory of potentiometric titrations, Problems, Nernst equation, standard electrode potential, Determination of cell potential, n, Kf and Ksp. pH titrations. Ion Selective Electrodes: Terminology, types and construction of ion selective electrodes. Electrical properties of membrane, Glass membrane electrodes, solid-state sensors, gas sensing and enzyme electrodes. Glass electrode with special reference to H⁺, Na⁺, K⁺ ions, interference, ion activity evaluation methods, operations of solid membrane electrode, operation of liquid membrane electrode, coated type ion electrode. Applications of ion selective electrode in determination of some toxic metals and some anions (F⁻, Cl⁻, Br⁻, I⁻ and NO₃⁻). Advantages of ISEs.
- Unit-IV : Electroanalytical Techniques: 12L**
 Polarography : Basics of polarography, reference and working electrodes, operational amplifiers concepts, components of the limiting current, adsorption, kinetic, catalytic and diffusion currents and to distinguish them. Dropping mercury electrode, Ilkovic equation-diffusion current constant and capillary characteristics determination. Half wave potential, Polarographic maxima. Role of temperature on diffusion current. Reversible, quasi reversible and irreversible electrode reactions and evaluation of parameters using various reactions. Organic polarographic analysis. Limitations of polarography, advancements-pulse and differential pulse polarography.
- Unit-V : Electroanalytical Techniques 12L**
 Voltammetry & amperometric: Linear and Cyclic sweep voltammetry. Randle's Sevcik equation. Adsorption complications in voltammetry. Tests for electrode reactions coupled with chemical reactions, EC and ECE reactions. Application of voltammetry in the study of unstable reaction intermediates. Enzyme catalyzed reactions and applications of voltammetry in monitoring such reactions.
 Stripping Technique: Anodic and cathodic stripping voltammetry and their applications in the trace determination of metal ions and biologically important compounds. Principal, methodology and applications amperometric titrations. Chronopotentiometry.

List of Books-

1. Day and Underwood: Quantitative Analysis
2. A. I. Vogel: A text book of quantitative analysis.
3. Flaschka: EDTA Titration
4. Meites and Thomas: Advanced Analytical Chemistry.
5. G. W. Ewing: Instrumental Methods of Chemical Analysis.
6. R. S. Draga: Physical Methods in Inorganic Chemistry
7. G. D. Christian: Analytical Chemistry
8. S. M. Khopkar: Basic Concept of Analytical Chemistry.
9. Kolltath and Ligane: Polarography
10. Braun: Instrumental Methods of Chemical Analysis
11. Willard, Merritt and Dean: Instrumental Methods of Analysis
12. Strouts, Crifillan and Wison: Analytical Chemistry.
13. J. W. T. Spinks and R. J. Woods: Introduction to Radiation Chemistry.
14. S. A. Skoog and D. W. West: Fundamental Of Analytical Chemistry
15. R. V. Dilts: Analytical Chemistry

Semester III**Paper XI****Special Paper-I****Inorganic Chemistry (Bio-inorganic Chemistry)**

Total Lectures: 60Hrs, 4 Hrs per week, 12 Hrs/unit Total Marks-50

Unit-I**12L**

- A) Essential and trace metals in biological systems:** Biological functions of inorganic elements, biological ligands for metal ions. Coordination by proteins, Tetrapyrrole ligands and other macrocycle. Influence of excess and deficiency of V, Cr, Mn, Fe, Co, Cu, & Zn. Genetic defects in the absorption of trace elements. Regulation and storage of trace elements. Role of minerals. Toxic effects of metals.
- B) Metal storage, transport and biomineralization with respect to Ferritin, Transferrin and Siderophores, Na⁺/K⁺ pump. Role of Ca in transport and regulation in living cells**

Unit-II**12L**

Medicinal use of metal complexes as antibacterial, anticancer, use of cis-platin as antitumor drug, antibiotics & related compounds. Metal used for diagnosis and chemotherapy with particular reference to anti cancer drugs. Chelate therapy, chemotherapy with compounds of some non essential elements; platinum complexes in cancer therapy. Antiviral activity of metal complexes. Gold containing drugs used in the therapy of Rheumatic-Arthritis, Gold complexes as anticancer drug. Lithium in psycho pharmacological drugs. Antimicrobial agents.

Unit-III**12L**

- A) Bio-energetics and ATP cycle:** DNA polymerization, metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem II in cleavage of water, Model systems.
- B) Electron transfer in Biology:** Structure and functions of metalloproteins in electron transfer proteins, cytochromes & Fe-S proteins, Non-heme iron proteins; Rubredoxins, Synthetic models. Biological Nitrogen fixation (in vitro and in vivo)

Unit IV**12L**

Transport & Storage of Dioxygen: Heme proteins & oxygen uptake, structure and functions of haemoglobin, myoglobin, hemocyanins & hemerythrin. Perutz mechanism showing structural changes in porphyrin ring system. Oxygenation and deoxygenation. Model compounds. Cyanide poisoning and treatment. Vanadium storage and transport.

Unit-V**12L**

Metallo enzymes: Apoenzymes, Haloenzyme & Coenzyme. The principle involved and role of various metals in-

- i) Zn-enzyme:- Carboxyl peptidase & Carbonic anhydrase.
- ii) Fe-enzyme:-Catalase Peroxidase & Cytochrome P-450
- iii) Cu-enzyme:-Super Oxide dismutase
- iv) Molybdenum:-Oxatransferase enzymes, Xanthine oxidase,Co-enzyme

Vit. B₁₂, Structure of vitamin B₁₂ Co-C bond cleavage, Mutase activity of co- Enzyme B-12, Alkylation reactions of Methyl Cobalamin. Synthetic model of enzyme action, stability and ageing of enzyme.

Books:

1. Akhmetov, N.: General and Inorganic Chemistry.
2. Aylett, B. and Smith, B.: Problems in Inorganic Chemistry, (English University Press)
3. Bertini, et al: Bioinorganic Chemistry (Viva)
4. Charlot, G and Bezier, D.: Quantitative Inorganic Analysis (John Wiley).
5. Douglas, B. E. McDaniel, D. H. et al: Concept and Models of Inorganic Chemistry (4th ed.) J. Wiley
6. Dutt P. K.: General and Inorganic Chemistry. (Sarat Books House)
7. Fenton, David E.: Biocoordination chemistry, Oxford
8. Jolly, W. L. : Inorganic Chemistry (4th edn.) Addison-Wesley.
9. Katakis, D. and Gordon, G.: Mechanism of Inorganic Reactions. (J. Wiley).

10. Leigh, G. J.: IUPAC Nomenclature of Inorganic Chemistry (1990;Jain-Interscience)
11. Massey, A. G.: Main Group Chemistry.
12. Porterfield, W. W.: Inorganic Chemistry-A unified approach (Holt Saunders)
13. Banerjee,D.:Coordination Chemistry,TMH
14. Lee J.D.:Concise Inorganic Chemistry,ELBS
15. Lippard S.J and Berg,J.M.: Principal of Bioinorganic Chemistry,University Sci.Book.,Mill Valley
16. Hay R.W.:Bioinorganic Chemistry, Ellis Horwood, Chichester and NY
17. Das A.K.: Text Book of Medicinal Aspects of Bioinorganic Chemistry,CBS
18. Sigel H.:Metal ions in Biological systems,Marcell Dekker,NY(Vol. I-31)
19. Reddy K.H.,Bioinorganic Chemistry,New Age Int.Pub.
20. Kaim W.and Schwederski B.:Bioinorganic Chemistry:Inorganic elements in the Chemistry of Life,JohnWiley & Sons.
21. Medicinal Inorganic Chemistry, Edited by Jonathan L.Sessler, Oxford University Press.

Semester III

Paper XII

Special Paper-II

Inorganic Chemistry (Solid State Chemistry)

Total Lectures:60 Hours,4Hours/week, 12Hours/unit Total Marks-50

Unit-I : **12L**

Crystal Structure of Some Simple Compounds:

- i) Ionic Crystals & Their structures, radius ratio rule, effect of polarization on crystals.
- ii) Covalent structure type-Diamond, Sphalerite & Wurtzite.
- iii) Geometry of simple crystal AB type: NaCl, CsCl & NiAs & Wurtzite, reasons for preference for a particular structure in above AB type of compounds.
- iv) AB_2 type: Fluorite, antiferrofluorites, Rutile structures. Li_2O , Na_2O , etc. $CdCl_2$, CdI_2 structures, difference between them. AB_2 type: ReO_3 , BiI_3 , $CrCl_3$, A_2B_3 type: Fe_2O_3 , Corundum Al_2O_3 , Mn_2O_3 .
- v) Ternary Compounds ABO_3 type: Perovskite, Barium titanate, lead titanate, $CaTiO_3$ Tolerance factor, charge neutrality & deviation structures. $FeTiO_3$.

- vi) AB_2O_4 type- Spinel, Normal & inverse, 2-3 and 4-2 spinel, packing of oxygen in tetrahedral & octahedral sites, sites occupancy number of site surrounding each oxygen, application of charge neutrality principles, site preferences in spinel, distorted spinel. Hausmannite (Jahn-Teller distortions), Factors causing distortion in spinel.

Unit-II: 12L

Lattice Defects: Perfect & Imperfect crystals, point defects, Interstitial, Schottky defect, Frenkel defect, line defect & other entities, thermodynamics of Schottky & Frankel defects. Dissociation, theory of dislocation, plane defects- Lineage boundary, grain boundary, stacking fault, 3D defects, Defects & their concentrations, ionic conductivity in solids, Non stoichiometric compounds. Electronic properties of Non-stoichiometric oxides, solid electrolytes, pyknetric & electrical conductivity methods of study of defects, radiation effects on solid nature and properties, photography, colour centers, order-disorder changes, defects, imperfection equilibrium, atom movements, and defect interactions.

Unit-III : 12L

Electronic Properties of materials: Metals, Insulators & semiconductors, electronic structure of solid: band theory, band structure of metals, insulators & semiconductors. Intrinsic & extrinsic semiconductors, doping semiconductors. Seebeck effect and Hall effect. Organic semiconductors, properties & their applications. Types of ionic conductors, mechanism of ionic conduction, diffusion, superionic conductors, phase-transitions & mechanism of conduction in super ionic conductors, applications of ionic conductors.

Unit-IV : 12L

Dielectric polarization: Piezo-electricity, pyroelectricity, ferrielectricity, antiferroelectricity, ferroelectricity & their applications.

Superconductivity: Introduction, discovery magnetic properties of super conductor, theory of super conductivity, Meissner effect, type I & II superconductors, Josephson effects, Hc- temperature superconductor, crystal structure of high temperature semiconductors, & its uses.

Lasers and Masers actions, laser production and applications

Unit-V : **12L**
Magnetic Properties of Materials: Introduction, Magnetization, Electronic Spin and Magnetic Moment, Classification of materials, magnetic susceptibility, paramagnetism in metal complexes, diamagnetism, ferromagnetic metals, ferromagnetic compounds (CrO_2), Antiferromagnetism- transition metal monoxides, ferrimagnetism (ferrites), magnetic anisotropy, magnetostriction, cooperative phenomena- magnetic domains, Domain Theory, hysteresis loops (hard & soft magnets) magnetic storage & applications of magnetic materials. Spin glasses.

Books:

1. Azaroff L. V., Introduction to Solids, TMH
2. West A. R., Solid State Chemistry and its Applications, Plenum
3. Rao C. N. R., Solid State chemistry, Dekkar
4. Hagenmuller, Preparative methods in solid state chemistry
5. Keer H. V., Principles of the Solid state, Wiley Eastern.
6. Hannay N. B., Solid State Chemistry
7. Chakrabarty D. K., Solid State Chemistry, New Age Int.
8. West A. R., Solid state Chemistry, John Wiley
9. Pillai S. O., Solid state Physics, Academic press
10. Rey T. J., The Defects Solid state, Interscience
11. Azoroff L. V. Brophy J. J., Electronic Process in Materials, McGraw Hills
12. Anderson and Leaver, Materials Science
13. Kirkendall, Analytical Methods of Materials Investigations
14. Greenwood N. N. Ionic Crystals, Lattice Defects and Nonstoichiometry, Butter worth
15. Kroger Chemistry of imperfect crystals, Holland
16. Callister W. D. Jr., Material Science and Engineering An Introduction, Wiley India
17. Van Bueren H. G., Imperfection in Crystals, Wiley-Interscience
18. Brandon D and Kaplan W. D. Microstructural Characterization of Materials, Wiley NY.
19. Hummel R. E. Electronic Properties of Materials, Springer-Verlag
20. Solymar L. and Walsh D., Electrical properties of Materials, Oxford University Press
21. Jiles D., Introduction to Magnetism and Magnetic Materials, Nelson Thornes, Cheltenham
22. Kotz J. C., and Treichel, P. Jr. Chemistry AND chemical Reactivity, Saunders

23. Masterton W. L. and Hurley C. N. chemistry, Principles and Reactions, Harcourt

SEMESTER III**Paper XI****Special Paper-I****Organic Chemistry (Organic Synthesis-I)**

Total Lectures: 60 Hrs, 4 Hrs per week, 12 Hrs/unit Total Marks-50

Unit-I : Photochemistry.

Interaction of radiation with matter, types of excitation, rate of excited molecules, quenching, Quantum efficiency, quantum yield, transfer of excitation energy, actinometry, singlet and triplet states, experimental methods in photochemistry of carbonyl compounds, and transition, Norrish type I and Norrish type II reactions Paterno-Buchi reaction, Photoreduction, Photochemistry of enones, Hydrogen abstraction rearrangement of unsaturated ketones and cyclohexadienones, Photochemistry of parabenzoquinones, photochemistry of Aromatic compounds with reference to isomerisation addition and substitution Photochemical isomerization of cis and trans alkenes, Photochemical cyclization of reaction, Photo-Fries rearrangement, Photo theory reaction of anilides 12L

Unit-II : Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene, allyl system, classification of pericyclic reaction. FMO approach, Woodward-Hoffman correlation diagram method and Perturbation of molecular orbital (PMO) approach of pericyclic reaction under photochemical conditions. Electrocyclic reactions, conrotatory and disrotatory motion $4n$ and $(4n+2)$ systems, with more emphasis on $(2+2)$ and $(4n+2)$

Cycloaddition of ketones Secondary effects in $(4+2)$ cycloaddition. Stereochemical effects and effect of substituents on rate of cycloaddition reaction, 1,3-dipolar-cycloaddition and chelotropic reaction. Sigmatropic rearrangement, suprafacial, and antarafacial shift involving carbon moieties, retention and inversion of configuration, $(3,3)$ and $(3,5)$ sigmatropic rearrangements, Claisen and Cope rearrangements. 12L

Unit-III: A) Oxidation-Reduction and Electron transfer reactions

- I) Oxidation: Principle, aromatisation, dehydration yielding C=C, oxidation aldehyde, ketone, cleavage of C-C single bond in glycols, ozonolysis, epoxidation, Oppenauer oxidation, Sommelet reduction.
- II) Reduction: Selectivity in reduction, reduction of nitro and nitroso compounds, metal hydride reduction, dissolving metal reduction, reduction of aldehydes, ketones to alcohols, reduction of carbonyl group to methylene.
- III) Electron transfer reaction: Selective oxidation of alkyl side chain in aromatic compounds, alcohols and acid using Co(III), Reduction with LiAlH_4 , NaBH_4 .

12L

Unit-IV: A) Formation of C-C bond

Principle, disconnection, synthons, electrophilic and nucleophilic carbon species, use of following reaction in carbon carbon bond formation, base catalysed condensation, Aldol, Claisen, Perkin, Stobbes, Knoevenagel use of malonic and acetoacetic esters. Michael addition. Wittig reaction, use of acetylides, acid catalysed condensation of olefins, FC reaction, Fries reaction and Diels Alder reaction.

12L

- Unit-V: A) Umpolung concept:** Dipole inversion, generation of acyl anion, use of 1,3-dithiane, methylthiomethylsulphoxide bis(phenylthiomethane). Metallated enol ethers, alkylidene dithiane, ketone thioacetals, 2-propenethiobismethyl thioallyl anion.
- B) Phosphorus and sulphur ylides:** Preparation and their synthetic application along with stereochemistry. Enamines: Chemistry of enamines and their synthetic applications.

12L

Books suggested.

- 1) Principle of organic synthesis. R.C. Norman & J.M. Coxon
- 2) Modern synthetic reaction. H.O. House W.A. Benjamin
- 3) Organic synthesis, The disconnection approach-S. Warren
- 4) Designing organic synthesis-S. Warren
- 5) Some modern methods of organic synthesis-W. Carruthers,
- 6) Advance organic reaction. Mechanism & structure-Jerry March
- 7) Advance organic chemistry Part-B-F.A. Carey & R.J. Sundberg, Plenum P.
- 8) Organic reaction and their mechanism-PS Kalsi
- 9) Protective group in organic synthesis-TW Greene, & PGM
- 10) The chemistry of organophosphorous-AJ Kirby, & SG Warren
- 11) Organosilicon compound-C. Eabon

- 12) Organic synthesis via Boranes-HC. Brown
- 13) Organoborane chemistry-TP Onak
- 14) Organic chemistry of boron-W. Gerrard
- 15) Fundamentals of photochemistry-KK Rohatgi & Mukharji
- 16) Photochemistry-Cundau & Gilbert
- 17) Aspects of organic photochemistry-WM Horspool
- 18) Photochemistry-JD Calvert
- 19) Photochemistry-RP Wayne

Semester-III**Paper XII****Special Paper-II****Organic Chemistry (Natural Product-I)****Unit-I : Carbohydrates**

Types of naturally occurring sugars, deoxy sugars, amino sugars, branched chain sugars, methyl ethers and acid derivatives of sugars, general methods of structure and ring size determination with reference to maltose, lactose, sucrose, starch and cellulose.

12L

Unit-II : A) Amino acids, protein and peptides.

Amino acids, structural characteristics, acid base property, stereochemistry of amino acids, optical resolution, Stecker synthesis, peptide and proteins. Structure of peptide and protein, primary, secondary, tertiary and quaternary structure. Reaction of polypeptide, structure determination of polypeptide, end group analysis, purines and nucleic acids, chemistry, structure and functional relation to gene of DNA and RNA.

8L

- B) Prostaglandins:** Occurrence, nomenclature, classification and physiological effects, synthesis of PGE₂ and PGE_{2a}

4L

Unit-III : Classification, Isolation, General Methods of structure determination of the following

12L

- A) Alkaloids:** Papaverine, Morphine, Reserpine, Nicotine.
B) Terpenoids: Camphor, Geraniol, Abietic acid, squalene

Unit-IV: A) Steroids and Hormones

12L

Cholesterol, Testosterone, Progesterone and Cortisone

- B) Biosynthesis of Natural Products.**

Biosynthesis of terpenes, alkaloids, and amino acids (Lysine and phenylalanine)

Unit-V: DYES

- A) Dyes:** General Introduction, classification on the basis of

structure and method of application dyeing mechanism, methods of dyeing, such as direct dyeing, vat dyeing, dispersive dyeing, formation of dye in fibre, dyeing with reactive dyes, study of quinoline yellow, cyamine dye, ethyl red, methylene blue, Alizarin, cyamine-green, fluorescein, eosin, erythrosine, Rhodomines and Indigo.

Books suggested :

- 1) Chemistry of alkaloids-SW Pelletier.
- 2) Chemistry of steroids-LF fisher & M fisher.
- 3) The molecules of nature-JB hendricson.
- 4) Biogenesis of natural compound-benfield
- 5) Natural product chemistry & biological significance, J.Mann, RS devison, JB hobbs, DV Banthripde & JB horborne.
- 6) Introduction to flavonoids-BA Bohm, Harwood
- 7) Chemistry of naturally occurring quinines-RH Thomson
- 8) The systematic identification of flavonoids-marby, markham, & thomos
- 9) Text book of organic medicinal chemistry-wilson, geswold
- 10) Medicinal chemistry Vol I & II-Burger
- 11) Synthetic organic chemistry-Gurudeep chatwal.
- 12) Organic chemistry of natural products Vol I & II-OP agrawal
- 13) Organic chemistry of natural products-Gurudeep chatwal
- 14) A textbook of pharmaceutical chemistry-Jayshree Ghosh
- 15) Synthetic dyes series-venkatraman
- 16) Chemistry process industries-shreve & brink
- 17) Principal of modern heterocyclic chemistry-LA paquelte
- 18) Heterocyclic chemistry-J Joule & G smith
- 19) Heterocyclic chemistry-morton
- 20) An introduction to chemistry of heterocyclic compound-JB acheson
- 21) Introduction to medicinal chemistry-A gringuadge
- 22) Wilson & Gisvold text book of organic medicinal & pharmaceutical chemistry-Ed. Robert F dorge
- 23) An introduction to drug design-SS pandey, & JR demmock
- 24) Goodman and Gilman's pharmacological basis of therapeutics-
- 25) Strategies for organic drug synthesis & design-D lednicer
- 26) Polymer science-v govarikar
- 27) Principle of polymer chemistry-PJ flory
- 28) An outline of polymer chemistry-james q.allen
- 29) Organic polymer chemistry-KJ Saunders.

Semester III
Paper- XI
(Special Paper-I)
Physical Chemistry

60 Hours (4-Hours/week)

50 Marks

12 hours/Unit

Unit-I Solid-state chemistry:

- A) Solid state reactions: General principles, experimental procedures, co-precipitation as a precursor to solid state reactions, other precursor methods, kinetics of solid state reactions. 6L
- B) Crystal Defects & Non-Stoichiometry: Intrinsic and extrinsic defects- point defects, line and plane defects, vacancies-Schotky defects and Frenkel defects. Thermodynamics of Schotky and Frenkel defect formation, color centers. Non-Stoichiometry and defects. Numericals. 6L

Unit-II Electronic properties and Band Theory:

- A) Metals, insulators and semiconductors, electronic structure of solids- band theory, band structure of metals, insulators and semiconductors. Intrinsic and extrinsic semiconductors, doping semiconductors, semiconductor p-n junctions. Color in inorganic solids, 6L
- B) Magnetic properties- Behavior of substances in magnetic field. Effect of temperature: Curie and Curie-Weiss Laws. Calculation of magnetic moments, magnetic materials, their structures and properties. Applications: structure / property relations. Numericals. 6L

Unit-III Glass, Ceramics and Multiphase materials:

- A) Factors influencing glass formation, kinetics and thermodynamics of glass formation, electrical (ionic) Conductivity of glasses, metallic glasses. Composition, properties and applications of glass-ceramics. 6L
- B) Properties and applications of ferrous and non-ferrous alloys. Phase diagram of iron-carbon system. Stainless steel, brass. 6L

Unit-IV Ceramics and Composites:

- A) Structure and properties of ceramic: Crystal structure, silicate ceramics, carbon, and imperfection in ceramic, diffusion in ionic materials, ceramic phase diagram. Type and application of ceramics, Glasses and glass ceramics clay product refractories, abrasive, cement and advance ceramics, fabrication and processing of ceramics, fabrication and processing of glass and clay product, powder processing and tape casting. 6L

- B) Particle reinforced Composites: Large particle and dispersion-strengthened Composites, Fiber reinforced Composites: Influence of fiber length, fiber orientation and concentration. Metal- Matrix Composites, Ceramics- Matrix Composites, Carbon-Carbon and hybrid Composites.

6L

Unit-V Superconductivity:

- A) High T_c Materials: Superconductivity in cuprates, preparation and characterization of 1-2-3 and 2-1-4 materials. Normal and Superconducting state of cuprates. The BCS theory. Applications of Low-temperature and High-temperature Superconductors. 6L
- B) Thin Films: Preparation techniques: evaporation/sputtering, chemical processes, MOCVD, sol-gel etc. Growth techniques, properties and applications of thin films. 6L

List of Books:

- 1) Physical chemistry by P.W. Atkins & dePaula 7th Edition
- 2) Industrial Chemistry by B.K. Sharma, Goel Publication House.
- 3) Physical Chemistry of Surface, by A.W. Admson, John Wiley and Sons 1990.
- 4) Electronic structure and Chemistry of Solids by P.A. Cox, Oxford University Press. 1991.
- 5) Solid State Chemistry by D.K. Chakraburti, New Edge International Publication 1996.
- 6) Principles of Solid State by H.V. Kirr, Wiley Eastern Publication.
- 7) Material Science & Engineering an Introduction, by W.D. Callister
- 8) Material Science by J.C. Anderson, K.K. Leaver, J.M. Alexander & R.D. Rawlings. ELBS.

Semester III**Paper- XII****Special Paper-II****Physical Chemistry**

60 Hours (4-Hours/week)

50 Marks

12 hours/Unit

Unit-I Polymers:

- A) Basic concepts: Monomers, repeat unit, degree of polymerization, linear branch, and network polymers, classification polymers, Polymerization: condensation, addition, radical chain ionic and coordination and copolymerisation. polymerization condition and polymer reaction, polymerization in homogeneous and heterogeneous system. 6L

- B) Polymer processing: Plastic, elastomer and fibers. Compounding, processing technique: Calendaring, die casting, rotational casting, film casting, injection molding, glow molding, extrusion molding, thermoforming, foaming, reinforcing and fibers spinning. 6L

Unit-II Polymer characterization:

- A) Polydispersion, average molecular weight concept. Number, weight and viscosity average molecular weight. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weight. End group, viscosity, light scattering, osmotic and ultra centrifugation method. 6L
- B) Analysis and testing of polymers: chemical analysis of polymer, X-ray diffraction study, microscopy. Thermal analysis and physical testing-tensile strength. Fatigue impact. Tear resistance. Hardness and abrasion resistance. 6L

Unit-III Structure and properties of Polymers:

- A) Morphology and order in crystalline polymers, configuration of polymers chains. Crystal structure of polymers. Morphology of crystalline polymers, strain induced morphology, crystallization and melting. 6L
- B) Properties and structure: Physical properties, crystalline melting point, T_m-melting point of homogeneous series, effect of chain flexibility and other steric factors. Entropy and heat of fusion, the glass transition temperature, the relation between T_g and T_m. Effect of molecular weight, diluents, chemical structures, chain topology, branching and crosslinking. Property requirements and polymer utilization. Numericals. 6L

- Unit-IV** A) Polymer composites: Polymer matrix material, reinforcement, properties of composite and composite system. Fabrication of polymer composite, processing science and quality assurance of composites, environmental effect on composites, Smart composites. 6L
- B) Polyethylene, polyvinyl chloride, polyamide, polyester, phenolic resin, epoxy resin and silicon polymer, Functional polymer: electrically conducting polymer. 6L

- Unit-V** A) Polymer degradation: Definition, Types: thermal, mechanical, degradation by ultrasonic waves, photo degradation, degradation by high-energy radiations, oxidative and hydrolytic degradation. 6L

- B) Polymer reactions: Hydrolysis, acetolysis, aminolysis, hydrogenation, addition and substitution reaction, reaction of various specific groups, cyclization reaction and cross linked reactions, reaction leading to graft and block copolymers, miscellaneous reactions. 6L

List of Books:

- 1) A Text Book of Polymer Science by Billmeyer, Jr. Wiley
- 2) Polymer Science by V.R.Gowarikar, N. V. Vishwanathan & J. Sreedhar, Wiley Estern.
- 3) Physical Chemistry Polymers by D.D. Deshapande, Tata McGraw Hill
- 4) Principles of Physical Chemistry by P.J.Flory, Cornell University Press
- 5) Introduction to Polymer Chemistry by R.B. Seymour, McGraw Hill.
- 6) A Practical Course in Polymer Chemistry by S.J. Pnnea, Program press.
- 7) Polymer Composite by M.C. Gupta & A.P. Gupta. New Age International Publication.

**Semester III
Paper XI
Special Paper-I**

**Industrial Chemistry (Heat Transfer, Unit Operations and
Material Balances)**

60hrs (4hrs/week). 12hrs/unit

50 Marks

Unit-I :

12L

- A) Fundamentals of Heat transfer:
Methods of heat transfer, Fourier's law, Newton's law, heat transfer by conductance, by convection and by radiation. Heat exchanger, types of heat exchanger, overall heat transfer co-efficient, double pipe heat exchanger, Shell & tube type etc.
- B) Fluid flow :
Fluid flow phenomenon, introduction, Laminar flow, Turbulent flow, Reynolds number, Bernoulli's equation, fans, blowers, compressors, pumps etc.

Unit-II : Unit Operations:

12L

- A) Distillation: Flash distillation, differential distillation, rectification, plate columns, packed columns.

- B) Gas Absorption : Introduction, equipments, packed columns, spray column mechanically agitated contactors.
- C) Evaporation : Introduction, short tube evaporator, forced circulation evaporator, falling film, climbing film, agitated evaporators.
- D) Filtration : Introduction, Filter media, filter aids, equipments sparkler filter, sand filters, bag filters, rotary drum filter etc. centrifuge.
- E) Crystallisation : Introduction, solubility, supersaturation, nucleation, crystal growth, equipments tank crystallizer, Swenson-Walker crystallizer, Oslo crystallizer.
- F) Drying: Introduction, free moisture, bound moisture, drying curve, equipments: tray dryer, fluid bed dryer, drum dryer

Unit-III : Material Balances

12L

Material balance without chemical reactions, flow diagram, without recycle or by-pass for above processes.
Material balances involving chemical reactions, Concept of limiting reactant, conversion, purge operation and energy balance.

Unit-IV : Catalysis

12L

Introduction, types, homogeneous & heterogeneous, Basic Principles, mechanism, factors affecting the performance, Introduction to phase transfer catalysis.
Industrial catalysts : Raney nickel, other forms of nickel, palladium and Supported palladium, copper chromate, vanadium & Platinum basecatalyst.
Aluminium alkoxides, titanium tetrachloride & titanates
Titanium dioxide & Zeigler Natta catalyst and zeolite Catalysts.

Unit-V : Materials of construction for chemical plant.

12L

- A) Metals and Alloys : Copper, Aluminium, Nickel, titanium and their alloys. Mechanical & chemical properties and their applications.
- B) Corrosion : Types of corrosion relevant to chemical industries, mechanism & prevention methods.
- C) Polymeric Materials: Industrial polymer and composite materials, their constitution, chemical and physical properties, industrial applications.

List of Books-

- 1) Heat transfer By Arora and Damkondwar, Pune
- 2) Heat and Mass transfer by A, G. Gavane, Nirali Prakashan. Pune VOL I & II

- 3) McCabe and Smith, Unit operations of Chemical Engineering, McGraw Hill.
- 4) Budger and Banchemo, Introduction to Chemical Engineering McGraw Hill. McGraw Hill.
- 5) Text Book of Industrial Chemistry Pragti Agencies Pune 2
- 6) Engineering Chemistry By Dr. S. S. Dara.
- 7) Catalysis in theory and practices, Ridder E. K. and Taylor H. S.
- 8) Phase transfer catalysis, Principles and techniques, Starles C.
- 9) Surface Chemistry by J. J. Bikermann, Academic Press.
- 10) Physical Chemistry of Surfaces, A. W. Aclamson.
- 11) Material science, O. P. Khanna, Khanna Publishers, Delhi

Semester III

Paper XII

Sp. Paper-II

Industrial Chemistry (Processes Economics And Industrial Management)

60hrs (4hrs/week). 12hrs/unit

50 Marks

- Unit-I : Manufacture of Heavy Chemicals 12L**
 Chemical processes for the manufacture of Heavy chemicals like- soda ash, bicarbonates, chlorine, caustic soda, bleaching power, calcium carbides and acids like H_2SO_4 , HCl, HNO_3 , H_3PO_4 .
- Unit-II : 12L**
- A) Industrial Gases: Heavy chemicals and production of gases. Chemistry, manufacture, storage, hazards & uses.- Hydrogen, Oxygen, nitrogen, carbon dioxide, chlorine, fluorine, SO_2 , phosgene, acetylene, argon, neon & helium.
 - B) Fertilizers: Fertilizer industries in India, Manufacture of Ammonium salts, Urea, nitrates, Ammonia, Nitrogenous fertilizers, phosphatic fertilizers, superphosphates, complex fertilizers, nitrogen fixation.
- Unit-III: 12L**
- A) Cement: Types of cement, manufacture- processes, and setting of cements.
 - B) Glass: Types, their composition & properties, manufacture of glass fitness, optical glass, coloured glasses, lead glass and neutron absorbing glass.
 - C) Ceramics: Introduction, types, manufacturing process, applications & refractories.
- Unit-IV : Chemical Process Economics 12L**
 Factors involved in project cost, estimation methods employed for the estimation of capital investment.

Methods of determining depreciation.
 Competitive & monopoly markets, some aspects of marketing profitability criterion.
 Economics of selecting alternatives.
 Break even point, production scheduling

Unit-V: A) Industrial Management 12L

Concept of scientific management in industry.
 Functions of management : Decision making, planning, organizing, Material management, Inventory control, Information system & decision making.

B) Safety :

General occupational safety, flammable materials, Handling, fuel fighting equipments, control measures for Toxic chemicals. Safety with chemical engineering operations, hazardous chemicals process. Safety in Laboratories and pilot plant. Safety in transportation & storage of chemicals, management of safety & loss prevention.

List of Books-

1. Charles E. Dryden, Outline of Chemical Technology Edited by M. Gopal Rao and Marshall Siting, East West Press 2nd Edition 1973.
2. Manual of Chemical Technology VOL I & II by Venkatesharul Educational Development Center. IIT Madras, 1977.
3. Chemical Process Industries by R. N. Shreves and M. J. A. Brink. McGraw Hill Ltd. 4th Edition 1977.
4. Economics of chemical industry, Hempel E. M.
5. Industrial organization and management, Bethal L. L.

Semester III

Paper XI

Analytical Chemistry
 (Advance Separation Techniques)

Total Lectures: 60Hrs, 4Hrsper week, 12Hrs/unit Total Marks-80

Unit-I : 12L

Separation Methods: Filtration, precipitation, distillation, molecular sieve, dialysis, Reverse osmosis, Ring oven methods, relative merit & demerit. Purification Techniques (Solid organic compounds, liquids etc.) Criteria of purity. Theory of chromatography, Classification, principles of chromatography, Van Deemeters Equation, Plate theory, significance of E, D_v, D_w . Techniques of

chromatographic separation gradient, isocratic, selective specific separation, types of chromatographic methods

Unit-II : **12L**

Gas Chromatography:-

Introduction to different types of gas chromatography, How does it differ from liquid chromatography. Principles of gas chromatography, plate theory of gas chromatography, Instrumentation for gas chromatography, working gas chromatography, application of gas chromatography, programmed temperature chromatography, flow programming chromatography, gas-solid chromatography, Columns for Gas Chromatography, choice of columns, polarity indices, Gas chromatography and Chirality.

Ion chromatography - Principle, structure and characteristics of resins, eluent, suppressor columns and detectors used in ion chromatography, analytical applications, environmental speciation by ion chromatography and applications. Hyphenated techniques in Chromatography.

Unit-III : **12L**

Gel Filtration:-

Introduction, types of gels, techniques used in equilibrium studies, estimating size parameters, molecular wt. determinations separating plant aspects.

Electrophoresis-Theory and classification, factors affecting mobility, macromolecular size and charge interactions with supporting electrolyte, pH and concentration discontinuities, Factors affecting electrophoresis phenomena-electrolysis, electrosomosis, temperature and supporting media. Instrumentation, methodology, Preparation of gel staining and destaining, preparative zone electrophoresis, continuous electrophoresis and Applications.

Capillary Electrophoresis-Principle, theory, instrumentation, sample preparation and applications, Capillary electrochromatography and Miscellar electrokinetic capillary chromatography

Unit-IV : **12L**

Membrane-Based Methods:-Dialysis-working of techniques, membranes, general consideration of diffusion, Donnan Membrane equilibrium and Applications.

Electrodialysis- working of techniques, membranes, Electrodialysis cells and Applications.

Ultrafiltration- working of techniques, membranes, non-gelatinous membranes and Applications. Dialysis compared with other membrane-separation methods.

Other Separation Methods:-Ultracentrifugation-Principle, sedimentation constant, sedimentation equilibrium, sedimentation velocity, methodology and applications.

Zone refining- Principle, zone leveling and applications

Unit-V : **12L**

Kinetic Methods of analysis-

Theoretical basis of kinetic methods of analysis, Rates of chemical reactions, rate laws, first order, second order kinetics, pseudo first order and second order reactions, factors affecting rate of reaction, methods of determining amount of the substance (tangent method) fix time and concentration method, addition method, oxidation reactions of H_2O_2 (thiosulphate, iodide, unimol), enzyme catalyzed reaction, inhibition and activation. Types of kinetic methods, differential and integral, applications.

Books Suggested :

1. Basic Concept in Analytical chemistry, by S.M. Khopkar.
2. Day & Underwood: Quantitative Analysis.
3. A. I. Vogel A Text book of Quantitative inorganic Chemistry, ELBS, London.
4. Analytical Chemistry, D.C. Das, PHI Learning Pvt. Ltd, New Delhi
5. Chromatography. By E Heftman, 5th edition, part-A and part-B, Elsewhere Science Publisher, 1992
6. S. Wilson & P. Jones: Chemical Analysis Vol I
7. Chromatography Today. By C F Poole and S K Poole, Elsewhere Science Publisher, 1991.
8. H.H. Willard, L.L. Merritt and J.A. Dean: Instrumental Methods of Analysis (Van Nostrand).
9. B. L. Krayner, H. H. Willard. L. Merritt, J. A. Dean & F. A. Settle: Instrumental Methods of Analysis (CBS Publishers, Delhi, 1986)
10. Analytical Chemistry. By G D Christian 4th edition, John Wiley and Sons, 1986. L. R. Snyder & C. H. Harvath: An Introduction to Separation Science (Wiley Interscience)
12. F. J. Wicher Robert: Standard Methods Chemical Analysis.
13. G. L. Davis Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, KLN Reddy, C. Sudhakar, Analytical chemistry.
14. R. D. Budhiraja Separation Chemistry, New Age.
15. R.L. Peesok and L.D. Shield: Modern Methods of Chemical Analysis.

- 16 Electrophoresis- Analytical Chemistry. Open Learning by M Melvin John Wiley and Sons.1987
- 17 Analytical Chemistry, S.P.J. Higson, , Oxford University Press
18. Chemical Separations and Measurement; Theory and Practice, D.G.Peters, J.M.Hayes and G.M.Hieftje, Saunders Golden Sunburst Series.

Semester III

Paper XII

Analytical Chemistry (Special Paper-II)

Recent Advances in analytical chemistry

Total Lectures: 60Hrs, 4Hrsper week, 12Hrs/unit Total Marks-80

Unit-I : 12L

High Performance liquid Chromatography:-

Principles, Instrumentation, Pumping systems, sample injection system, Columns and columns packings, Stationary support in HPLC, applications, Validation of HPLC method . Preparative HPLC, Fast HPLC, Trouble shooting in HPLC, Flash chromatography, Capillary HPLC

Super critical fluid chromatography,

Introduction, properties of super critical fluids, characteristics of super critical fluid, Instrumentation and applications of SFC, Comparison of HPLC with SFC..

Super critical fluid extraction-Introduction, advantages of SFE, instrumentation , supercritical fluid choice, offline and on-line extraction and application.

Unit-II : 12L

Functional group analysis- terminal methylene group, nitro and Grignard reagent by titrimetry. Analytical organic reagents, specificity, selectivity, sensitivity, stability, masking, demasking, types of organic reagents and principles of underlying the uses of 2-pyridylazo-nathtol (PAN), dithizone, 8- hydroxyquinoline, magneson I & II phenyl arsonic acid, rubeanic acid and ethylene-diamine tetraacetic acid EDTA.

Unit-III : Recent advances in Analytical chemistry:- 12L

Ultra purity, ultra trace analysis, laboratory designing, purifications of reagents, pre-concentration techniques, methods of trace analysis such as NAA, XRF, EDX, AAS, and ICP. High purity materials for electronics industry, contamination, control during analytical operations. Importance of speciation analysis

Unit-IV : 12L

Partical size determination- Introduction, low angle light scattering, instrumentation, theoretical models and application. Dynamic light scattering-principles, instrumentation and applications. Photosedimentation-settling velocity and partical size, instrumentation and applications.

Surface charactenzation by spectroscopy & microscopy:-

Introduction to the study of surfaces, types of surface measurements, spectroscopic surface methods, general techniques in surface spectroscopy, sampling of surfaces, surface contamination. Scanning electron microscopy (SEM) and scanning probe microscopy.

Unit-V : 12L

Sensors:-

Glass membrane electrodes-solid state sensors-liquid membrane electrodes-gas sensing and enzyme electrodes-interferences-ion activity evaluation method-measurement of pH-glass electrode for pH measurements-electrometric measurement of pH. Bio-sensors-principles, types and applications

Book Suggested:

1. Analytical chemistry- Problems and Solution- S. M. Khopkar, New Age International Publication.
2. Day & Underwood: Quantitative Analysis.
3. Findley: Practical Physical Chemistry:
4. Vogel A Text book of Quantitative inorganic Chemistry, ELBS, London.
5. Strouts Galfillal: Analytical Y. Lyalikov: Physocochemical Analysis
6. S. M. Khopkar: Basic concep in Analytical Chemistry
7. Meites and Thomas: Advance Analytical Chemistry. (Mc Graw Hill)
8. H.H. Willard ,L.L. Merritt and J.A. Dean: Instrumental Methods of Analysis (Van Nostrand).
9. B. L. Krayar, H. H. Willard. L. Merrit, J. A. Dean & F. A. Settle: Instrumental Methods of Analysis (CBS Publishers, Delhi, 1986)
10. R. D. Brown Instrumental Methods of Chemical Analysis ,McGraw Hill
11. L. R. Shyder & C. H. Harvath: An Introduction to Separation Science (Wiley Interscience).

12. Elemental Analysis of Airborne Particles, Ed. S. Landberger and M. Creatchman, Gordon and Breach Science Publication.
13. Atmospheric pollution, W. Buch, McGraw Hill, New York.
14. Fundamentals of Air Pollution, S. J. Willason, Addison - Wesley Publishers.
15. Analytical Aspect of Environmental chemistry, D. F. S. Natush and P. K. Hopke. John Wiley & sons. New York.
16. Analytical chemistry- Problems and Solution- S. M. Khopkar, New Age.
17. Environmental Chemistry, J.W. Vanloon, Oxford University Press.

Semester III

Practical V

Inorganic Chemistry Practical

Practical Workload 9 Hrs./week 100 Marks

Quantitative Inorganic Analysis:

- 1) Detection and determination of Ascorbic acid from biological sample.
- 2) Determination of Phosphates from plant samples by spectrophotometry.
- 3) Determination of iron from pharmaceutical samples and coordination compounds.
- 4) Determination of Calcium from given drug sample by complexometry.
- 5) Determination of Iron, Calcium and Phosphorus from milk powder.
- 6) Simultaneous Spectrophotometric determination of-
 - i) Chromium and Manganese
 - ii) Titanium and Vanadium.
 - iii) Cobalt and Chromium
- 7) Analysis of stainless steel (Cr/Ni)
- 8) To determine the stability constant and stoichiometry of Ferric-thiocyanate complex by spectrophotometrically.
- 9) To study the stoichiometry and stability of Fe³⁺ salicylate complex by job's and mole ratio method spectrophotometrically.
- 10) Estimate the amount of copper (II) with EDTA photometric titration
- 11) Determination of capacity of anion and cation exchange resin by column method.
- 12) To estimate the amount of magnesium and zinc in the given sample solution by ion exchange chromatography method.
- 13) Separation and estimation of Fe²⁺, Co²⁺ and Ni²⁺ by anion exchanger.
- 14) Separation and estimation of Halide by anion exchanger.

- 15) Separation and estimation of-
 - i) Cobalt and nickel
 - ii) Calcium and Zinc and
 - iii) Zinc and Magnesium by anion exchange.
- 16) Separation and estimation of Fe³⁺ and Mg²⁺ by solvent extraction
- 17) Solvent extraction by binary mixtures i. e. Al/Mg, Mg/UO₂, Cu/Ni, Cu/Co etc. and quantitative determination by spectrophotometry.
- 18) Nickel / Molybdenum / tungston/vanadium / Uranium etc by extractive spectrometric method.
- 19) Separation, identification and quantitative determination of metal ions by paper chromatography.
- 20) Separation and identification of sugars/ honey/halides by paper chromatography and determination of R_f values
- 21) Thin layer chromatographic separation, identification and determination of R_f values -
 - a. Metal ions (Mn, Co, Ni, Cu, Zn, Cd, Pb, alkali metals etc)
 - b. Amino acids/ Organic compounds
 - c. Sulpha drugs in tablets and ointments.
- 22) Estimation of zinc/metals by fluorimetrically.
- 23) Nephelometric determinations of sulphate, phosphate, silver.
- 24) Potentiometric determination of the percentage of sodium carbonate in commercial washing soda.
- 25) Water analysis:
 1. Determination of hardness, alkalinity, salinity, Halides, Fluoride, Nitrite, Nitrate, phosphate and Sulphate.
 2. Determination of DO, COD and BOD.
 3. Determination of toxic metals viz As, Cd, Pb, Hg, and Ni in water and wastewater by suitable method.

The Practical examination will be based on the Inorganic Chemistry.

Time: 6-8 hours (one day examination) Marks: 100

I) Exercise -1 (Based on Instrumental) - 40 Marks

II) Exercise-2 (Based on Separation Method) - 40 Marks

III) Record - 10 Marks

IV) Viva- Voce - 10 Marks

Total - 100 Marks

List of Books-

1. Day and Underwood: Quantitative Analysis
2. Vogel A.I: A textbook of quantitative Inorganic analysis, Longman.
3. Flaschka: EDTA Titration

- B) Photoelectron spectroscopy: Basic principle, photoelectric effect, ionization process, Koopmans theorem PES and X-PES, PES spectra of simple molecule, ESCA, chemical information from ESCA. Auger electron spectroscopy-basic idea. surface characterization by spectroscopy and microscopy, (SEM). 6L

- Unit-II :** A) X-ray diffraction :Interaction of x-ray with matter, scattering and diffraction. Bragg method Debye-Sherrer method of X-ray structural analysis of crystals, index reflection, identification of unit cell from systematic absence in diffraction pattern structure of simple lattice and x-ray intensities structure factor , its relation to intensity of electron density procedure for x-ray structure analysis. 4L
- B) Electron diffraction : Scattering intensity Vs scattering angle, wierl equation, measurment techniques, elucidation of structure of simple gas phase molecules.Low energy electron diffraction and stucture of surface. 4L
- C) Neutron diffraction: Scattering of neutrons by solids and liquids magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cell. 4L

- Unit-III** A) Raman spectroscopy: Classical and quantum theories of raman effects,Pure rotational and vibrational and vibrationalrotational raman spectra,selection rules,mutual exclusion Raman spectroscopy,coherent antistokes Raman spectroscopy (CARS).Applications for the study of active sites of metalloproteins. 6L
- B) Electron Spin Resonance Spectroscopy : Introductiuon ,basic principle.zero field splitting and kramers degeneracy, factors effecting the g values,hyperfying splitting, determination of g values.Instrumentation,working of instruments,sensitivity,concentration,choice of solvent. presentation of ESR spectra,application of ESR to study the free radicals,structure determination,reaction velocities,application to inorganic compounds including biological system and to inorganic free radicals such as PH_4^+ , F_2^- , $[\text{BH}_3]^+$,determination of oxidation state of metals,Eldor and Eldor techniques. 6L

- Unit-IV :** Mossbauer spectroscopy: Basic principle,spectral parameters and spectrum display.Doppler shift.recoilless emission of radition.isomer shift,quadrupole splitting,magnetic hyperfying splitting.application of the techniques to the studies of 1. Bonding and structure of Fe^{+2} ,and Fe^{+3} compounds including those of intermediate spin (2) Sn^{+2} and Sn^{+4} compounds - Nature of M-L bond, coordination number, Structure and (3) Detection of oxidation state and in equivalent MB atoms. Mossbauer spectroscopy of Biological Systems. 12L
- Unit-V :** Structural Problem : Problems based on IR, Mass, UV, PMR, ^{13}C NMR data and structure determination of organic molecules / inorganic compounds. 12L

Books suggested

- 1) Spectroscopic identification of organic compound-RM Silverstein,GC Bassler and TC Morril,John Wally
- 2) Introduction to NMR spectroscopy-RJ Abraham,J Fisher and Ploftus Wiely
- 3) Application of spectroscopy to organic compound-JR Dyer,Printice Hall
- 4) Organic spectroscopy-William kemp,ELB with McMillan
- 5) Spectroscopy of organic molecule-PS Kalsi,Wiley,Esterna,New Delhi
- 6) Organic spectroscopy-RT Morrison,and RN Boyd
- 7) Practical NMR spectroscopy-ML Martin,JJ Delpenck, and DJ Martyin
- 8) Spectroscopic methods in organic chemistry-DH Willson,I Fleming
- 9) Fundamentals of molecular spectroscopy-CN Banwell
- 10) Spectroscopy in organic chemistry-CNR Rao and JR Ferraro
- 11) Photoelectron spectroscopy-Baber and Betteridge
- 12) Electron spin resonance spectroscopy-J Wertz and JR Bolten
- 13) NMR ~ Basic principle and application-H Guntur
- 14) Interpritation of NMR spectra-Roy H Bible
- 15) Interpritation of IR spectra-NB Coulthop
- 16) Electron spin resonance theory and applications-W gordy
- 17) Mass spectrometry organic chemical applications ,JH Banyon

Total Lectures: 60Hours, 4Hours per week, 12Hours/unit Total Marks: 50

- Unit-I** : 12L
Radiochemical Methods: Elementary working, principles of Geiger Muller, Ionisation, proportional and I-ray counters. Radiotracer techniques, application of radiotracers in analytical chemistry. Neutron activation analysis (NAA): Principle, technique and applications in preparation of some commonly used radioactive isotopes. Isotopic Dilution Analysis (IDA), substoichiometric IDA, experimental technique and applications of IDA, advantages and limitations of IDA and comparison of IDA with NAA. Principle of Radiometric titrations, types, Experimental techniques and its applications. Carbon dating. Numericals.
- Unit-II** : **Online Analyzers** 12L
Automation in Chemical Analysis: Introduction, Classification of automated methods, principles and techniques of auto-analyzers employed for microanalysis with emphasis on the basis sequences in operational modes in segmented and non-segmented flow and applications. Selection of online analyzers.
 Flow Injection Analysis: Introduction, principal, theoretical aspects of FIA, techniques, pretreatment of sample in packed reactors, components of FIA apparatus, Factors affecting FIA and applications for the determination F⁻, Cl⁻, PO₄⁻, SiO₃²⁻, NO₂⁻, NO₃⁻, SO₄²⁻, BO₃³⁻, Ca²⁺, Mg²⁺, Al³⁺, Mn²⁺, Cr⁶⁺, Fe³⁺ in water.
- Unit-III** : **Optical Methods Of Analysis:** 12L
A) Molecular Luminescence Spectroscopy: Introduction, Molecular fluorescence, phosphorescence and Chemiluminescence, theory, factors affecting fluorescence and phosphorescence, instrumentation and analytical applications. Applications of fluorimetry. Fluorescence quenching. Photoacoustic spectroscopy: Theory, Instrumentation, PAS-gases and condensed systems, chemical and surface applications. Qualitative and quantitative analysis.
B) Inductively Coupled Plasma Atomic Emission Spectroscopy (ICPAES):
 Principles, atomization and excitation, ICP-source, Instrumentation and applications.

- Unit-IV: Analysis of Food, Body fluids and Drugs:** 12L
A) The chemical and nutritional composition of food: analysis of trace elements such as Pb, As, Cd in food, Analysis of Tea, Milk, Spices. Chemical preservation of food, Analysis of sodium benzoate and sodium metabisulphite, Analysis of adulterants in food, Analysis of artificial sweeteners in food and colouring agents.
B) Clinical Chemistry and Drug Analysis: Composition of blood, collection and preservation of samples, clinical analysis, serum electrolytes, blood glucose, blood urea nitrogen, uric acid, albumin, globulin, barbiturates, acid and alkaline phosphatases. Immunoassay :principles of radio immunoassy(RIA) and applications. The blood gas analysis trace elements in the body. Narcotics and dangerous drugs, classification of drugs, screening by gas and thin layer chromatography and spectrophotometric measurements
- Unit-V** : **Fuel analysis:** 12L
 Solid, Liquid and gaseous fuels. Characteristics of ideal fuels. Ultimate and proximate analysis of coal, heating values, grading of coal, liquid fuels-flash point, aniline point, knocking, antiknock compounds, octane number, cetane number and carbon residue. Gaseous fuels, producer gas and water gas, determination of calorific value. Analysis of fuel Gas. Numerical problems.

List of Books-

1. Day and Underwood: Quantitative Analysis
2. A. I. Vogel: A text book of quantitative Inorganic analysis.
3. Flaschka: EDTA Titration
4. Meites and Thomas: Advanced Analytical Chemistry.
5. G. W. Ewing: Instrumental Methods of Chemical Analysis.
6. R. S. Drago: Physical Methods in Inorganic Chemistry
7. G. D. Christian: Analytical Chemistry
8. S. M. Khopkar: Basic Concept of Analytical Chemistry.
9. Kolltath and Ligane: Polarography
10. R.D.Braun: Instrumental methods of chemical Analysis
11. Willard, Merritt and Dean: Instrumental methods of Analysis
12. Strouts, Crifillan and Wison: Analytical Chemistry.
13. J. W. T. Spinks and R. J. Woods: Introduction to Radiation Chemistry.
14. S. A. Skoog and D. W. West: Fundamental Of Analytical Chemistry
15. R. V. Dilts: Analytical Chemistry

Semester IV
Paper-XV
Special Paper-III

Inorganic Chemistry (Photoinorganic & Organometallic Chemistry)

Total Lectures: 60Hrs, 4 Hrs per week, 12 Hrs/unit Total Marks-50

- Unit-I :** 12L
- A) Basics of Photochemistry:** Absorption, excitation, photochemical laws, quantum yield, electronically excited states-life times-measurements of the times. Flash photolysis, stopped flow techniques, Energy dissipation by radiative and no-radiative processes, absorption spectra, Frank-Condon principles; photochemical stages-primary & secondary processes.
- B) Properties of excited states:** Photochemical kinetics, Calculation of rates of radiative processes.
- Unit-II** 12L
- A) Excited States of Metal Complexes:** Electronically excited states of metal complexes, charge transfer spectra, charge transfer excitations, methods for obtaining charge transfer spectra.
- B) Ligand field Photochemistry:** photosubstitution, photo oxidation & photoreduction.
Liability and selectivity, zero vibrational levels of ground state and excited state, energy content of excited state, zero-zero spectroscopic energy, development of the equations for redox potentials of the excited states.
- Unit-III** 12L
- A) Redox reactions by Excited Metal Complexes:** Energy transfer under conditions of weak interaction & strong interaction π exciplex formation, conditions of excited states to be useful as redox reactants, excited electron transfer, metal complexes as attractive candidates (2,2-bipyridine & 1,10-Phenanthroline complexes.), illustration of reducing and oxidizing character of ruthenium (II); role of spin-orbit coupling, lie time of these processes. Application of redox processes of electronically excited states for catalytic purposes, transformation of low energy reactants in to high-energy products, chemical energy in to light.
- B) Metal Complex Sensitizers:** Metal Complex Sensitizers, electron relay, metal colloid systems, and semiconductor supported metal or oxide systems, water photolysis, nitrogen fixation & carbon dioxide reduction.

- Unit-IV :** 12L
- Organotransition Metal Chemistry:**
Alkyls and Aryls of Transition Metals:
Types, routes of synthesis, stability & decomposition pathways of alkyls & aryls of transition metals.
Organocopper in Organic synthesis.
Compounds of Transition Metal π -Carbon Multiple bonds:
Alkylidenes, alkylidynes, low valent carbenes & carbynes π -synthesis, nature of bond, structural characteristics, nucleophilic & electrophilic reactions on ligands, role in organic synthesis.
- Unit-V :** 12L
- Transition Metal Pi Complexes-**Carbon multiple bonds.
Nature of bonding, structural characteristics & synthesis, properties of transition metal pi- Complexes with unsaturated organic molecules, alkenes alkynes, allyl, diene, dienyl, arene & trienyl complexes. Application of transition metal, organometallic intermediates in oraganic synthesis relating to nucleophilic & electrophilic attack on ligands, role in organic synthesis.
- Books:**
1. Elschenbroich Ch.and Salzer A.: Organometallics, VCH,Weinheim, NY
 2. Balzani Vand Cavassiti V.:Photochemistry of Coordination compounds,AP,London
 3. Purcell K.F.and KotzJ.C., An Introduction to Inorganic Chemistry,Holt Sounder,Japan.
 4. Rohtagi K.K.and Mukharjee,Fundamentals of Photochemistry,Wiley eastern
 5. Calverts J.G.and Pits.J.N.,Photochemicals of Photochemistry,John Wiley
 6. Wells,Introduction of Photochemistry
 7. Paulson,Organometallic Chemistry,Arnold
 8. Rochow,Organometallic Chemistry,Reinhold
 9. Zeiss,Organometallic Chemistry,Reinhold
 10. Gilbert A.and Baggott,J,Essential of Molecular Photochemistry,Blackwell Sci.Pub.
 11. Turro N.J.and Benjamin W.A.,Molecular Photochemistry
 12. CoxAand Camp,T.P.Introductory Photochemistry,McGraw-Hill
 13. KundallR.P.and GilbertA,Photochemistry, Thomson Nelson Coxon J and Halton B.,Organic Photochemistry,CambridgeUniversity Press.

Semester IV
Paper-XVI
Special paper-IV
Inorganic Chemistry (Materials Chemistry)

Total Lectures: 60Hrs, 4 Hrs per week, 12 Hrs/unit Total Marks-50

Unit-I : Glasses, Ceramics & Composites: 12L

Glass: A general idea of Glassy state, types, their composition & properties, glass formers & modifiers, optical glass, coloured glasses, lead glass, neutron absorbing glass.

Ceramics: General introduction, types, manufacturing process, structure, mechanical properties.

Unit-II 12L

A) Liquid Crystals: Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematics & smectic mesophases; smectic-Nematic transition clearing temperature-homeotropic, planar & schlieren textures twisted nematics, chiral nematics, molecular arrangement in smectic A & smectic C phases, optical properties of liquid crystals. Dielectric susceptibility & dielectric constants.

Lytotropic phases & their description of ordering in liquid crystals.

B) Bio-materials: Biomineralisation, controlled formation of biological composites, bone & other mineralised tissues, materials of construction, applications (General aspect only).

Unit-III : 12L

Nanoparticals & Nanostructural materials : Introduction, methods of preparation, physical properties, and chemical properties. Molecular Precursor routes to inorganic solids:- Introduction, sol-gel chemistry of metal alkoxide, hybrid organic-inorganic compounds

Nanoporous Materials: Introduction, Zeolites & molecular sieves, determination of surface acidity, porous lamellar solids, composition-structure, preparation & applications.

B) Solid State Reaction: General principles, reaction rates, reaction mechanism, reaction of solids, factors influencing reactivity, photographic process.

Unit-IV 12L

A) Fertilizers: Classification of fertilizers, nitrogen fertilizers, phosphate fertilizers, N, P, K fertilizers, H_3PO_4 production without using H_2SO_4 .

B) Coordination Polymers:

Natural polymers and reactions yielding coordination polymers. Synthesis of coordination polymers. Use of polymeric ligands in synthesis of coordination polymers. Metal coordination polymers. Silicon polymers. Organosilicon polymers. Synthesis and their uses.

Unit-V: 12L

Catalysis: Basic principals, thermodynamic and kinetic aspects, industrial requirements, classification, theories of catalysis, homogeneous and heterogeneous catalysis. Introduction, types & characteristics of substrate-catalyst interactions, kinetics and energetic aspects of catalysis, selectivity, stereochemistry, orbital symmetry and reactivity. Catalytic reactions of coordination and Organometallic compounds including polymerization activation of small molecules, addition to multiple bonds, hydrogenation, Zeigler-Natta polymerization of olefins, hydroformylations, oxidations, carbonylations and epoxidation.

Books Suggested:

1. Barsoum, M.W., Fundamentals of Ceramics, McGraw Hill, New Delhi
2. Ashcroft, N.W. and Mermin, N.D., Solid State Physics, Saunders College
3. Callister W.D., Material Science and Engineering, An Introduction, Wiley
4. Keer, H.H., Principles of Solid State, Wiley Eastern
5. Anderson J.C., Lever K.D., Alexander J.M and Rawlings, R.D., ELBS
6. Gray G.W. Ed. Thermotropic Liquid Crystals, John Wiley
7. Kelkar and Hatz Handbook of Liquid Crystals, Chemie Verlag.
8. Kalbunde K.I., Nanoscale Materials in Chemistry, John Wiley, NY.
9. Shull R.D., McMichael R.D. and Swartzendruber L.J., Studies of Magnetic Properties of Fine particles and their relevance to Materials Science, Elsevier Pub. Amsterdam
10. Breck D.W., Zeolite Molecular Sieves: Structure Chemistry and Use, Wiley Chichester, Eng.
11. Morrish A. H., Haneda K., Zhou X. Z. In Nanophase Materials: synthesis, properties, applications, Kulwer, London.

Organic Chemistry (Organic Synthesis: II)

Total Lectures: 60Hrs, 4 Hrs per week, 12 Hrs/unit Total Marks-50

Unit-I : A) **Chemo and Regio Selectivity.** 6L
Selectivity in organic synthesis, chemo and regio selectivity, stereoselective and stereospecific reactions, Kinetic and Thermodynamic control in reaction.

B) **Application of organometallics in organic synthesis.**
Use of Organometallic compounds of Mg, Li, Zn, B, Sn and organocopper compounds in organic synthesis. Organotransition metal reagents of C, R, Fe, Co, Rh, Ni and Pd.

Unit-II : **Designing the synthesis based on retrosynthetic analysis** 6L
12L

A disconnection approach to the synthesis of organic compound. Different consideration in designing target molecule, concept of synthon, FGI, Chemoselectivity, regioselectivity, specificity, stereoselectivity, general strategy choosing a disconnection. Types of bond disconnection, some of the applications of these concepts in designing the synthesis of common important class of the compounds.

Unit-III: A) **Protection and Deprotection of functional groups** 12L

Protection and deprotection of functional groups like, hydroxyl, amino, carbonyl and carboxylic acids groups, techniques employed for these.

B) **Phase Transfer Catalysis and Crown ethers.** Their methods of preparation and application in Organic Synthesis, Mechanism of Phase transfer reaction.

Unit-IV A) **Selective Organic Name Reaction** 12L
Stark-Enamine reaction, Michel addition, Favorski reaction, Mannich reaction, Sharpless asymmetric epoxidation, Ene reaction, Baeyer-Villiger reaction.

B) **Reagents in Organic Synthesis:** Use of following reagents in Synthesis and functional group transformations such as complex metal hydrides, Gilman reagents, Lithium dialkyl cuprate LDA, DCC, Trimethyl silyl Iodide, Tributyl Tin hydride, Woodward and Prevost Hydroxylation, DDQ, Peterson Synthesis, Wilkinson's Catalyst, Becker Yeast.

Unit-V: A) **Polynuclear Hydrocarbons:** 12L
Introduction, Comparative study of the aromatic character of linear and nonlinear Ortho fused Polynuclear Hydrocarbon. General methods of preparation of fluorine, anthracene and phenanthrene.

B) **Heterocyclic Compounds:**
Nomenclature and familiarity with the heterocyclic ring (3-7 members containing up to 3 heteroatoms). Detailed chemistry of Pyrazole, imidazole, oxazole, thiazole, thiazine, pyrimidines, pyrazines and zepines

Books suggested.

- 1) Principle of organic synthesis. ROC Norman & JM coxon
- 2) Modern synthetic reaction. H.O. House W.A. Benjamin
- 3) Organic synthesis, The disconnection approach-S. Warren
- 4) Designing organic synthesis-S. Warren
- 5) Some modern methods of organic synthesis-W. Carruthers,
- 6) Advance organic reaction. Mechanism & structure-Jerry March
- 7) Advance organic chemistry Part-B-F.A. Carey & RJ Sundberg, Plenum P.
- 8) Organic reaction and their mechanism-PS Kalsi
- 9) Protective group in organic synthesis-TW Greene, & PGM
- 10) The chemistry of organophosphorous-AJ Kirby, & SG Warren
- 11) Organosilicon compound-C. Eabon
- 12) Organic synthesis via Boranes-HC. Brown
- 13) Organoborane chemistry-TP Onak
- 14) Organic chemistry of boron-W. Gerrard
- 15) Fundamentals of photochemistry-KK Rohatgi & Mukharji
- 16) Photochemistry-Cundau & Gilbert
- 17) Aspects of organic photochemistry-WM Horspoot
- 18) Photochemistry-JD Calvert
- 19) Photochemistry-RP Wayne

SEMESTER-IV

Paper XVI

ORGANIC CHEMISTRY (Natural Product-II)

Unit-I : **Synthesis Polymers and Rubbers -** 12L

A) **Synthesis Polymers-** Introduction, types of polymerization, Mechanism of condensation Polymerization, Addition polymerization free radical cationic, anionic and copolymerization, chain transfer agents, stereoregulated polymers. Atactic, Isotactic and syndiotactic polymers.

- B) Study of synthetic Rubbers: Buna S SBR, cold rubber, Buna N, NBR, Butyl Rubber, polyisoprene, polyurethanes, vulcanization mechanism, foaming agents, plasticizers, stabilizers, silicones.

Unit-II : General aspects of drug: 12L

Historical, Definitions used in drug chemistry-pharmacy, pharmacology, pharmacodynamics, pharmacodynamic agents, metabolite and antimetabolites, gram positive and gram negative Bacteria, Virus, Actinomycetes, Mutation, Chemotherapy, Nomenclature of medicinal compounds.

Classification of drugs on basis of their

Therapeutic actions.

1. Chemotherapeutic agents

2. Pharmacodynamic agents

Mechanism of Chemotherapeutic action:

1. Biological defences

2. Chemical defences

a) Surface active agents

b) Metabolic Antagonism

Assay of Drugs:

1. Chemical assay

2. Biological assay

3. Immunological assay

Unit-III DRUGS DESIGN: 12L

Development of new drugs, procedures followed in drug design. Concept Of lead compound and modification concept of Prodrugs and Softdrugs structure activity relationship (SAR) Factors affecting bioactivity resonance, inductive effect, isosterism, Biosterism, Spatial consideration, theories of drug activity occupancy theory, Rate theory induced fit theory, Quantitative structure activity relationship.

History and development of QSAR, Concept of drug receptor interaction, Physico-Chemical parameter. Lipophilicity, Partition coefficient Electronic ionization constants, Steric Hindrance and surface activity parameters and redox potential. Free Wilson analysis, Hansch analysis LD-50, ED-50 (Mathematical derivatives of equations included)

Unit-IV : MEDICINAL CHEMISTRY 12L

- A) Antibiotics: Introduction, Penicillin V And G, Streptomycin, Chloramphenicol, Tetracyclins.

- B) Antimalarial : Chemotherapy of malaria, Aminoquinolines, pamaquine, chloroquine and sulphones.

- C) Antipyretic and Analgesic: Aspirin, salol, phenacetin, antipyrin.

Unit-V: Vitamin and Natural Pigments 12L

- A) Vitamins: Structure determination and chemistry of Thiamine (Vitamin B1) Ascorbic acid (Vitamin C) Vitamin E and A.

- B) Natural Pigments: Chemistry of Carotenes, anthocyanins, General study of porphyrins, structure and synthesis of Hemoglobin and chlorophyll.

Books suggested :

- 1) Chemistry of alkaloids-SW Pelletier.
- 2) Chemistry of steroids-LF Fisher & M Fisher.
- 3) The molecules of nature-JB Hendrickson.
- 4) Biogenesis of natural compound-benfield
- 5) Natural product chemistry & biological significance, J. Mann, RS Devison, JB Hobbs, DV Banthripde & JB Horborne.
- 6) Introduction to flavonoids-BA Bohm, Harwood
- 7) Chemistry of naturally occurring quinines-RH Thomson
- 8) The systematic identification of flavonoids-marby, markham, & thomos
- 9) Text book of organic medicinal chemistry-wilson, geswold
- 10) Medicinal chemistry Vol I & II-Burger
- 11) Synthetic organic chemistry-Gurudeep chatwal.
- 12) Organic chemistry of natural products Vol I & II-OP Agrawal
- 13) Organic chemistry of natural products-Gurudeep chatwal
- 14) A textbook of pharmaceutical chemistry-Jayshree Ghosh
- 15) Synthetic dyes series-venkatraman
- 16) Chemistry process industries-shreve & brink
- 17) Principles of modern heterocyclic chemistry-LA Paquette
- 18) Heterocyclic chemistry-J Joule & G Smith
- 19) Heterocyclic chemistry-morton
- 20) An introduction to chemistry of heterocyclic compound-JB Acheson
- 21) Introduction to medicinal chemistry-A Gringuade
- 22) Wilson & Gisvold text book of organic medicinal & pharmaceutical chemistry-Ed. Robert F dorge
- 23) An introduction to drug design-SS Pandey, & JR demmock
- 24) Goodman and Gilman's pharmacological basis of therapeutics-
- 25) Strategies for organic drug synthesis & design-D Lednicer
- 26) Polymer science-v govarikar

- 27) Principle of polymer chemistry-PJ flory
 28) An outline of polymer chemistry-james q.allen
 29) Organic polymer chemistry-KJ Saunders.

Semester IV
Paper- XV
Special Paper-III
Physical Chemistry

60 Hours (4-Hours/week) 50 Marks 12 hours/Unit

Unit-I : Liquid Crystals:

- A) Mesomorphic behavior, thermotropic liquid crystals, nematic and smectic meso phases, smectic and nematic transitions, and clearing temperature, twisted nematics, chiral nematics molecular arrangement in smectic A and Smectic C phases, optical properties of liquid crystals
 6L
- B) General properties of liquids: liquid as dense gases, liquid as disorder solid, different types of intermolecular forces in liquids, theory of liquids.
 6L

Unit-II Isotope Effect:

Equilibrium isotope effects, equilibria in solution, primary kinetic isotope effect, semi classical treatment, quantum mechanical tunneling, reactions of Muonium, isotope effects of heavy atoms, secondary kinetic isotope effect.
 12L

Unit-III Reactions in solutions:

- A) Reaction between ions: Influence of solvent, dielectric constant & ionic strength, pre-exponential factor, single sphere activated complex.
 6L
- B) Ion dipole & dipole-dipole reaction, Diffusion controlled reaction, influence of hydrostatic pressure, substituent and correlation effect. Hammett equation, compensation effect, diffusion controlled reaction: full microscopic and partial microscopic diffusion controlled and ionic reactions.
 6L

Unit-IV Chemical kinetic methods:

- A) Basic principle of chemical relaxation method, chemical relaxation in two and multi-step systems, thermodynamic aspect of chemical relaxation.
 6L
- B) Experimental methods for relaxation kinetics and applications: Temperature jump method, electrical field jump method, ultrasonic relaxation method.
 6L

Unit-V Reaction Dynamics:

- A) Molecular dynamical calculations for $H + H_2$, $Br + H_2$, and more complex reactions. Chemi-luminescence: highly dilute flames, diffusion flames.
 6L
- B) Molecular beams: Stripping and rebound mechanism, state to state kinetics, influence of reactant vibrational energy and rotational energy, spectroscopy of transition species.
 6L

List of Books:

- 1) Physical chemistry by P.W. Atkins & dePaula 7th Edition
- 2) Chemical Kinetics by K.J. Laidler. IIIrd Edition. Pearson Education.
- 3) Liquid State by J.A. Pryde.
- 4) Theotropic Liquid Crystals by G.W. Gray, Wiley
- 5) Hand Book of Liquid Crystals by Kelkar & Hatz, Chemie Verlag.
- 6) A Dynamic Liquid State, A. F.M. Barton, Longman.
- 7) Chemical Kinetics & Dynamics by J.I. Steinfeld, J.S. Francisco & W.L.Hase. Printice Hall. 1989.
- 8) Kinetic & Mechanism of Chemical Transformation by J. Rajaram & J. Kuriacose, McMillion.

Semester IV
Paper- XVI
Special Paper-IV
Physical Chemistry

60 Hours (4-Hours/week) 50 Marks 12 hours/Unit

Unit-I Nuclear Chemistry:

- A) General characteristics of radioactive decay, decay kinetics parent daughter decay growth relationship. α - decay, β - decay, nuclear de-excitation, Secular and transient equilibrium, α - particle energy spectrum, Geiger-Nuttal's Law, Theory of α , and β decay process,
 6L
- B) Detection and measurement of activity: The electrometer, the ionization chamber, electro pulse counter, scintillation, semiconductor, thermo-luminescence and neutron detector.
 6L

Unit-II Nuclear reactions:

Bathe's notation, types of nuclear reactions, conservation in nuclear reaction, reaction cross section, compound nucleus theory, experimental evidence of Bohr's theory: Experiments of Ghoshal, of Alexander and Simonoff specific nuclear reactions, trans uraniens, photonuclear reactions, thermonuclear reaction, fusion reactors, origin and evolution of elements.
 12L

Unit-III Nuclear fission:

- A) Process of nuclear fission, fission fragments and their mass and charge distribution. Fission energy, fission cross-section and threshold. Theory of nuclear fission, fission neutrons, other types of nuclear fissions. 6L.
- B) Nuclear reactors: Nature of nuclear reactor, Natural Uranium reactor, classification of reactors critical size of thermal reactors, the breeder reactors. Reprocessing of spent fuel, nuclear waste management. 6L.

Unit-IV Radiation Chemistry:

Interaction of radiation with matter, Radiation track spurs and d-rays, linear energy transfer, Bathes equation for linear energy transfer, Bremsstrahlung effect. Passage of neutron through matter, Interaction of g-radiation with matter: photoelectric effect and Compton effect, pair production phenomenon, units of measuring radiation absorption, radiolysis of water, radiolysis of some aqueous solutions. 12L.

- Unit-V A) Radiation dosimetry:** Unit of radiation energy, chemical dosimeter, Fricke dosimeter and ceric sulphate dosimeter, conversion of measured dose values, Distribution of water, free radicals in water, radiation induced color centers in crystals. 6L.
- B) Applications of radioactivity:** Probing by isotopes, the Szilard-Chalmers reaction, cow and milk system. Principle and applications of radioisotopes as tracers, radioisotopes as source of electricity. 6L.

List of Books:

- 1) Introduction to radiation chemistry by J.W.T. Spinks and R.J.Woods.
- 2) Essentials of Nuclear chemistry by S.J.Arnikaar.

Semester IV**Paper XV****Special Paper-III****(Unit Processes)****Industrial Chemistry**

60hrs (4hrs/week). 12hrs/unit

50 Marks

- Unit-I A) Nitration:** Introduction, nitrating agents, equipment for nitration, manufacture of nitrobenzene, Ortho and para nitrochlorobenzene.

- B) Amination by reduction:** Introduction, methods of reduction metal & acid, sulphide reduction, metal & alkali reduction, manufacture of aniline, meta nitro aniline
- C) Halogenation:** introduction, reagents of halogenation, aromatic halogenation, manufacture of chlorobenzene, dichlorofluoromethane

- Unit-II A) Sulphonation:** introduction, sulphonating agents, factor affecting sulphonation, equipment, manufacture of benzene sulphonic acid, sulphonation of anthraquinone
- B) Oxidation:** introduction, oxidizing agents, vapour & liquid phase oxidation, manufacture of acetic acid, acetaldehyde, benzoic acid.
- C) Hydrogenation:** introduction, catalyst used for hydrogenation, hydrogenation of vegetable oil, manufacture of methanol,

- Unit-III A) Esterification:** Introduction, esterification by organic acids, esters by adding unsaturated systems, manufacture of ethyl acetate, cellulose acetate.
- B) Hydrolysis:** introduction, hydrolysis agents, acid hydrolysis alkali hydrolysis, enzymatic hydrolysis, factors affecting hydrolysis,.
- C) Alkylation:** Introduction, alkylating agents, factors affecting alkylation, manufacture of ethyl benzene, phenyl ethyl alcohol

Unit-IV - Petroleum Refining and Petrochemical Technology :

- A) Petroleum refining practice
- Petroleum Refining in India
 - Indian Standards for Motor gasoline, Kerosene and Diesel
 - Atmospheric and vacuum distillation of crude
 - Petroleum coking and visbreaking
 - Fluidised catalytic cracking, catalytic reforming, catalytic alkylation, catalytic isomerisation.
 - Hydrocracking & Hydrotreating
 - Lube processing.
- B) Petrochemical Industry :
- Petrochemical Industry in India
 - Petrochemical Feed stocks.
 - Naphtha cracking & separation and purification of olefins to get ethylene, propylene, butylenes etc.
 - Manufacture of BTX aromatics
 - Butadiene & Xylenes separation techniques.
 - Important monomers like, Styrene, DMT & Caprolactum.

Unit-V - Polymers

- 1) Nomenclature, classification of polymer : Natural and synthetic polymers, organic and inorganic polymers, thermoplastic and thermosetting polymers, plastic elastomers, fibres and liquid resin, block & graft copolymers.
- 2) Types of polymerization: Addition (chain) : Polymerization- free radical, ionic, coordination and their mechanism, condensation (step) polymerization polycondensation, polyaddition, ring opening, linear and cross-linked and their mechanism, copolymerisation.
- 3) Techniques of polymerization : Bulk, solution, suspension and emulsion polymerization.
- 4) Molecular weight and size : Number-average and weight-average molecular weights viscosity-average molecular weight, degree of polymerization, significance of polymer molecular weight, size of polymer molecule; molecular weight determination: by Osmometry (membrane & vapour phase), end group analysis, viscometry and light scattering methods.
- 5) Physical characteristics of polymers : Glass transition temperature and crystallinity of polymer, Determination of Glass transition temperature.
- 6) Manufacturing, properties and uses of following polymers:
 - i) Natural and synthetic rubber
 - ii) Synthetic fibers - polyesters, polyamides, rayons
 - iii) Synthetic plastics : Polyolefins, polyurathanes
 - iv) Silicones

List of Books-

1. Unit Process in Organic Synthesis, by P. H. Groves
2. Modern Petroleum Technology by G. D. Hobson and W. Pohl.
3. Petroleum refining and engineering by W. L. Nelson.
4. Petroleum refining technology and economics by J. H. Gary and G. E. Handwerk.
5. The Petroleum chemical industry by Goldstein and Waddams.
6. Petroleum processing handbook by W. E. Bland and R. L. Davidson.
7. The Text book on Petrochemical by Dr. B. K. Bhaskar Rao, Khanna Publishers New Delhi.
8. Modern Petroleum refining Processes by Dr. B. K. Bhaskar Rao, Oxford, IBH, 1984
9. Petroleum product handbook, V. B. Guthrie.
10. Textbook of polymer science by F. Bill Mayer, Wiley Inter Science.

11. Polymer Science by V. Govarikar, N. Viswanathan and J. Sreedhar, New Age International (P) Ltd. Publishers New Delhi
12. Physical chemistry of polymers by D. D. Deshpande, Tata McGraw Hill.
13. Principles of polymer chemistry By P. J. Flory, Cornell Univ. Press.
14. Introduction to polymer chemistry by R. B. Seymour McGraw Hill.
15. A Practical Course in polymer chemistry by S. J. Pinner, Pergamon press.
16. Laboratory preparation of macro chemistry by E. M. M. Effery McGraw Hill.

Semester IV
Paper XVI
Special Paper-IV
(Chemical Processes Industries)
Industrial Chemistry

60hrs (4hrs/week). 12hrs/unit

50 Marks

Unit-I : Dyes**12L**

- i) Chemistry of dyes :- Introduction, classification of dyes on the basis of structure and the mode of application to the fibre. Colour and chemical constitution of dyes. General methods of preparation of important azodyes, Cyanindyes and anthraquinone vat dyes.
 - ii) Chemistry of intermediates :- Introduction to the history of dyes. Natural to synthetic dyes.
 - 1) Manufacturing, properties and uses of following polymers:
 - i) Natural and synthetic rubber
 - ii) Synthetic fibers - polyesters, polyamides, rayons
 - iii) Synthetic plastics : Polyolefins, polyurathanes
 - iv) Silicones
- Mediates: - chloronitrobenzene Nitroanilines, diaminobenzenes.
- Napthalene intermediates :- Naphthyl sulphuric acids, Naphthyl amine sulphuric acids.
- Miscellaneous
- i) Amino anthraquinones, methyl & methylamino anthraquinones, Disperse dye intermediates, disperse - reactive intermediates.

- ii) Analysis & applications of dyes :- Different methods used in analysis, Nitrate value determination, Coupling value, titanium chloride reduction, metal estimations - Cu, Ni, Cr etc.

Dyeing methods :- Dyeing methods for direct, acid, reactive disperse, vat, cationic, sulphur, indigo and azoics.

Unit-II : Sugar Industries 12L

Manufacturing of sugar from sugarcane : Introduction, agriculture, harvesting, preparation of cane for mashing, juice extraction, diffusion, juice purification, evaporation, crystallisation (production of raw sugar), centrifugation, sugar refining, decolouring, purification, filtration, crystallisation grade analysis.

Analysis of bagasse and molasses, byproducts of sugar industries.

Unit-III : Pulp and paper industries 12

- A) Chemistry of paper making, raw materials-
- physical properties of wood, classification of woods, plants used in pulp & paper, grass.
 - Chemical composition of wood, non-woody fibers used in pulping
 - Lignin-lignification of wood, chemical aspects of lignin formation.
 - Structure & properties of lignin
- B) Pulping:
- Preparation of pulp, wood, chips
- Manufacture of mechanical pulp, woods used, types, grades & uses.
- Equipment for ground wood pulping process
- Semichemical pulping, wood preparation, digesters
- Steam cooking
- Utilisation of secondary fibres.
- Rag pulping
- C) Bleaching
- bleaching of wood pulp-bleaching practice
 - stock preparation-internal sizing of papers
 - Filling paper manufacture - Additives
 - types of paper machine - sheet formation
 - press section - drying of papers
 - cylinder mould type -calendaring
 - Speciality papers-injection moulding

Unit-IV : Pharmaceuticals 12L

Product profile study of the following drugs and intermediates with particular stress on the manufacturing process engineering problems involved, quality control, equipment and economics ;

- i) Sulpha drugs :- Sulphaguanidine, sulphamethoxazole.
- ii) Antimicrobial :- chloramphenicol, streptomycin, Tetracyclines, ciprofloxacin.
- iii) Analgesic :- anti inflammatory, Acetyl Salicylic acid, Ibuprofen, paracetamol.
- iv) Vitamin - Vit. A, Vit. B₆, Vit. C
- v) Barbiturates :- Pentobarbital
- vi) Beta- blockers :- propranolol, atenolol, Beta-Nifedine, (Antihypertension)
- vii) Cardiovascular agent :- Methyldopa, enalaprilmaleate, Benazepril.
- viii) Antihistamines - Chlorpheniramine maleate,
- ix) Antidepressants - Resperidone, sertraline
- x) Anticancer drugs & antiacids.

Unit-V : Agrochemicals 12L

Inorganic insecticides :- Arsenic insecticides, fluoro insecticides

Insecticides of plant origins: - Nicotine, nicotine, pyrethroids, rotenoids, analogin, allethrin.

Chlorinated hydrocarbon:- DDT, dieldrin, DDT, endosulphan.

Organophosphorus Insecticides :-

Dithiophosphoric acid derivatives :- Malathion, dimethoate, Dimecron.

Diphosphoric acid derivatives :- Parathion, methyl parathion, thiophos, chlorpyrifos, diazinon.

Pyrophosphoric acid derivatives.

Sulphate, phosphoramide.

Other organophosphorus Insecticides.

Isoproturon, trichlorfon.

Carbamate insecticides.

Carbaryl, imidacloprid, phosalone, pyrethrin.

Fungicides:-

Inorganic Fungicides:-

Sulphur, limesulphur, copper sulphate, Bordeaux paste, Bordeaux paint, Burgundy, copper oxychloride.

Organomercuric compounds:-

Ethyl mercuric chloride, cereasn Dithiocarbamates- Ziram, thiram, Zinc, captan.

Miscellaneous fungicides :- Polpet, Bavistin

List of Books-

1. Synthetic dyes by Venkatram (VOL I & II)
2. Fundamental processes of dye chemistry, by Fietz.
3. Dyes and Intermediates by Adrahaedt
4. Chemical Process Industries by R. N. Shreves and M. J. A. Brink.
5. Pulp and paper chemistry and chemical Technology by James P. Casey
6. The chemistry of cellulose by Emit Ptauseg, John wiley and sons, New York.
7. Indian Pharmacopoeia, 1985
8. British pharamacopoeia, 1990
9. Textbook of Organic Medicinal and Pharmaceutical Chemistry by Willson, Jisvold, Dejjia, Lippinett Toppan.
10. Essentials of Medicinal Chemistry by Korolkovas and Burkhatther-Wiley-Interscience.
11. Pharmaceutical Dosage forms
12. Pesticites-Color Publications, P. L. Bombay
13. Elements of Plant Protection by L. L. Pyenson, John Wiley and sons.
14. Chemistry of Pesticides by N. N. Melnikov Springer-Verlag, New York
15. Fungicites in Plant Disease control by Y. L. Nines, Oxford and IBH Publishing company New Dehli.
16. Methods Pesticides Analysis by Sree Ramuly, U. I. Oxford and IBH Publishers.
17. Charles E. Dryden, Outline of Chemical Technology Edited by M. Gopal Rao and Marshall Siting, East West Press 2nd Edition 1973.

Semester-IV

Paper XV

Analytical Chemistry

Analysis of commercial products

Total Lectures: 60Hrs, 4Hrsper week, 12Hrs/unit Total Marks-80

Unit-I : **12L**

Pharmaceutical analysis:-

Requirement of a quality control laboratory for pharmaceutical units, SOP of sophisticated instruments,

source of impurities in pharmaceutical raw materials such as chemicals, reagents and solvents, atmospheric and microbial contaminants, packing errors, chemical instability, container contamination, physical changes, temperature effects, manufacturing and storage effects. General manufacturing processes, stability studies, shelf life fixation for formulated products. Introduction to pharmaceutical formulations, Standardization, Evaluation analysis of common drugs, Antibiotics-Chloramphenicol, Ampicilline, Terramycine.

Vitamins- Vitamin B₁₂, B₆, Vitamin K

Sulpha drugs-Sulphaguandine, Sulphapyrazine, Sulphanilamide Analysis of common drugs (aspirin, paracetamol etc..)

Unit-II : **12L**

a) Analysis of petroleum and petroleum products- Introduction, constituents and fractionation, Quality control requirements of petrol and petroleum products, safety and hazardous aspects .Analysis of petroleum products-specific gravity, viscosity, doctor test, sulphuric acid absorption, aniline point, vapour pressure and colour determination, cloud point, pour point. Determination of water, neutralization value, ash content estimation of sulphur and lead in petrol.

b) Analysis of Explosive -General methods, heat of explosion, hygroscopicity, moisture by Karl Fischer titration, qualitative tests of explosives, qualitative analysis of explosive mixtures, Dynamites .Blasting caps and electric detonators, primers, liquid propellants and solid propellants

Unit-III : **12L**

Analysis of Paints, soap and detergents

Analysis of Paints and Pigments-Preliminary inspection of sample, Test on the total coating. Separation of pigments, binder and thinner of latex paints, determination of volatile and non volatile constituents, flash points, separation of pigments, estimation of binders and thinners. Modification of binder. Identification and analysis of thinner.

Analysis of soaps-

General idea of soaps and detergents, sampling, separation, identification , determination of soap composition-fatty acids, total anhydrous soap and combined

alkali, potassium, water, determination of inorganic fillers and soap builders, determination of other additives.

Analysis of Detergents- types, method of analysis, sampling, separation, identification of components, determination of surfactants, determination of surfactants-anionic, cationic, non-ionic. Determination of Abrasives, Ammonia, Carbonates, Cellulose, Glycerine, Silicates, Sulphates, Phosphates, moisture content, saponification value.
Analytical techniques used for analysis of soaps and detergents

Unit-IV :**12L****Forensic Analysis-**

General introduction of forensic analysis, sampling, sample storage, sample dissolution, classification of poisons, lethal dose, significance of LD-50 and LC-50, general discussion of poisons with special reference to mode of action of cyanide, organophosphate and snake venom.

Analytical toxicology: Isolation, Identification, Estimation of poisonous materials such as lead, mercury and arsenic in biological samples. Quantification of drugs, insecticides, alkaloids and other products of synthetic and natural origin, ethyl alcohol, methyl alcohol, Zinc phosphides, effects of Kerosene and cooking gas. General discussion, Diagnosis and Management of poison, food poisoning, narcotic, stimulants, paralytic, antihistamine.

Unit-V :**12L**

Analysis of cosmetics, creams, lotions and hair dyes:-

- a) **Composition of creams and lotions:** Determination of water, propylene glycol, non-volatile matter and ash content, analysis of borates, carbonates, sulphates, phosphate, chloride, Titanium and Zinc oxide.
- b) **Analysis of face powder:** Estimation of boric acid, Mg, Ca, Zn, Fe, Al and Ba
- c) Analysis of deodorants and antiperspirants-composition, analysis of fats and fatty acids, boric acid, zinc, iron, aluminium, lead, copper, mercury, phosphorus and urea.
- d) Analysis of ingredients of hair dyes.
- e) Analysis of Vanishing cream
- f) Analysis of Lipsticks

List of Books-

1. Pharmacopoeia of India Volume I and II.
2. Aids to the Analysis of Food and Drug by Nicholls
3. Standard Methods of Chemical Analysis. 6th Ed. Vol I & II (D. Van. Nostard comp) by F.J. Welcher
4. Forensic pharmacy by B.S Kuchekar, A.M Khadatare (Nirali Prakashan)
5. Treatise on Analytical Chemistry Vol..I & II by L.M. Kolthoff.
6. Separation Chemistry in Chemistry and Biochemistry. By Roy Keller, M Decker Inc
7. G D. Christian: Analytical Chemistry
8. Handbook of Analysis and Quality, Control for Fruits and Vegetable Products 2nd Ed Mc.Graw hill) by S.Ranganna.
9. Encyclopedia of Industrial chemical Analysis Vol I to 20 (John Wiley) Riech
10. Cosmetics by W D Poucher (Three volumes)
11. Willard, Merritt and Dean: Instrumental methods of Analysis
12. Strouts, Crifillan and Wison: Analytical Chemistry.
13. Textbook of Forensic pharmacy- B. M. Mithal 9th Edn (1993) National Centre, Calcutta. V. Malik, Drug and Cosmetics Act.
14. Textbook of Forensic Pharmacy by B M Mithal 9th edition 1993, National Centre Kolcutta
15. Forensic Pharmacy by B.S Kuchekar, and A.M Khadatare Nirali Prakashan

Semester-IV**Paper XVI**

Analytical Chemistry (Special Paper-IV)

Applied analytical chemistry

Total Lectures: 60Hrs, 4Hrs per week, 12Hrs/unit Total Marks-80

Unit-I :**12L**

Agricultural analysis-I

Soil analysis- Classification and composition, Soil formation, weathering, (especially SRMs), composition soil sampling, field description of soils, physical analysis, determination of major and minor constituents, exchange capacity, soil reaction, chemical analysis as a measure of soil fertility. Analysis of constituents such as Nitrogen, Phosphorus, Potassium and micronutrients.

Stock feeds analysis - feeding stuffs, qualitative analysis and quantitative analysis.

Plant analysis- Preparation of sample, moisture determination- methods of washing, methods of plant

analysis- starch, sugars, determination of mineral constituents (Fe, Mn, Mo, Si, Ca, Mg, P, S, C and N).

Unit-II : Agricultural Analysis-II 12L

Analysis of Fertilizers- Sampling, sample preparation. Analysis of nitrogen, phosphorus and potassium. Nitrogen: urea nitrogen, total Kjeldahl nitrogen method, Ammonianitrogen, phosphorus: total phosphorus. available and non-available, alkalimetric ammonium molybdophosphate method, potassium : potassium by sodium tetraphenylborate method.

Pesticides and insecticides analysis- Introduction, classification, Analysis of organochlorine, organophosphorus and carbonate pesticides, analysis of DDT, gammexane, endosulphan, zinab, ziram, malathion, thiram, thiometon, simazine and chloridane . Green technologies in agriculture industries and water resource managements

Unit-III 12L

Analysis of minerals, ores and alloys

- a) Minerals and ores-Hematite, pyrolusite, ypsum, dolomite chromate, bauxite, limestone, illmenite and uranium ores.
- b) Metal and alloys analysis- iron, different kinds of iron, steel, Cu-Ni alloy, solder, bronze, aluminium alloy, ferroalloys of silicon, molybdenum, chromium, titanium and vanadium.

Unit-IV : 12L

Industrial pollution- Sugar industry, paper and pulp industry, nuclear power plant, polymer drugs, radionuclide analysis, disposal of wastes and their management. Principles of decomposition Biodegradability, classification of hazardous substances and water, chemical classes of hazardous wastes, hazardous substances to health better industrial process. Industrial Operation and Green Methodology . Introduction and evolution of green chemistry, green reagents, solvents and catalysts

Hazardous substance analysis- nature, source, treatment and disposal of hazardous waste, classification of hazardous substances and wastes, origin, toxic substances, chemical, classification hazardous wastes, physical and chemical methods of wastes treatment and preparation of waste and ultimate disposal of hazardous waste.

Case studies-Bhopal gas, chronobyal, Three Mile Island minamata disasters.

Unit-V : Analysis of mineral materials: 12L

a) **Cement-** Loss on ignition, insoluble residue, total silica, sesquioxides, lime, magnesia, ferric oxide, sulphuric anhydride, air and dust pollution from cement plants, atmospheric dispersion of pollutants in cement industry.

b) **Glass and Glass-Ceramics-** Introduction, composition, methods of analysis- sampling and sapling preparation, composition analysis- preliminary testing, decomposition. Chemical method for the individual constituents-Si, B, Pb, Zn, Al, Cl, Mg, Ti.

List of Books-

1. Agricultural Analysis. By Kanwar
2. A. I. Vogel: A text book of quantitative Inorganic analysis.
3. Soil Analysis. By Jackson.
4. Encyclopedia of Industrial Methods of Chemical Analysis. By F D Snell (All senus).
5. G. W. Ewing: Instrumental Methods of Chemical Analysis.
6. Standard Methods of Chemical Analysis. By F J Welchar
7. G D. Christian: Analytical Chemistry
8. S. M. Khopkar: Basic Concept of Analytical Chemistry.
9. Handbook of Air Pollution. By Stern, APHA , 1980.
10. Fundamentals of Analytical Chemistry 6th edition by D. A. Skoog, D. M. West and F. S. Holler
11. Industrial Chemistry by B. K. Sharma.
12. Strouts, Crifillan and Wison: Analytical Chemistry.
13. Principle and practice of Analytical chemistry by F. U. Fifeild and D. Keuley 3rd edition, Blackie and sons Ltd..
14. S. A. Skoog and D. W. West: Fundamental Of Analytical Chemistry.
15. Pollution Control in Process Industries by S. P. Mahajan.

Semester IV

Practical-VII

Inorganic Chemistry Special

Practical Workload 9 Hrs./week Time: 9-12 hours Marks: 100

- Unit-I**
- 1) Extraction and absorption spectral study of chlorophylls from green leaves.
 - 2) Determination of Phosphates from cold drink samples by spectrophotometry.

- 3) Analysis of talcum and nyclin powders (Mg-complexometry, ZnO/H_3BO_3)
- 4) Determination of iron in soap bar.
- 5) Analysis of N, P, K from fertilizer
- 6) Analysis of cement/paint/soil.

Unit-II : Study of complex formation:

- 1) To determine the formula and formation of a complex by spectrophotometry (Job's/mole/Slope ratio methods)
- 2) To determine stepwise proton-ligand and metal-ligand stability constant of complex by Irving-Rossotti method.
- 3) To determine the instability constant of complex by potentiometry ($AgNH_3$, Ag-thiosulphate)
- 4) To determine the composition and formation constant of a Fe-SSA complex by conductometry.
- 5) Determination of composition and stability constant of complex by polarography.

Unit-III: Inorganic reaction mechanism:

Kinetics and mechanism of following reactions:

- 1) Substitution reactions in octahedral complexes (Acid/Base hydrolysis)
- 2) Redox reactions in octahedral complexes.
- 3) Isomerization reaction of octahedral complexes.
- 4) Enzyme kinetics in presence of metal ions.
- 5) To determine the corrosion rate of metal strip.
- 6) To study the 1,10 phenanthroline as corrosion inhibitor for mild steel in sulphuric acid.
- 7) To study the adsorption and desorption of gases on heterogeneous catalyst.

Unit-IV: Solid State:

- 1) Preparation of oxides and mixed oxides (Mn_2O_3 , NiO, Cu_2O , Fe_3O_4 , $ZnFe_2O_4$, $ZnMn_2O_4$, $CuMn_2O_4$ and $NiFe_2O_4$)
- 2) Preparation of Silica and Alumina by sol-Gel technique.
- 3) To study the electrical conductivity of ferrites, Magnetites, doped oxides and pure samples and determine band gap.

Unit-V : Two/Three steps synthesis and characterization:

Synthesis of metal complexes/Polymers/Lanthanide complexes and their structural characterizations by possible physical methods such as: elemental analysis (N, S, M % etc.), m.p. Solubility, MW, molar conductance, magnetic moment, thermogravimetric analysis, IR and electronic spectral data, determination of crystal field parameters (minimum five)

Book Suggested:

1. Synthesis and Characterization of Inorganic Compounds, W. L. Jolly, Prentice Hall.
2. Inorganic Experiments, J. Derck Woollins, VCH.
3. Practical Inorganic Chemistry, G. Mairand, B. W. Rockett, Van Nostrand.
4. A Text Book of Quantitative Inorganic Analysis, A. I. Vogel, Longman.
5. EDTA Titrations. F. Laschka
6. Instrumental Methods of Analysis, Willard, Merit and Dean (CBS, Delhi).
7. Inorganic Synthesis, Jolly
8. Instrumental Methods of Chemical Analysis, Yelri Lalikov
9. Fundamental of Analytical Chemistry, Skoog D.A. & West D.M Holt Rinehart & Winston Inc.
10. Experimental Inorganic Chemistry, W.G.Palmer, Cambridge.
11. Solid state Chemistry, N.B.Haney
12. Introduction to Thermal Analysis, Techniques & Applications, M.E.Brown, Springer
13. Preparation and Properties of solid state Materials, Wilcox, Vol. I&II, Dekker
14. The Structure and Properties of Materials Vol.IV, John Wulff, Wiley Eastern.

The Practical examination will be based on the Inorganic Chemistry.

Time: 6-8 hours (Two days examination)	Marks: 100
I) Exercise -1 (Synthesis & Analysis)	- 40 Marks
II) Exercise-2 (Kinetics/complex)	- 40 Marks
III) Record	- 10 Marks
IV) Viva- Voce	- 10 Marks
Total	-100 Marks

SEMESTER IV

Practical VII

Organic Chemistry Special

Practical Workload 9 Hrs./week Time: 9-12 hours Marks: 100

Unit-I : QUALITATIVE ANALYSIS.

Separation of the components of a mixture of three organic compounds (three solids, two solids and one liquid, two liquids and one solid, all three liquids and identification of any two components using chemical methods or physical techniques. Purification of the compounds by crystallization, chromatographic techniques (Minimum of 12 mixtures to be done)

UNIT-II: ORGANIC ESTIMATION

Organic Estimation.

1. Estimation of nitrogen.
2. Estimation of halogen.
3. Estimation of sulphur.

Spectrophotometric/calorimetric Estimation.

4. Estimation of streptomycin sulphate.
5. Estimation of B-12.
6. Estimation of amino acids.
7. Estimation of proteins.
8. Estimation of carbohydrates.
9. Estimation of Ascorbic acid.
10. Estimation of Aspirin.
11. Solvent extraction of oil from oil seeds and determination of saponification value, iodine value of the same oil.

Organic practical :

Two Days Examination - 9-12 Hrs.

100 Marks

Distribution of marks:

Unit I	40
Unit II	40
Record	10
Viva-voce	10
TOTAL	100

BOOKS SUGGESTED :-

1. Textbook of practical organic chemistry qualitative and quantitative analysis (Vol I & II)- A.I. Vogel.
2. Elementary practical organic chemistry small scale preparation (Langman)- A.I. Vogel.
3. A handbook of organic analysis.-H.T.Clark.
4. Systematic qualitative organic analysis ~H. Middleton.
5. Advanced practical organic chemistry-N. K. Vishnoi.

6. Small scale organic preparation-P.J. Hill
7. Practical organic chemistry-H. Dupont Durst & George W.Gokal.
8. Experimental organic chemistry Part I & II, P. R. Singh, D. S. Gupta & K.S. Bajpai.
9. Vogel's textbook of practical organic chemistry-A.R. Tatchell

Semester IV**Practical-VII****Physical Chemistry Special**

Practical Workload 9 Hrs./week Time: 9-12 hours Marks: 100

Use of Computer Programmes 5 terms of practicals.

Treatment of experimental data, X-Y plots, programs with data preferably from physical chemistry practical. Students will operate two packages I) MS-Word and II) MS-Excel.

Part-A

- 1) To find out Energy of activation & Temperature coefficient of hydrolysis of methyl / ethyl acetate
- 2) To find out Energy of activation of the reaction between potassium persulphate & potassium iodide.
- 3) Determination of partial molar volume of solute and solvent in binary mixture.
- 4) To study the variation of solubility of calcium sulphate with ionic strength and hence determine thermodynamic solubility product.
- 5) To study the adsorption of acetic acid on charcoal and prove the validity of Freundlich and Langmuir adsorption isotherm.
- 6) To determine the critical micelle concentration of soap.
- 7) To determine the molecular weight of high polymer by viscosity measurement.
- 8) To find out partition coefficient of Iodine/Benzoic/Salicylic acid between benzene and water.

Part-B

- 1) Determination of half wave potential of metal ions by polarography.
- 2) Simultaneous determination of suitable of metal ion by polarography
- 3) Analysis of aspirin conductometrically and potentiometrically
- 4) Determination of sodium, potassium, lithium and calcium by Flame photometric individually and mixture.
- 5) Electronics measurement of resistance with multimeter and use of Wistone Bridge for accurate measurement of resistance.
- 6) Determine the dipole moment of given liquid.

- 7) Plot the current voltage curve for copper sulphate and sulphuric acid using bridge platinum electrode.
- 8) Determine the transport number of ions by moving boundary method.
- 9) Determine the composition of binary mixture spectrophotometrically

Physical Chemistry Practical :

Distribution of marks:

Two Days Examination - 9-12 Hrs.	100 Marks
Unit A	40
Unit B	40
Record	10
Viva-voce	10
TOTAL	100

Semester IV Practical-VII Industrial Chemistry Special

Practical Workload 9 Hrs./week Time: 9-12 hours Marks: 100

Multi step organic Synthesis:

- 1) Nitrobenzene - m-dinitrobenzene - m-nitroaniline- m-nitrophenol. Anthranilic acid - phenylglycine orthocarboxylic acid - indigo
- 2) Cyclohexanone - cyclohexanone oxime - caprolactum.
- 3) Preparation of P- bromoaniline from aniline.
- 4) Preparation of Synthetic Zeolites.
- 5) Determination of N^{\sim} and P^{\sim} nitrogen and phosphorus containing fertilizer respectively by suitable methods.
- 6) Determination of Iron and Calcium from Cement by suitable methods.
- 7) Determination of Lead (Pb) from Opal Glass by suitable methods.
- 8) Experiments based on distillation under reduced pressure, fractional and steam distillation.
- 9) Measurement of flash point, ignition point, kinematic viscosity by U-tube method.
- 10) Estimation of Copper from fungicides.
- 11) Determination of pesticide contents in the soil.
- 12) Preparation of Methyl orange, Methyl red, orange II, Fluorescein, Quinoline, Anthraquinone.
- 13) Quantitative estimations of important commercially available drugs.

- 14) Qualitative analysis of commercial available drugs including chromatographic technique.
- 15) Preparation of simple drugs involving two or three steps.
- 16) Preparation of melamine - HCHO resin.
- 17) Determination of number average molecular weight (Mn) by end group analysis by conductometric method.
- 18) Determination of average molecular weight of polymer by viscometric method.
- 19) Determination of reducing sugar in cane juice.
- 20) Determination of moisture content and ash content of wood sample.
- 21) Experiments based on simple & fractional crystallization.
- 22) Analysis of nonfibrous materials used in pulp industries such as caustic soda as Na_2O , Soda ash as Na_2O , lime as CaO .
- 23) Extraction of essential oils from medicinal plants (Tikhadi).
- 24) Separation of Chromium (VI) & Chromium (III) by TLC in wastewater sample from electroplating industry.
- 25) Preparation of selected pesticide formulations in the form of dusts, emulsions, sprays.
- 26) Determination of calorific value of fuels.

Distribution of marks:

The Practical examination will be based on the syllabus for Industrial Chemistry (Elective Paper).

Time: 9-12 hours (Two days examination)	Marks: 100
I) Exercise -1 (Synthesis)	- 40 Marks
II) Exercise-2 (Analysis)	- 40 Marks
III) Record	- 10 Marks
IV) Viva- Voce	- 10 Marks
Total	- 100 Marks

List Of Books-

1. Practical Engineering by S. S. Dara.
2. Laboratory Preparation of Microchemistry by E. M. M. Effery, McGrawHill.
3. Practical Course in Polymer Chemistry by S. J. Pnnea, Pargaman Press
4. Practical Pharmacognosy by T. B. Willis.
5. Practical Pharmacognosy by T. N. Vasudevan.
6. Indian Pharmacopea-1985, British Pharmacopea-1990.
7. Handbook of Drugs and Cosmetics by Mehrotra
8. Methods of Pesticide Analysis by Sree Ramuly U. I. Oxford and IBH Publishing Co.

9. Methods of testing for petroleum and petroleum products. IS 1448-1960 Part I to Part IV. Published by ISI New Delhi 1967
10. IP Stands for Petroleum and products Published Applied Service Publisher Ltd. London, 33rd Edition 1974.
11. American Stds. For testing Materials, New York 1967.
12. Textbook of Inorganic Chemistry by A. I. Vogel.
13. Instrumental Methods of Analysis by Willard, Merit and Dean
14. Industrial Chemicals, Faith et. al. Wiley Interscience New York
15. Textbook Of Practical Organic Chemistry by I. C. Voley.
16. Industrial Organic Chemistry by J. K. Stille
17. Unit Operations by Kale
18. Reagents for Organic Synthesis Fisher and Fisher.
19. Technique of Organic Chemistry Vol I, Part I- IV A. Weishberger.

Semester IV

Analytical Chemistry Practicals (Special)

Total Hours: 90 hrs. (9 Hours per week)

Marks: 100

- 1) Solvent extraction of Al/Mg or Mg/UO₂ using 8- hydroxy quinoline complex and determination by spectrophotometry.
- 2) Separation and estimation of copper and cobalt on cellulose Column.
- 3) Analysis of pyrolomite with respect to I) iron II) Manganese
- 4) Assay of sulphadiazine
- 5) Analysis of vit. C in juice and squashes
- 6) Determination of saponification value and iodine value of oil.
- 7) Determination of p- nitrophenol by colorimetry.
- 8) Determination of iron in syndets by colorimetric method.
- 9) Determination of Phenol by Conductometry.
- 10) Potentiometric determination of thiourea.
- 11) Estimation of calcium/sodium in the sample of dairy whitener by flame photometry.
- 12) Analysis of pigments with respect to Zn and Cr.
- 13) To determine the amount of each copper and bismuth or copper and iron (III) from the given mixture at 745 nm by spectrophotometric titration using solution of
- 14) EDTA identification of sulphadiazine in tablets and ointments by TLC.
- 15) Fertilizer analysis for N, P, K
- 16) Analysis of iodized table salt for its iodine content.
- 17) Estimation of the purity of given azo dye colorometrically.
- 18) Chemical analysis of chilly and turmeric powder.
- 19) Simultaneous estimation of Cl and I by potentiometric method.

- 20) Colorimetric determination of simple ions (phosphate, sulphate, nitrate/nitrite, toxic heavy metals).
- 21) Analysis of soap and detergent.
- 22) Determination of alcohol from beverages spectrophotometrically using dichromate.
- 23) Determination of amount of Zinc from the given sample solution by Nephelometric/Turbidimetric titration using standard solution of Ba (NO₃)₂ or
- 24) Pb (NO₃)₂ Analysis of Pharmaceutical mixtures
- 25) Simultaneous determination of Vitamic C and Vitamin E
- 26) Analysis of some common pesticides insecticides, plastics and detergents
- 27) To determine the amount of each para nitro-phenol and meta nitro-phenol from the given mixture by spectrophotometric titration using standard solution of NaOH (max-280 nm)
- 28) Estimation of sodium benzoate/sodium metabisulphite. boric acid and salicylic acid in food
- 29) Analysis of chrome steel alloy for chromium and nickel content
- 30) Agricultural analysis of soil sample, animal feeds, soil micronutrients, milk powder for Ca, Fe and P content.
- 31) Any other relevant expt. may be added

The Practical examination will be based on the syllabus of Analytical Chemistry (Special Papers).

Time: 6-8 hours (one day examination)

Marks: 100

- | | |
|----------------|------------|
| I) Exercise -1 | - 40 Marks |
| II) Exercise-2 | - 40 Marks |
| III) Record | - 10 Marks |
| IV) Viva- Voce | - 10 Marks |

.....
 Total -100 Marks

M.Sc. (Chemistry)

Semester-IV

Practical-VIII - Project Work

Time : 9 Hrs. Per Week

Marks : 100

The Students will develop utilities such as analytical spectra, simulation programmes that will supplement laboratory exercises in their subject of specialization. For this, variety of small research project designed by the teacher based on the interest of the student and capabilities should be worked out.

The project will be evaluated by external and internal examiners.

Study Tour: Educational / Industrial tour is compulsory for M.Sc. Chemistry.

(i) Semesters I / II : Visit to local industry.

(ii) Semester III / IV : Education tour to visit the industry / Research Laboratory.

List of equipments/apparatus required for the M.Sc. Chemistry Semester-I to IV Practicals.

1. Conductivity meter	03 nos./batch
2. pH meter	03 nos./batch
3. Potentiometer	03 nos./batch
4. Polarimeter	02 nos./batch
5. Centrifuge machine	02 nos./batch
6. Vacuum Pump	01 no./batch
7. Hot air oven	01 no./batch
8. Blower hot & cold	03 nos./batch
9. Stop watch	10 nos./batch
10. Weight box con. 100 gm.	10 nos./batch
11. Analytical double pan balance	10 nos./batch
12. One pan electrical balance	10 nos./batch
13. Tripple beam balance	02 nos./batch
14. Melting point apparatus	02 nos./batch
15. Spectro photometer	02 nos./batch
16. Water still	01 no./lab
17. Colorimeter	02 nos./batch
18. Thermostate	01 no./batch
19. Electrodes platinum	03 nos./batch
Silver	03 nos./batch
Glass	03 nos./batch
Reference	03 nos./batch
20. Heating mantle	02 nos./batch
21. Glass double distillation unit	01 no./lab
22. Flamed Photometer	01 no./batch
23. LCR meter	01 no./lab
24. Polarograph with recorder	01 no./lab
25. U.V. visible spectrophotometer	1 no./lab
26. Standard cell	02 nos./batch
27. Muffle furnace	01 no./lab
28. D.C. Voltmeter	01 no./lab
29. Infrared lamp	05 nos./lab

30. Refrigerator	01 no./lab
31. Magnetic stirrer 2 ml, 5 ml.	02 nos./batch
32. Dimmer state	01 no./lab
33. Abbe's refractometer	01 no./batch
34. Sodium lamp for polarimeter	02 nos./batch
35. T.L.C. Kit	01 no./lab
36. Calorimeter	01 no./lab
37. Bomb Calorimeter	02 nos./batch
38. BOD analyser	01 no./lab
39. Water analysis kit	01 no./lab
40. Computer-386/486	01 no./lab
41. U.V. Lamp	02 no./lab
42. Ice making machine	01 no./lab
43. LCR bridge	01 no./lab
44. HPLC	01 no./lab
45. Deioniser	01 no./lab
46. Ion exchange column's	04 no./lab
47. Turbidity meter	01 no./lab
48. Optical densitometer	01 no./lab
49. Orsat apparatus (gas analysis)	01 no./lab
50. Interferometer (ultrasound)	01 no./batch
51. You's balance	01 no./lab
52. Hydraulic press	01 no./lab
53. Shaking machine	01 no./lab
54. G.M. Counter	01 no./lab
55. Electrophoresis apparatus	01 no./lab
56. Karl-Fisher Titration apparatus	01 no./lab
57. Power supply (regulator)	01 no./batch
58. Regulated furnace	01 no./lab
59. Thermocouple	01 no./lab
60. Vacuum oven	01 no./lab
61. Top pan balance	01 no./lab
etc.,	

List of glasswares (main) for M.Sc. Chemistry Semester-I to IV Practicals

1. Soxhlet set	02 nos./batch
2. Kjeldahl's apparatus set (for Nitrogen element estimation)	02 nos./batch
3. Distillation unit	04 nos./batch
4. Separating funnel	10 no./batch

5. Steam distillation unit	02 nos./batch
6. Vacuum desiccator	01 no./batch
7. Paper chromatography chamber	03 nos./batch
8. Silica crucibles	20 nos./batch
9. Sintered glass crucibles g4/g5	20 nos./batch
10. Spot test plates	10 nos./batch
11. Wash bottles	10 nos./batch
12. Density bottles	10 nos./batch
13. Viscometer	10 nos./batch
14. Kipp's apparatus	10 nos./batch
15. Beakers, capacity :50 ml, 100 ml, 250 ml, 400 ml, 500 ml, 1000ml,	
16. Conical flask : 100 ml, 250 ml.	
17. Burettes with stop cock, capacity : 2ml, 5 ml, 10ml, 25 ml.	
18. Lambda pipette	02 nos./batch
19. Volumetric flasks, capacity : 10 ml, 25 ml, 50 ml, 100 ml, 250 ml, 500 ml, 1000ml.	
20. Measuring cylinder, capacity : 10 ml, 25 ml, 50 ml, 100 ml, 500 ml, 1000 ml	
21. Pipette, capacity : 1 ml, 2 ml, 5 ml, 10 ml, 25 ml.	
22. Stalagmeter	10 nos./batch
23. Thermometer (b-24) 0 to 3600C (quick fit)	05 nos./batch
24. Water suction pump (glass)	05 nos./batch
25. Filtration flasks with buckner funnels 50 ml	10 nos./batch
100ml	10 nos./batch
250ml	10 nos./batch
500ml	10 nos./batch
26. Quick fit stand joints b-14, b-19, b24	
27. China dishes	10 nos./batch
28. Dessicators	10 nos./batch
29. Thiel's tube for melting point	05 nos./batch
30. Quick fit water condensers b-19, b-24	10 nos./batch
31. Quick fit flasks, Capacity 50 ml, 100 ml, 250 ml, 500 ml, 1000 ml.	10 nos./batch

M.Sc. Sem. I to Sem. IV
(Microbiology)

Prospectus No. 2017128

संत गाडगे बाबा अमरावती विद्यापीठ

SANT GADGE BABA AMRAVATI UNIVERSITY

विज्ञान विद्याशाखा
(FACULTY OF SCIENCE)

अभ्यासक्रमिका
विज्ञान पारंगत परिक्षा (सुक्ष्मजीवशास्त्र)
सत्र-१ ते सत्र-४

PROSPECTUS
OF
MASTER OF SCIENCE EXAMINATION
IN MICROBIOLOGY
Semester - I & Semester III Winter 2016
Semester - II & Semester IV Summer 2017



2016

Visit us at www.sgbau.ac.in

Price Rs. /-

PUBLISHED BY
Dr. Ajay P. Deshmukh
Registrar
Sant Gadge Baba
Amravati University
Amravati-444602

- © "या अभ्यासक्रमिकेतील (Prospectus) कोणताही भाग संत गाडगे बाबा अमरावती विद्यापीठाच्या पूर्वानुमती शिवाय कोणासही पुनर्मुद्रित किंवा प्रकाशित करता येणार नाही."
- © "No part of this prospectus can be reprinted or published without specific permission of Sant Gadge Baba Amravati University"

INDEX

M.Sc.Part-I & Part-II (Semester I to IV) Examinations in Microbiology (Prospectus No.2014128)

Sr.No.	Paper No.	Paper	Page Nos.
1.		Special Note	1
2.		Ordinance No.4 of 2008	3
3.		Direction No.14 of 2009	12
4.		Direction No.26 of 2010	14
5.		Direction No.27 of 2010	37
6.		Direction No.39 of 2011	40
7.		Direction No.25 of 2012	43
8.		Direction No.07 of 2014	46
9.		Direction No.08 of 2014	47
10.	M . S c . P a r t - I S e m e s t e r I		
	I	Microbial Techniques	2
	II	Microbial Enzymology	3
	III	Microbial Physiology and Photosynthesis	4
	IV	Environmental Microbiology	4
11.	M.Sc. Part-I Semester-II :		
	V	Biostatistics, Bioinformatics and Computer Applications	6
	VI	Enzyme Technology	8
	VII	Microbial Metabolism	9
	VIII	Environmental Microbiology and Extremophiles	10
12.	M.Sc. Part-II Semester-III :		
	IX	Molecular Biology	12
	X	Virology	13
	XI	Fermentation Technology	14
	XII	Immunology	15

13.	M.Sc. Part-II Semester-IV :		
	XIII	Biotechnology	18
	XIV	Clinical Virology	19
	XV	Microbial Technology	19
	XVI	Medical Microbiology	20

SANT GADGE BABA AMRAVATI UNIVERSITY
SPECIAL NOTE FOR INFORMATION OF THE STUDENTS

- (1) Notwithstanding anything to the contrary, it is notified for general information and guidance of all concerned that a person, who has passed the qualifying examination and is eligible for admission only to the corresponding next higher examination as an ex-student or an external candidate, shall be examined in accordance with the syllabus of such next higher examination in force at the time of such examination in such subjects papers or combination of papers in which students from University Departments or Colleges are to be examined by the University.
- (2) Be it known to all the students desirous to take examination/s for which this prospectus has been prescribed should, if found necessary for any other information regarding examinations etc., refer the University Ordinance Booklet the various conditions/provisions pertaining to examination as prescribed in the following Ordinances.

- Ordinance No. 1 : Enrolment of Students.
 Ordinance No. 2 : Admission of Students
 Ordinance No. 4 : National cadet corps
 Ordinance No. 6 : Examinations in General (relevent extracts)
 Ordinance No. 18/2001 : An Ordinance to provide grace marks for passing in a Head of passing and Improvement of Division (Higher Class) and getting Distinction in the subject and condonation of defficiency of marks in a subject in all the faculties prescribed by the Statute NO.18, Ordinance 2001.
 Ordinance No. 9 : Conduct of Examinations (relevent extracts)
 Ordinance No. 10 : Providing for Exemptions and Compartments
 Ordinance No. 19 : Admission of Candidates to Degrees.
 Ordinance No. 109 : Recording of a change of name of a University student in the records of the University.

Ordinance No.19/2001 : An Ordinance for Central Assessment Programme, Scheme of Evaluation and Moderation of answerbooks and preparation of results of the examinations, conducted by the University, Ordinance 2001.

Dr. Ajay P. Deshmukh
 Registrar
 Sant Gadge Baba Amravati University.

PATTERN OF QUESTION PAPER ON THE UNIT SYSTEM.

The pattern of question paper as per unit system will be broadly based on the following pattern

- (1) Syllabus has been divided into units equal to the number of question to be answered in the paper. On each unit there will be a question either a long answer type or a short answer type.
- (2) Number of question will be in accordance with the unit prescribed in the syllabi for each paper i.e. there will be one question on each unit.
- (3) For every question long answer type or short answer type there will be an alternative choice from the same unit. However, there will be no internal choice in a question.
- (4) Division of marks between long answer and short answer type question will be in the ratio of 40 and 60
- (5) Each short answer type question shall contain 4 to 8 short sub question with no internal choice.

%ORDINANCE NO. 4 of 2008

Examinations leading to the Degree of विज्ञान पारंगत (Master of Science)(Four Semesters Degree Course), Ordinance, 2008.

Whereas it is expedient to provide an Ordinance regarding Examinations leading to the Degree of विज्ञान पारंगत (Master of Science) (Four Semesters Degree Course), in the faculty of Science. The Management Council is hereby pleased to make the following Ordinance.

1. This Ordinance may be Called, "Examinations leading to the Degree of विज्ञान पारंगत (Master of Science) (Four Semesters Degree Course), Ordinance, 2008".
2. This Ordinance shall come into force w.e.f. the date of its approval by the Management Council.
3. The duration of the course shall be two academic years,
 - (a) M.Sc. Course is divided into Semester-I, Semester-II, Semester-III & Semester-IV.
 - (b) University shall hold examinations in Winter and in Summer every year for all semesters.
 - (c) The main examination of odd semesters shall be held in Winter and the main examination of even semesters shall be held in Summer every year. The supplementary examination for odd semesters shall be held in Summer and the supplementary examination for even semesters shall be held in Winter every year.
4. The period of Academic Session/Term shall be such as may be notified by the University and the Examination shall be held at such places and on such dates as may be fixed by the Board of Examinations.
5. Subject to their compliance with the provisions of this Ordinance and of other Ordinances in force from time to time, the following persons shall be eligible for admission to the examinations, namely:-
 - (A) For विज्ञान पारंगत भाग-१ प्रथम सत्र M.Sc.Part-I:-
 - (a) A collegiate candidate admitted to the Degree of Bachelor of Science who has prosecuted a regular course of study in a college or a University Department.
 - (b) a teacher admitted to the Degree of Bachelor of Science and eligible under Ordinance No. 18;
 - (c) a woman candidate admitted to the Degree of Bachelor of Science, who has not pursued a course of study in the University or a College;

% As approved by Management Council on dated 30.5.2008, Vide Item No. 196, and latest amended vide Ordinance No. 14 of 2009 (M.C. dated 25.5.09)

Provided that, applicants eligible under clauses (b) and (c) above shall, if laboratory work is prescribed in the subject which they offer for examination, attend the full course of laboratory instruction in the University Department or a College or a recognised Institution imparting instruction upto the standard of the examination;

Provided further, that in the case of applicants under clauses(b) and (c) above, not less than one academic year shall have elapsed since the date of their passing the examination for the Degree of विज्ञान स्नातक (Bachelor of Science);

- (d) Candidate who has passed B.Sc.Examination of Sant Gadge Baba Amravati University with Chemistry as one of the optional subjects and has also passed the Diploma of Associateship of Institution of Chemists (India) Calcutta and is working as Jr/Sr.Laboratory Asstt. in National Environmental Engineering Research Institute, Nagpur (NEERI) or Council of Scientific and Industrial Research (CSIR), Nagpur or Indian Bureau of Mines (IBM) will be eligible to appear at M.Sc.Semester-I in Chemistry only, without prosecuting a regular course of study in a College/ Department in the University.

Provided he produces certificate of completion of practical course prescribed for M.Sc. Part-I (Semester-I & Semester-II) Examination in Chemistry from his employer.

- (e) any other graduate in Science not eligible under clause (a) (b) or (c) above, shall be eligible for admission to the examination in Mathematics only, after a lapse of not less than one academic year since the date of his passing the examination for the Degree of विज्ञान स्नातक (Bachelor of Science):
- (f) an applicant holding the भेषजी स्नातक (B.Pharm) or the विज्ञान स्नातक कृषी (B.Sc.Agri.) Degree shall be eligible for admission to the विज्ञान पारंगत (M.Sc.) Course in Biochemistry only; (Note: The विज्ञान स्नातक (B.Sc.) Degree referred to in clause (a) above, shall include the विज्ञान स्नातक (B.Sc.) Degree of the University or an equivalent Degree of any other Statutory University)

- (g) an applicant holding the B.Sc. (Ind.Chem.) Degree of the Banaras Hindu University;
- (h) an applicant holding B.A./B.Sc. with Mathematics/ Statistics or Bachelor of Computer Science Degree for admission to M.Sc. Course in Statistics or Mathematics ;
- (i) i) for admission to M.Sc. Microbiology a candidate shall have offered Microbiology or Industrial Microbiology or Biochemistry as a subject of study and examination at the B.Sc. degree.
- ii) for admission to M.Sc. Biochemistry a candidate shall have offered Microbiology or Industrial Microbiology or Biochemistry as a subject of study and examination at the B.Sc. degree.
- For admission to M.Sc.Biochemistry, in case of vacancies, a students offering Chemistry alongwith Biological Science shall be admitted.
- (j) i) for admission to M.Sc. Electronics (Instrumentation) a candidate shall have offered Physics or Electronics (Instrumentation) or Electronics or Electronics Science or Computer Maintenance as subjects of study and examination at the B.Sc. level and B.C.S. degree of this University or any other equivalent Degree of Statutory University.
- ii) a person passing B.E. (Electronics & Telecommunication or Industrial Electronics) Examination of Sant Gadge Baba Amravati University is eligible to take admission directly at second year of M.Sc. Electronics (Instrumentation). Such a student who is admitted to second year of M.Sc. Electronics (Instrumentation) shall be awarded M.Sc. degree on the basis of his performance at M.Sc. Part-II only.
- (k) for admission to (M.Sc.) Geography a candidate shall have offered Geography as a subject to study and examination at the B.Sc. Degree.

- (l) for admission to (M.Sc.) Petrochemical Science, a candidate shall have offered Petrochemical Science subject to study and examination at the B.Sc. Degree.
- (m) i) for admission to M.Sc. Part-I (Environmental Science) a candidate shall have offered one of the optional subject as Environmental Science or Botany or Zoology or Life Sciences or Microbiology or Biochemistry or Biotechnology at B.Sc. degree,
- ii) Sixty percent seats of the total intake shall be reserved for students who have passed B.Sc. with Environmental Science. If students having Environmental Science as an optional subject are not available then students having other optional subjects be considered.
- (n) for admission to M.Sc. Geoinformatics or Remote Sensing and GIS, a candidate shall have passed B.Sc. in any discipline of Life Sciences. Preference shall be given to graduates having offered Geology at undergraduate level.
- (o) for admission to M.Sc. Bioinformatics a candidate shall have passed B.Sc. in any discipline of Life Sciences, Bio Sciences or Bachelor Degree in Agriculture, Veterinary and Fishery Sciences, Pharmacy, or Medical Sciences - Bachelor of Medicine and Bachelor of Surgery, Bachelor of Dental Surgery, B.A.M.S., B.H.M.S. or any equivalent examination recognised by Sant Gadge Baba Amravati University.
- (B) For विज्ञान पारंगत भाग-२ (M.Sc. Part-II) Examination:-
- (a) a student who has been admitted to the Degree of विज्ञान स्नातक (Bachelor of Science) and who has since passing the M.Sc.Part-I (Semester-I & II) Examinations, prosecuted a regular course of study for not less than one academic year in the University or in the College in the subject in which he offers himself for the M.Sc.Part-II Examinations;
- (b) a teacher admitted to the Degree of विज्ञान स्नातक (Bachelor of Science) and eligible under Ordinance

No. 18 and who has not less than one academic year previously, passed the M.Sc.Part-I Examination in the subject in which he offers himself for M.Sc.Part-II Examinations;

- (c) a woman candidate admitted for the Degree of विज्ञान स्नातक (Bachelor of Science) and who has not less than one academic year previously, passed the M.Sc. Part-I Examination in that subject in which she offers herself for the M.Sc. Part-II Examinations;
- (d) a candidate who has been admitted under Para 3 (A) (d) above and who has not less than one academic year previously, passed M.Sc. Part-I Examination in the subject Chemistry in which he offers himself for the M.Sc.Part-II Examination.
- Provided he produces a certificate of completing of practical course prescribed for M.Sc. Part-II Examination in Chemistry from his employer;
- (e) any other Graduate in Science not eligible under clause (a) (b) or (c) who has not less than one academic year previously, passed the M.Sc. Part-I (Semester-I & Semester-II) Examinations in the subject which he offers himself for the Part-II Examination;
6. Subject to his / her compliance with the provisions of this Ordinance and other Ordinances (Pertaining to Examination in General) in force from time to time, the applicant for admission, at the end of the course of study of a particular term shall be eligible to appear at it, if,
- He / She satisfied the conditions in the table and the provisions thereunder.
 - He / She has prosecuted a regular course of study in the university / college affiliated to the university.
 - He / She has in the opinion of the Head of the Department / Principal shown satisfactory progress in his / her study.

Name of Exam.	The student should have passed the Examination of satisfactory	The student should have completed the session/semester
M.Sc.Part-I(Semester-I)	The qualifying examination mentioned in para 5	M.Sc.Part-I (Semester-I)
M.Sc.Part-I (Semester-II)		M.Sc.Part-I (Semester-I & II)
M.Sc.Part-II (Semester-III)	Semester-I	M.Sc.Part-II (Semester-III)
M.Sc.Part-II (Semester-IV)	Semester-I	M.Sc.Part-II (Semester-III & IV)

7. Without prejudice to the provisions of Ordinance No.6 relating to the Examinations in General, the provisions of Paragraphs 8,10, and 31 of the said Ordinance shall apply to every collegiate candidate.
8. The fee for each Semester Examination shall be as prescribed by the University time to time.
- Provided that a non-collegiate candidate, other than an ex-student shall also pay a registration fee as prescribed by the University time to time.
9. Every candidate for admission to the examination shall offer one of the following subjects for his examination, namely-
- Mathematics,
 - Physics,
 - Chemistry,
 - Botany,
 - Zoology,
 - Geology,
 - Statistics,
 - Biochemistry,
 - Microbiology,
 - Electronics (Instrumentation),
 - Geography,
 - Geoinformatics,
 - Remote Sensing & GIS,
 - Environmental Science, and
 - Bioinformatics.

Provided firstly, that an examinee who has passed Part-II Examination in one of the subjects listed above from 1 to 15 and is desirous of appearing.

- (a) in any other subject, or
- (b) in a new paper or a combination of papers in the subject in which he has passed, may, without prosecuting a regular course of study present himself in any subsequent academic year for Part-I of the Examination in that other subject or that new paper or new combination of papers, and after not less than one academic year after passing the said Part-I Examination, for Part-II Examination in the said new paper or the said new combination of papers.

Provided secondly, that a candidate eligible for appearing at an examination under the first proviso shall, in the subject or a new paper or the new combination of papers which he is offering for the examination, attend the full course of practical Training, wherever such training is prescribed in the University Department or a College or a recognised Institution imparting instruction upon the standard of the Examination.

Provided thirdly, that an examination successful under clause (b) of the first proviso shall not be awarded division nor shall he be eligible for any scholarship, medal or prize of the University.

10. An examinee at the M.Sc. Part-I or the M.Sc. Part-II Examination shall have the option of not being declared successful at the examination in case he does not secure a minimum of Second Division marks /Higher Second Division marks fifty five percent marks (55%) at the Examination. The option will have to be exercised everytime an application is submitted to any of the three examinations and shall be on the proforma printed on the application form itself. Once exercised the option shall be binding upon the examinee, and shall not be revoked under any circumstances.
11. Any person who has obtained a Third Division at the M.Sc. Examination of this University shall be eligible to take the examination again under this Ordinance in the same subject or group of subjects as the case may be for improving his division. In such a case the provisions of Ordinance No.138 relating to Improvement of Division shall apply.
12. (1) The scope of the subject shall be as indicated in the syllabus.
(2) The medium of instruction and examination shall be English.
13. The number of papers and marks allotted to each subject and the minimum marks which an examinee must obtain in order to pass the examination shall be as indicated in Appendix:-A

14. Examinees who are successful in the M.Sc. Semester-I, II, III & IV Examination and have obtained not less than 60% marks in the aggregate of the M.Sc. Semester-I, II, III & IV Examinations taken together shall be placed in the First Division, those obtained less than 60% but not less than 55% marks, in the Higher Second Division, those obtained less than 55% but not less than 48% marks, in the Second Division, and all other successful examinees, in the Third Division.
15. Provision of Ordinance No. 18 of 2001 relating to the an Ordinance to provide grace marks for passing in a Head of passing and improvement of division (higher class) and getting distinction in the subject and Condonation of Deficiency of Marks in a subject in all the faculty prescribed by the Statute No.18, Ordinance, 2001, shall apply to the examinations under this ordinance.
16. As soon as possible after the examination, but not later than 30th, June next following, the Management Council shall publish a list of successful examinees arranged in Three Divisions. The names of examinees passing the examination as a whole in the minimum prescribed period and obtaining the prescribed number of places in each subject in the First or Second Division, shall be arranged in Order of Merit as provided in the Examinations in General Ordinance No.6.
17. Save as provided in Paragraph 11 of this ordinance, no person shall be admitted to an examination under this ordinance, if he has already passed the same examination of this University or an equivalent examination in M.Sc. Part-I (Semester-I & II), and M.Sc. Part-II (Semester-III & IV) of any other Statutory University.
18. Examinees successful at the M.Sc. Part-I (Semester-I & II), and M.Sc. Part-II (Semester-III & IV) shall on payment of the prescribed fees, be entitled for the award of the respective Degree in the prescribed form, signed by the Vice-Chancellor.

(Note : - " P.G. Workload in the faculty shall be as per Ordinance No. 131.")

APPENDIX-A
SCHEME OF EXAMINATION FOR M.Sc. PART-I & II.
(FOR ALL SUBJECTS)

i) M.Sc. Part-I Semester-I	Paper-I	-	50 Marks	Practical-I	-	40 Marks
	Paper-II	-	50 Marks	Internal Assessment	-	10 Marks
	Paper-III	-	50 Marks	Practical-II	-	40 Marks
	Paper-IV	-	50 Marks	Internal Assessment	-	10 Marks
M.Sc. Part-I Semester-II	Paper-V	-	50 Marks	Practical-III	-	40 Marks
	Paper-VI	-	50 Marks	Internal Assessment	-	10 Marks
	Paper-VII	-	50 Marks	Practical-IV	-	40 Marks
	Paper-VIII	-	50 Marks	Internal Assessment	-	10 Marks
M.Sc. Part-II Semester-III	Paper-IX	-	50 Marks	Practical-V	-	40 Marks
	Paper-X	-	50 Marks	Internal Assessment	-	10 Marks
	Paper-XI	-	50 Marks	Practical-VI	-	40 Marks
	Paper-XII	-	50 Marks	Internal Assessment	-	10 Marks
M.Sc. Part-II Semester-IV	Paper-XIII	-	50 Marks	Practical-VII	-	40 Marks
	Paper-XIV	-	50 Marks	Internal Assessment	-	10 Marks
	Paper-XV	-	50 Marks	Project Work	-	40 Marks
	Paper-XVI	-	50 Marks	Internal Assessment	-	10 Marks

ii) For the subject Mathematics, there shall be five theory papers of sixty marks for each semester.

- Notes:-**(1) Minimum pass marks for theory and practical examination including internal assessment shall be 36% separately.
- (2) (a) Topic of project work shall be given by concerned supervisor with prior approval of Head of Department.
There shall be no duplication of the topic of the project work. Project shall be based on research in the laboratory and / or field work. Project work shall be allotted at the beginning of third semester and the student shall have to submit it atleast 15 days before commencement of practical examination of the fourth semester. Project work will be evaluated by external and internal examiners.
- (b) There should be atleast 2 to 3 external examiner for a batch of 10 students or 3 to 5 external examiner for a batch more than 10 students.
- (3) There shall be separate exemption in theory and / or practical on getting minimum pass marks.
- (4) Internal Assessment marks for all semesters shall be granted on the basis of - performance of students in any of the following activities:-
(i) Study tour, (ii) Seminar, (iii) field visits, (iv) Industrial visits, (v) visit to research institute / organisation.
(vi) Assignments, (vii) Unit test and any other co-curricular activities.
- (5) The concerned Department or College shall have to maintain the record of award of internal assessment marks.

DIRECTION

No. : 14 / 2009

Date : 29.6.2009

Subject : Examinations leading to the Degree of विज्ञान पारंगत (Master of Science) (Four Semester Degree Course), Direction, 2009.

Whereas, Ordinance No.4 of 2008 in respect of Examinations leading to the Degree of विज्ञान पारंगत (Master of Science) (Four Semester Degree Course) Ordinance, 2008 is in existence in the University.

AND

Whereas, the Board of Studies in Computer Science (including Computer Application and Computer Science (Computer Software)) in the faculty of Science in its meeting held on 5.6.2009 has resolved to accept revised syllabi of M.Sc. Semester-I to IV Computer Software, eligibility criteria and other details.

AND

Whereas, the Board of Studies further recommended that the scheme of examination will be applicable as per Ordinance No.4 of 2008 to M.Sc. Computer Software, as it is, and the revised syllabi shall be implemented from the academic session 2009-10 expeditiously in the light of advancement of knowledge in the subject.

AND

Whereas the Hon'ble Vice-Chancellor has accepted the revised syllabi of M.Sc. Computer Software, Eligibility criteria, Scheme of examinations and other details under section 14(7) of the Maharashtra Universities Act, 1994 on behalf of the faculty of Science and Academic Council.

AND

Whereas, Original Ordinance No.4 of 2008 is required to be amended for inclusion of the above said course.

AND

Whereas, the matter for the admission to student at the examination of above said course is required to be regulated by an Ordinance, and making amendments in Ordinance is time consuming process.

AND

Now, therefore, I, Dr. Kamal Singh, Vice Chancellor of Sant Gadge Baba Amravati University, in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act., 1994, do hereby direct as under:

1. This Direction may be called 'Examinations leading to the Degree of विज्ञान पारंगत (Master of Science) (Four Semester Degree Course), Direction, 2009'.
2. This direction shall come into force from the date of its issuance.
3. Eligibility criteria for admission to M.Sc. Computer Software shall be as given below.
`A person who has passed the Degree of Bachelor of Science with Computer Science/Vocational Computer Application Subjects
OR
A person who has passed the Degree of Bachelor of Science with Post Graduate Diploma in Computer Science of this University
OR
An Examination Recognised as an equivalent of this University or of any other statutory University.
4. The Scheme of Examination for M.Sc. Computer Software shall be as per Ordinance No.4 of 2008 as other Science subjects, as it is.

Amravati
Date : 29/6/2009

Sd/
(Dr.Kamal Singh)
Vice-Chancellor

DIRECTION

No. : 26 / 2010

Date : 24/06/2010

Subject : Scheme for Choice Based Credit System (CBCS) and Awarding Grades to the Post Graduate Students in the Faculty of Science, Direction, 2010.

Whereas, University Grants Commission, New Delhi vide D.O.No.F-2/2008/(XI Plan), Dtd.31 Jan.2008 regarding new initiatives under the 11th Plan - Academic Reforms in the University has suggested for improving quality of higher education and to initiate the Academic Reform at the earliest.

AND

Whereas, the Academic Council while considering the above letter in its meeting held on 30.4.2008, vide item No.55 has resolved to refer the same to Dean's Committee, and the Dean's Committee in its meeting held on 19.07.2008 has decided to refer the matter to all Board of Studies.

AND

Whereas, the recommendations of various Board of Studies in the faculty of Science regarding Upgradation and Revision of various syllabi and introduction of choice based credit pattern Examination System at post graduate level was considered by the faculty of Science in its meeting held on 7.12.2009 and constituted a Committee of all Chairmen of Board of Studies and one member nominated by Chairmen of respective B.O.S. under the Chairmanship of Dean of faculty to decide the policy decision regarding choice based credit system examination pattern at P.G. level.

AND

Whereas, the faculty of Science in its emergent meeting held on 11th May, 2010 vide item No.27, has considered, accepted and recommended to Academic Council, the policy decision regarding introduction of Scheme for Choice Based Credit System (CBCS) and Awarding Grades to the Post Graduate Students in the Faculty of Science under ordinance No.4 of 2008. The recommendations of the faculty was approved by the Academic Council in its emergent meeting held on 28.5.2010, vide item No.36.

AND

Whereas, Ordinance No.4 of 2008 in respect of Examinations leading to the Degree of विज्ञान स्नातक (Bachelor of Science) is in existence in the University as per semester pattern examination system.

AND

Whereas, it is necessary to frame the Regulation regarding the Scheme for Choice Based Credit System (CBCS) and Awarding Grades to the Post Graduate Students in the Faculty of Science which is to be implemented from the Academic Session 2010-11 of M.Sc.Semester-I & onwards to all subjects in the faculty of Science and framing of Regulation for the above examination is likely to take some time.

AND

Whereas, the admission of students in the above pattern at M.Sc. Part-I (Semester-I) of all subjects in the faculty of Science are to be made in the Academic Session 2010-11.

Now, therefore, I, Dr. Kamal Singh, Vice Chancellor of Sant Gadge Baba Amravati University, in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act., 1994, do hereby direct as under:

1. This Direction may be called `Scheme for Choice Based Credit System (CBCS) and Awarding Grades to the Post Graduate Students in the Faculty of Science, Direction, 2010.
2. This Direction shall come into force with effect from the examination as shown below for all subjects for the Examinations leading to the Degree of Master of Science in the faculty of Science-
 - (i) Winter 2010 examination for M.Sc. Part-I, Semester-I,
 - (ii) Summer-2011 examination for M.Sc. Part-I, Semester-II,
 - (iii) Winter-2011 examination for M.Sc. Part-II, Semester-III,
 - (iv) Summer-2012 examination for M.Sc. Part-II, Semester-IV.
3. The detailed Scheme for Choice Based Credit System (CBCS) and Awarding Grades to the Post Graduate students in the Faculty of Science is as given below-

I. The CBCS System

All Programmes (named after the Core subject) mentioned in para 9 of Ordinance No.4 of 2008 shall be run on Choice Based Credit System (CBCS) and the grades in 7 point scale will be awarded to the students. It is an instructional package developed to suit the needs of students to keep pace with the developments in higher education and the quality assurance expected of it in the light of liberalization and globalization in higher education.

II. Credits and Degrees

- i) A candidate who has successfully completed all the core courses Compulsory, Elective/ Specialised courses and project prescribed and optional approved by the University for the programme

and accumulated not less than 72 (52 core and elective) Credits and who has put in the minimum residence time shall be eligible to receive the degree.

- ii) One Credit shall mean one teaching period per week for one semester (of 16 weeks) for theory courses and one laboratory session of two periods / week for one semester. One teaching period shall be of 60 minutes duration including 10 minutes for discussion / movement.

III. Courses

- (i) **Core Course :-** A core course is a course that a student admitted to a particular programme must successfully complete to receive the degree. There may be two kinds of core courses: The **hard-core** courses which cannot be substituted by any other course and which must be successfully completed and **soft-core** courses which may be substituted by equivalent courses from the same department. In all P.G. programmes a project with 03 credits shall be included. The project may include a viva-voce examination with a credit of 1, Normally no theory course shall have more than 4 credits.
- (ii) **Elective Course :** Means a optional course from the basic subject or specialization.

The core credits for any P.G. programme (inclusive of hard-core, soft-core and project) shall not exceed 60 credits and shall not be less than 48 credits. Each Board of Studies shall specify the core-credit load for their respective programme apart from approving syllabi, for all the courses offered by the department.

(iii) General Interest Course (GIC)

The General Interest Course shall be the choice of student. The student who choose the GIC shall have to register for it on payment of fees as prescribed by the University.

The Departmental Committee shall follow a selection procedure on a first come first served basis, fixing the maximum number of students, after counselling to the students etc. to avoid overcrowding to particular course(s) at the expense of some other courses.

- (iv) Each **Course** is designed such that it includes lectures / tutorials / laboratory or field work / Seminar / Practical training / Assignments / Term paper / Report writing or review of literature and any other innovative practice etc., to meet effective teaching and learning needs.

- (v) **Attendance :-** Students must have 75% of attendance in each Core and Elective course for appearing the examination. However student having attendance less than 75% may apply to the H.O.D. for condonation of attendance upto 15% under the provision of para 6-A (i) of Ordinance No.6.

IV. Registration for General Interest Course :-

- i) Each student, on admission shall be assigned to a faculty advisor who shall advise the student about the academic programme and counsel him on the choice of courses listed in Appendix-Q depending on his general interest, academic background and objective.
- ii) With the advice and consent of the faculty advisor the student shall register for courses he plans to take for the semester before classes start. No student shall be permitted to register for courses exceeding 30 credits per semester including those of repeat courses nor shall any student be permitted to register for any course without satisfactorily completing the prerequisites for the course except with the permission of the concerned teacher in the prescribed format.
- iii) If the student feels he has registered for more courses than he can handle, he shall have the option of dropping one or more of the courses he has registered for, with the consent of his advisor before the end of 3rd week of the semester. However, a student, to retain his status, should have registered at least for core course and elective course of that semester.
- iv) Students, other than those freshly admitted, shall register for the courses of their choice in the preceding semester by filling in the prescribed forms.
- v) The University shall prescribe the maximum number of students in each General Interest Course taking into account the teachers and Physical facilities available in the Department.
- vi) The University may make available to all students a listing of all the courses offered in every semester specifying the credits, the prerequisites, a brief description or list of topics the course intends to cover, the instructor who is giving the courses, the time and place of the classes for the course. This information shall be made available on the University website.
- vii) Normally no course shall be offered unless a minimum of 10 students are registered.

- viii) The student shall have to pay the prescribed fee per course for the registration.

V. Programme Committee :-

There shall be the programme committee at the University level constituted as under-

- i) Dean of the faculty (Chairman)
- ii) Heads of all the Departments - (Member)
- iii) Three teachers from the affiliated colleges having post graduate courses other than University Department - nominated by the Vice-Chancellor. (Member)
- iv) Deputy Registrar (Acad) - (Secretary)

Duties and responsibilities of the Programme Committee shall be as under-

- i) To identify the General Interest Courses (GIC) as per the need of the student and availability of teachers in the Departments.
- ii) To approve the time table of GIC and make it available to the students before the commencement of respective semester. This time table also be made available on the University website.
- iii) To consider and approve the report of grievance redressal committee.
- iv) To remove the difficulties if any faced during implementation of the CBCS and report it to Hon'ble Vice-Chancellor for further action.
- v) Any other matter as it think fit for the effective implementation of CBCS.

VI. Departmental Committee

1. Every P.G. programme of the University/College shall be monitored by a committee constituted for this purpose by the Department.
The Committee shall consist of H.O.D. as a Chairman and all the teachers of the Deptt. of its members including one student members per class. There shall be atleast one student member on the committee.

VII. Grievances Redressal Committee

The University or College shall form a Grievance Redressal Committee for each course in each department with the Course Teacher and the HOD. This Committee shall solve all grievances relating to the Internal Assessment marks of the students.

VIII. Total credits per semester :-

Table-I
For all subjects other than Mathematics,
Biotechnology & Computer Science

Course	Credits				Total
	Sem-I	Sem-II	Sem-III	Sem-IV	
Core	12	12	12	12	48
Elective	04	04	04	04	16
GIC	00	04	04	04	12
Lab. Course	06	06	06	03	21
I.A.	04	04	04	04	16
Project	00	00	00	03	03
Total	26	26 or 30	26 or 30	26 or 30	116

Table-II
For Mathematics

Course	Credits				Total
	Sem-I	Sem-II	Sem-III	Sem-IV	
Core courses	12	12	12	12	48
Elective Courses	08	08	08	08	32
GIC	'	04	04	04	12
Internal Assessment	05	05	05	05	20
Project	'	'	'	04	04
Total	25	25 or 29	25 or 29	25 or 33	116

Table-III
For Biotechnology

Course	Credits				Total
	Sem-I	Sem-II	Sem-III	Sem-IV	
Core courses	16	12	12	08	48
Elective Courses	'	9	'	9	18
Lab courses	24	18	18	12	72
Seminar	'	01	01	'	02
Project				06	06
Assignment			02		02
Internal Assessment			02		02
Total	40	40	35	35	150

Table-IV
For Computer Science

Course	Credits				Total
	Sem-I	Sem-II	Sem-III	Sem-IV	
Core	25	20	15	10	70
Elective	-	05	05	05	15
GIC	-	-	05	-	05
Lab. Course	06	06	06	03	22
I.A.	-	-	-	02	02
Project	-	-	-	04/02	06
Total	31	31	31	26	119

IX. Grade Awards :-

- (i) A seven point rating scale is used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master's Programme. Grade points are based on the total number of marks obtained by him/her in all the heads of examination of the course. These grade points and their equivalent range of marks are shown separately in Table-I. The performance of the student in theory, practical, internal assessment, subjects shall be evaluated in accordance with following Table-I.

TABLE -I

Grade	Range of Marks obtained out of 100 or Equivalent fraction	Grade Points	Remarks (Not to be displayed On transcripts)
O	90-100	10	Outstanding
A+	80-89	9	Excellent
A	70-79	8	Very Good
B+	60-69	7	Good
B	55-59	6	Fair
C+	50-54	5	Average
C	40-49	4	Below Average
F	Below 40	0	Fail

TABLE-II: Final Grade Points for SGPA and CGPA

Grade Points	Final Grade	Remarks (Not to be displayed On transcripts)
9.00-10.00	O	Outstanding
8.00 – 8.99	A+	Excellent
7.00-7.99	A	Very Good
6.00-6.99	B+	Good
5.50 – 5.99	B	Fair
5.00 – 5.49	C+	Average
4.00 – 4.99	C	Below Average

Equivalence of the conventional division/class with the CGPA is in accordance with the following table no. 4.

Table III. Equivalence of Class/Division to CGPA

Sr.No.	CGPA	Class/Division
1	8.00 or more	First Class – Exemplary
2	7.50 or more but less than 8.00	First Class with Distinction
3	6.00 or more but less than 7.49	First Class
4	5.50 or more but less than 5.99	Higher Second Class
5	4.00 or more but less than 5.49	Second Class
6	Less than 4.00	Fail

The overall performance of a student is evaluated by assigning appropriate weightage to all the **four** semesters in order to maintain the quality of education. A student is permitted to appear for the semester examination subject to he or she has a minimum attendance of 75% in theory and practical classes, completes all his/her internal/ sessional assignments and clears all his/her dues. Non appearance in any examination is treated as the student having secured zero mark in that subject examination.

The evaluation is based on an average weightage system. Every subject has credit points based on the hours of study required. Every student is assessed in a subject with appropriate weightage to internal/ sessional work and semester examination, thereby making the students study regularly. Every student is awarded Grade points out of maximum 10 points in each subject (based on 7 Points Scale). Based on the Grade points obtained in each subject, Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) are computed.

X. Computation of SGPA & CGPA

Every student will be awarded points out of maximum 10 points in each subject. (based on 7 Points Scale). Based on the Grade points obtained in each subject the Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) are computed. The computation of SGPA & CGPA, is as under:

Semester Grade Point Average (SGPA) is the weighted average of points obtained by a student in a semester and is computed as follows:

$$SGPA = \frac{U1 \times M1 + U2 \times M2 + \dots + Un + Mn}{U1 + U2 + \dots + Un}$$

Where U1, U2, ũ .. are subject credit of the respective course and M1, M2, ũ .. are the Grade Points obtained in the respective subject (out of 10)

The Semester Grade Point Average (SGPA) for all the four semesters is also mentioned at the end of every semester.

The Cumulative Grade Point Average (CGPA) is used to describe the overall performance of a student in the course and is computed as under:

$$CGPA = \frac{\sum_{n=1}^4 SGPA(n)C_n}{\sum_{n=1}^4 C_n}$$

Where SGPA (n) is the nth Semester SGPA of the student and C_n is the nth Semester total credit. The SGPA and CGPA are rounded off to the second place of decimal.

XI. Internal Evaluation Method :-

- (i) At the beginning of each course, every teacher shall inform his/her students unambiguously the method he/she proposes to adopt for the continuous assessment. Normally the teacher concerned may conduct three written sessional examinations spread periodically during the semester and select best two for contributing to the final marks.
- (ii) At the end of each semester the Departmental Committee shall assign grades to the students.
- (iii) The Departmental Committee shall prepare the copies of the result sheet in duplicate.

- (iv) Every student shall have the right to scrutinize answer scripts of sessional/end-semester examinations and seek clarifications from the teacher regarding evaluation of the scripts immediately thereafter or within 3 days of receiving the evaluated scripts.
- (v) The Department shall display the grade points and grades for the notice of students.
- (vi) The department shall send all records of evaluation, including sessional evaluation, for safekeeping to the Controller of Examinations as soon as all the formalities are over.

XII. Grade Card

The University shall issue at the beginning of each semester a grade card for the student, containing the grades obtained by the student in the previous semester and his Semester Grade Point Average (SGPA).

The grade card shall list:

- (a) the title of the courses along with code taken by the student
- (b) the credits associated with the course,
- (c) the grade and grade points secured by the student,
- (d) the total credits earned by the student in that semester.
- (e) the SGPA of the student,
- (f) the total credits earned by the students till that semester and
- (g) the CGPA of the student (At the end of the IVth Semester)

XIII. At the end of the IVth semester, the University shall issue the statement of marks to the Students showing details of marks obtained by the student in each Head in each semester along with grade total marks.

XIV. Power to modify and remove difficulties :-

1. Notwithstanding anything contained in the foregoing, Hon'ble V.C. in consultation with the Dean of the faculty shall have the power to issue directions or orders to remove any difficulty,
2. Nothing in the foregoing may be construed as limiting the power of the University to amend, modify or repeal any all of the above.

sd/-

Amravati
Date : 2/6/2010

(Dr.Kamal Singh)
Vice-Chancellor

**Examination Scheme under C.B.C.S. for the subject other than
Mathematics, Biotechnology and Computer Science in the
faculty of Science
M.Sc. Part-I
Semester-I**

SA-Subject abbreviation; C-Core; E- Elective

Sr.No.	Paper / Code	Course	Theory				Practical		
			Max. Marks (Credits)	Min Pass Marks (Min. Grade Pt.)	Int. Ass. (Credits)	Min. Pass Marks (Min. Grade Pt.)	Th + Int. Ass. Min. Pass Mar (Grade Pt.)	Max. Marks (Credit)	Min. Marks marks (Min. Grade Point)
1	2	3	4	5	6	7	8	9	10
1	ISA-1	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
2	ISA-2	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
3	ISA-3	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
4	ISA-4	E	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
5	ISA-5	Lab-I	'	'	'	'	'	100 (03)	40 (04)
6	ISA-6	Lab-II	'	'	'	'	'	100 (03)	40 (04)

Total Marks : 600; Minimum Total Credits : 26

- Note :-** (1) If the student has scored minimum marks or minimum grade points mentioned in Column No.8 out of the sum of total marks of theory and internal assessment taken together then he/she will be declared to have cleared with (04+01) 05 credits.
- (2) If the student has scored minimum marks or minimum grade points in either theory or in internal assessment then he/she will be declared to have cleared in that particular head.

**Examination Scheme under C.B.C.S. for the subject other than
Mathematics, Biotechnology and Computer Science in the faculty
of Science**

M.Sc. Part-I

Semester-II

SA-Subject abbreviation; C-Core; E-Elective; GIC-General Interest Course

Sr.No.	Paper / Code	Course	Theory				Practical		
			Max. Marks (Credits)	Min Pass Marks (Min. Grade Pt.)	Int. Ass. (Credits)	Min. Pass Marks (Min. Grade Pt.)	Th + Int. Ass. Min.Pass Mar (Grade Pt.)	Max. Marks (Credit)	Min. Marks marks (Min. Grade Point)
1	2	3	4	5	6	7	8	9	10
1	2SA-1	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
2	2SA-2	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
3	2SA-3	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
4	2SA-4 Or 2GIC-X	E and/or GIC	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
5	2SA-5	Lab-III	'	'	'	'	'	100 (03)	40 (04)
6	2SA-6	Lab-IV	'	'	'	'	'	100 (03)	40 (04)

Total Marks : 600; Minimum Total Credits : 26

- Note :-** (1) If the student has scored minimum marks or minimum grade points mentioned in Column No.8 out of the sum of total marks of theory and internal assessment taken together then he/she will be declared to have cleared with (04+01) 05 credits.
- (2) If the student has scored minimum marks or minimum grade points in either theory or in internal assessment then he/she will be declared to have cleared in that particular head.

**Examination Scheme under C.B.C.S. for the subject other than
Mathematics, Biotechnology and Computer Science
in the faculty of Science**

M.Sc. Part-II

Semester-III

SA-Subject abbreviation; C-Core; E-Elective; GIC-General Interest Course

Sr.No.	Paper / Code	Course	Theory				Practical		
			Max. Marks (Credits)	Min Pass Marks (Min. Grade Pt.)	Int. Ass. (Credits)	Min. Pass Marks (Min. Grade Pt.)	Th + Int. Ass. Min.Pass Mar (Grade Pt.)	Max. Marks (Credit)	Min. Marks marks (Min. Grade Point)
1	2	3	4	5	6	7	8	9	10
1	3SA-1	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
2	3SA-2	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
3	3SA-3	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
4	3SA-4 Or 3GIC-Y	E and/or GIC	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
5	3SA-5	Lab-V	'	'	'	'	'	100 (03)	40 (04)
6	3SA-6	Lab-VI	'	'	'	'	'	100 (03)	40 (04)

Total Marks : 600; Minimum Total Credits : 26

- Note :-** (1) If the student has scored minimum marks or minimum grade points mentioned in Column No.8 out of the sum of total marks of theory and internal assessment taken together then he/she will be declared to have cleared that (04+01) 05 credits.
- (2) If the student has scored minimum marks or minimum grade points in either theory or in internal assessment then he/she will be declared to have cleared in that particular head.

Appendix-D

**Examination Scheme under C.B.C.S. for the subject other than
Mathematics, Biotechnology and Computer Science
in the faculty of Science**

**M.Sc. Part-II
Semester-IV**

SA-Subject abbreviation; C-Core; E-Elective; GIC-General Interest Course

Sr.No.	Paper / Code	Course	Theory				Practical		
			Max. Marks (Credits)	Min Pass Marks (Min. Grade Pt.)	Int. Ass. (Credits)	Min. Pass Marks (Min. Grade Pt.)	Th + Int. Ass. Min.Pass Mar (Grade Pt.)	Max. Marks (Credit)	Min. Marks marks (Min. Grade Point)
1	2	3	4	5	6	7	8	9	10
1	4SA-1	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
2	4SA-2	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
3	4SA-3	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
4	4SA-4 Or 4GIC-Z	E and/or GIC	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)	'	'
5	4SA-5	Lab-V	'	'	'	'	'	100 (03)	40 (04)
6	4SA-6	Project	'	'	'	'	'	100 (03)	40 (04)

Total Marks : 600; Minimum Total Credits : 26

- Note :-** (1) If the student score Minimum Marks or Minimum Grade Points mentioned in Column No.8 out of the sum total marks of theory and internal assessment taken together then he/she will be declared to have clear (04+01) 05 credits.
- (2) If the student score Minimum Marks or Minimum Grade Points in either theory or in internal assessment then he/she will be declared to have clear in that Particular Head.

Appendix-E

**Examination Scheme under C.B.C.S. for the subject
Mathematics in the faculty of Science**

**M.Sc. Part-I
Semester-I**

Sr.No.	Paper / Code	Course	Theory				
			Max. Marks (Credits)	Min Pass Marks (Min. Grade Pt.)	Int. Ass. (Credits)	Min. Pass Marks (Min. Grade Pt.)	Th + Int. Ass. Min.Pass Mar (Grade Pt.)
1	2	3	4	5	6	7	8
1	1MTH-1	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
2	1MTH-2	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
3	1MTH-3	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
4	1MTH-4	E	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
5	1MTH-5	E	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
			400 (20)		100 (05)		

Total Marks : 500; Total Credits : 25

- Note :-** (1) If the student score Minimum Marks or Minimum Grade Points mentioned in Column No.8 out of the sum total marks of theory and internal assessment taken together then he/she will be declared to have clear (04+01) 05 credits.
- (2) If the student score Minimum Marks or Minimum Grade Points in either theory or internal assessment then he/she will be declared to have clear either of the head.

**Examination Scheme under C.B.C.S. for the subject
Mathematics in the faculty of Science**

**M.Sc. Part-I
Semester-II**

Sr.No.	Paper / Code	Course	Theory				
			Max. Marks (Credits)	Min Pass Marks (Min. Grade Pt.)	Int. Ass. (Credits)	Min. Pass Marks (Min. Grade Pt.)	Th + Int. Ass. Min.Pass Mar (Grade Pt.)
1	2	3	4	5	6	7	8
1	2MTH-1	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
2	2MTH-2	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
3	2MTH-3	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
4	2MTH-4	E	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
5	2MTH-5 and/or 2GIC-X	E and/or GIC	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
			400 (20)		100 (05)		

Total Marks : 500; Total Credits : 25

- Note :-** (1) If the student score Minimum Marks or Minimum Grade Points mentioned in Column No.8 out of the sum total marks of theory and internal assessment taken together then he/she will be declared to have clear (04+01) 05 credits.
- (2) If the student score Minimum Marks or Minimum Grade Points in either theory or internal assessment then he/she will be declared to have clear either of the head.

**Examination Scheme under C.B.C.S. for the subject
Mathematics in the faculty of Science**

**M.Sc. Part-II
Semester-III**

Sr.No.	Paper / Code	Course	Theory				
			Max. Marks (Credits)	Min Pass Marks (Min. Grade Pt.)	Int. Ass. (Credits)	Min. Pass Marks (Min. Grade Pt.)	Th + Int. Ass. Min.Pass Mar (Grade Pt.)
1	2	3	4	5	6	7	8
1	3MTH-1	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
2	3MTH-2	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
3	3MTH-3	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
4	3MTH-4	E	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
5	3MTH-5 and/or 3GIC-Y	E and/or GIC	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
			400 (20)		100 (05)		

Total Marks : 500; Min.Total Credits : 25

- Note :-** (1) If the student score Minimum Marks or Minimum Grade Points mentioned in Column No.8 out of the sum total marks of theory and internal assessment taken together then he/she will be declared to have clear (04+01) 05 credits.
- (2) If the student score Minimum Marks or Minimum Grade Points in either theory or internal assessment then he/she will be declared to have clear either of the head.

**Examination Scheme under C.B.C.S. for the subject
Mathematics in the faculty of Science**

**M.Sc. Part-I
Semester-IV**

Sr.No.	Paper / Code	Course	Theory				
			Max. Marks (Credits)	Min Pass Marks (Min. Grade Pt.)	Int. Ass. (Credits)	Min. Pass Marks (Min. Grade Pt.)	Th + Int. Ass. Min.Pass Mar (Grade Pt.)
1	2	3	4	5	6	7	8
1	4MTH-1	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
2	4MTH-2	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
3	4MTH-3	C	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
4	4MTH-4	E	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
5	4MTH-5 and/or 4GIC-Z and/or Project	E and/or GIC and/or Project	80 (04)	32 (04)	20 (01)	08 (04)	40 (04)
			400 (20)		100 (05)		

Total Marks : 500; Min.Total Credits : 25

- Note :-** (1) If the student score Minimum Marks or Minimum Grade Points mentioned in Column No.8 out of the sum total marks of theory and internal assessment taken together then he/she will be declared to have clear (04+01) 05 credits.
- (2) If the student score Minimum Marks or Minimum Grade Points in either theory or internal assessment then he/she will be declared to have clear either of the head.

Scheme of Teaching and Examination under C.B.C.S. for the Subject Biotechnology

M.Sc. (Biotechnology) SEMESTER PATTERN

M.Sc.Part-I (SEMESTER-I)

T: Lectures, P: Practical, TU: Tutorial/Assignment; G.I.C. – General Interest Course

S N	Subject Code	Paper	Course	Hrs/ Week		Credits		Examination Scheme								
								Theory				Practical				
				T	P/ TU	Theory	Pract.	Paper Hrs	Max External; Marks	Max Internal Marks	Total	Min Passing Grade Points	Max Marks Practical	Max Marks Int. Ass	Total	Min Passing Grade Points
1	1BTB-1	I	C	04	06	04		3	100		100	4	--	--	--	--
2	1BTB-2	II	C	04	06	04		3	100		100	4	--	--	--	--
3	1BTB-3	III	C	04	06	04		3	100		100	4	--	--	--	--
4	1BTB-4	IV	C	04	06	04		3	100		100	4	--	--	--	--
5	1BTB-5	Lab-I		--	P 01		12	--	--	--	--	--	80	20	100	5
6	1BTB-6	Lab-II		--	P 02		12	--	--	--	--	--	80	20	100	5
				16	24	16	24				400				200	

Total Credits: 40

Scheme of Teaching and Examination under C.B.C.S. for the Subject Biotechnology

M.Sc. (Biotechnology) SEMESTER PATTERN

M.Sc.Part-I (SEMESTER-II)

T: Lectures, P: Practical, TU: Tutorial/Assignment; G.I.C. – General Interest Course

S N	Subject Code	Paper	Course	Hrs/ Week		Credits		Examination Scheme								
								Theory				Practical				
				T	P/ TU	Theory	Practical	Paper Hrs	Max Theory	Max Internal	Total	Min Passing Grade Points	Max Marks Practical	Max Marks Int. Ass	Total	Min Passing Grade Points
1	2BTB-1	V	C	04	06	4		3	100		100	4	--	--	--	--
2	2BTB-2	VI	C	04	06	4		3	100		100	4	--	--	--	--
3	2BTB-3	VII	C	04	06	4		3	100		100	4	--	--	--	--
4	2BTB-4 and/or 2GIC-X	VIII	E and/or GIC	04	06	4		3		100	100	4	--	--	--	--
5	2BTB-5	Lab-III			P 02		12	--	--	--	--	--	80	20	100	5
6	2BTB-6	Lab-IV			P 02		12	--	--	--	--	--	80	20	100	5
		Total		16	25	16	24				400				200	

Total Credits: 40

Scheme of Teaching and Examination under C.B.C.S. for the Subject Biotechnology
M.Sc. (Biotechnology) SEMESTER PATTERN
M.Sc.Part-II (SEMESTER-III)

T: Lectures, P: Practical, TU: Tutorial/Assignment; G.I.C. – General Interest Course

S N	Subject Code	Paper	Course	Hrs/ Week		Credits		Examination Scheme								
								Theory				Practical				
				T	P/ TU	Theory	Pract.	Paper Hrs.	Max Theory	Max Internal	Total	Min Passing Grade Points	Max Marks Practical	Max Marks Int. Ass	Total	Min Passing Grade Points
1	3BTB-1	IX	C	04	06	04		3	100	--	100	4	--	--	--	--
2	3BTB-2	X	C	04	06	04		3	100	--	100	4	--	--	--	--
3	3BTB-3	XI and 3GIC-Y	C and GIC	04	06	04		3	100	--	100	4	--	--	--	--
4	3BTB-4	Lab-V			P 02		18	--	--	--	--	--	80	20	100	5
5	3BTB-5	Internal Assessment			01		02		--	--	--	--	--	75	75	5
6	3BTB-6	Assignment					02		--	--	--	--	--	50	50	5
7		Seminar			01	1		-	--	--	--	--	--	75	75	5
		Total		12	20	13	22	-	--	--	300	--	--	--	300	--

Total Credits: 35

Scheme of Teaching and Examination under C.B.C.S. for the Subject Biotechnology
M.Sc. (Biotechnology) SEMESTER PATTERN
M.Sc.Part-II (SEMESTER-IV)

T: Lectures, P: Practical, TU: Tutorial/Assignment; G.I.C. – General Interest Course

S N	Subject Code	Paper	Course	Hrs/ Week		Credits		Examination Scheme								
								Theory				Practical				
				T	P/ TU	Theory	Pract.	Paper Hrs.	Max Theory	Max Internal	Total	Min Passing Grade Points	Max Marks Practical	Max Marks Int. Ass	Total	Min Passing Grade Points
1	4BTB-1	XII	C	04	06	04		3	100	--	100	4	--	--	--	--
2	4BTB-2	XIII	C	04	06	04		3	100	--	100	4	--	--	--	--
3	4BTB-3 and/or 4GIC-Z	XIV	E and/or GIC	04	06	04		3		100	100	4	--	--	--	--
4	4BTB-4	Lab-VI					18						80	20	100	5
5	4BTB-5	Project			06		06						200	--	200	5
		Total		12	24	12	24	-	--	--	300	--	--	--	300	--

Total Credits: 35

Scheme of Teaching and Examination under C.B.C.S. for the subject Computer Science
M.Sc. (Computer) SEMESTER PATTERN
M.Sc.Part-I (SEMESTER-I)

T: Lectures, P: Practical, TU: Tutorial/Assignment; G.I.C. – General Interest Course, C-Core

S N	Subject Code	Paper	Course	Hrs/ Week		Credits		Examination Scheme									
								Theory				Practical					
				T	P/ TU	Theory	Practical	Paper Hrs	Max External; Marks	Max Internal Marks	Total	Min Passing Grade Points	Max Marks Practical	Max Marks Int. Ass	Total	Min Passing Grade Points	
1	1MCS-1	I	C	5	-	5	-	3 Hrs	100	-	100	40	4.00				
2	1MCS-2	II	C	5	-	5	-	3 Hrs	100	-	100	40	4.00				
3	1MCS-3	III	C	5	-	5	-	3 Hrs	100	-	100	40	4.00				
4	1MCS-4	IV	C	5	-	5	-	3 Hrs	100	-	100	40	4.00				
5	1MCS-5	V	C	5	-	5	-	3 Hrs	100	-	100	40	4.00				
6	1MCS-6	Lab-I	-	-	7	-	03										
7	1MCS-7	Lab-II	-	-	7	-	03							100	-	100	40 4.0
		Total		25	14	25	06							100	-	100	40 4.0

Total Credits: 40

Scheme of Teaching and Examination under C.B.C.S. for the subject Computer Science
M.Sc. (Computer) SEMESTER PATTERN
M.Sc.Part-I (SEMESTER-II)

T: Lectures, P: Practical, TU: Tutorial/Assignment; G.I.C. – General Interest Course, C-Core

S N	Subject Code	Paper	Course	Hrs/ Week		Credits		Examination Scheme									
								Theory				Practical					
				T	P/ TU	Theory	Practical	Paper Hrs	Max Theory	Max Internal	Total	Min Passing Grade Points	Max Marks Practical	Max Marks Int. Ass	Total	Min Passing Grade Points	
1	2MCS-1	VI	C	5	-	5	-	3 Hrs	100	-	100	40	4.00				
2	2MCS-2	VII	C	5	-	5	-	3 Hrs	100	-	100	40	4.00				
3	2MCS-3	VIII	C	5	-	5	-	3 Hrs	100	-	100	40	4.00				
4	2MCS-4	IX	C	5	-	5	-	3 Hrs	100	-	100	40	4.00				
5	2MCS-5 Or 2GIC-X	X	E or GIC	5	-	5	-	3 Hrs	100	-	100	40	4.00				
6	2MCS-6	Lab-III	-	-	7	-	03	-	-	-	-						
7	2MCS-7	Lab-IV	-	-	7	-	03	-	-	-	-			100	-	100	40 4.0
				25	14	25	06							100	-	100	40 4.0

Total Credits: 40

Scheme of Teaching and Examination under C.B.C.S. for the subject Computer Science

M.Sc. (Computer) SEMESTER PATTERN

M.Sc.Part-II (SEMESTER-III)

Appendix-O

T: Lectures, P: Practical, TU: Tutorial/Assignment; G.I.C. – General Interest Course

S N	Subject Code	Paper	Course	Hrs/ Week		Credits		Examination Scheme									
								Theory				Practical					
								Paper Hrs.	Max Theory	Max Internal	Total	Min Passing Grade Points	Max Marks Practical	Max Marks Int. Ass	Total	Min Passing Grade Points	
T	P/ TU	Theory	Pract.														
1	3MCS-1	XI	C	5	-	5	-	3 Hrs	100	-	100	40	4.00				
2	3MCS-2	XII	C	5	-	5	-	3 Hrs	100	-	100	40	4.00				
3	3MCS-3	XIII	C	5	-	5	-	3 Hrs	100	-	100	40	4.00				
4	3MCS-4	XIV	E	5	-	5	-	3 Hrs	100	-	100	40	4.00				
5	3MCS-5 Or 3GIC-Y	XV	E or GIC	5	-	5	-	3 Hrs	100	-	100	40	4.00				
6	3MCS-6	Lab-V	-	-	7	-	03			-							
7	3MCS-7	Lab-VI	-	-	7	-	03			-				100	-	100	40 4.0
		Total		25	14	25	06							100	-	100	40 4.0

Total Credits: 35

Scheme of Teaching and Examination under C.B.C.S. for the subject Computer Science

M.Sc. (Computer) SEMESTER PATTERN

M.Sc.Part-II (SEMESTER-IV)

Appendix-P

T: Lectures, P: Practical, TU: Tutorial/Assignment; G.I.C. – General Interest Course

S N	Subject Code	Paper	Course	Hrs/ Week		Credits		Examination Scheme									
								Theory				Practical					
								Paper Hrs.	Max Theory	Max Internal	Total	Min Passing Grade Points	Max Marks Practical	Max Marks Int. Ass	Total	Min Passing Grade Points	
T	P/ TU	Theory	Pract.														
1	4MCS-1	XVI	C	5	-	5	-	3 Hrs	100	-	100	40	4.00				
2	4MCS-2	XVII	C	5	-	5	-	3 Hrs	100	-	100	40	4.00				
3	4MCS-3 Or 4GIC-Z	XVIII	E or GIC	5	-	5	-	3 Hrs	100	-	100	40	4.00				
4	4MCS-4	Lab-VII	-	-	7	-	03	4 Hrs	-	-	-	-	-	100		100	40 04
5	4MCS-5	Project	-	-	7	-	03+1			-	-	-	-	100	50	100	40 04
6	4MCS-6	Seminar	-	02	-	-	01+1			-	-	-	-	100	50	150	60 04
7	4MCS-7	Internal Assesment	-	06	-	-	02			-	-	40	4.00		50	50	20 04
		Total		23	14	15	11										

Total Credits: 35

**List of General Interest Courses (GIC) to be opted
by the student/s in Semester-II**

Sr.No.	Subject	Subject Code Elective	Equivalent General Interest Course Code
1	2	3	4
1	Chemistry	2CHE3	2GIC-1
		2CHE4	2GIC-2
2	Physics	2PHY3	2GIC3
		2PHY4	2GIC4
3	Mathematics	2MTH4	2GIC5
		2MTH5	2GIC6
4	Zoology	2ZOO3	2GIC7
		2ZOO4	2GIC8
5	Botany	2BOT3	2GIC9
		2BOT4	2GIC-A
6	Statistics	2SCA3	2GIC-B
		2SCA4	2GIC-C
7	Biotechnology	2BTB3	2GIC-D
		2BTB4	2GIC-E
8	Computer Science	2CMS3	2GIC-F
		2CMS4	2GIC-G
9	Microbiology	2MCB3	2GIC-H
		2MCB4	2GIC-I
10	Electronics	2ELE3	2GIC-J
		2ELE4	2GIC-K
11	Biochemistry	2BMC3	2GIC-L
		2BMC4	2GIC-M
12	Geology	2GEO3	2GIC-N
		2GEO4	2GIC-O
13	Bioinformatics	2BIT3	2GIC-P
		2BIT4	2GIC-Q
14	Environmental Science	2ENV3	2GIC-R
		2ENV4	2GIC-S
15	Geoinformatics	2GIT3	2GIC-U
		2GIT4	2GIC-V
16	Computer Software	2CSW3	2GIC-W
		2CSW4	2GIC-1A
17	Remote Sensing and GIS	2RSG3	2GIC-1B
		2RSG4	2GIC-1C
18	Pharmaceutical Chemistry	2PCH3	2GIC-1D
		2PCH4	2GIC-1E

Note : Title of the paper shall prescribed in the respective prospectuses.

No. : 27 / 2010

Date : 24.6.2010

Subject : Examinations leading to the Degree of विज्ञान पारंगत (Master of Science) (Four Semester Degree Course), Direction, 2010.

Whereas, Ordinance No.4 of 2008 in respect of Examinations leading to the Degree of विज्ञान पारंगत (Master of Science) (Four Semester Degree Course) Ordinance, 2008 is in existence in the University.

AND

Whereas, the Academic Council in its meeting held on 28.5.2010 vide item No.36 has approved the policy decision regarding introduction of Scheme for Choice Based Credit System (CBCS) and Awarding Grades to the Post Graduate Students in the Faculty of Science, for all subjects along with Draft Regulation in this behalf.

AND

Whereas, due to implementation of Scheme for Choice Based Credit System (CBCS) and Awarding Grades to the Post Graduate Students in the Faculty of Science, the provision under Ordinance No.4 of 2008 need to be revised accordingly.

AND

Whereas, admission to students for M.Sc. Part-I (Semester-I) for all subjects in the faculty of Science are to be made in the Academic Session 2010-11 in choice based credit system (C.B.C.S.).

AND

Whereas, making amendments in Original Ordinance No.4 of 2008 is likely to take some time.

Now, therefore, I, Dr. Kamal Singh, Vice Chancellor of Sant Gadge Baba Amravati University, in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act., 1994, do hereby direct as under:

1. This Direction may be called `Examinations leading to the Degree of विज्ञान पारंगत (Master of Science) (Four Semester Degree Course), Direction, 2010_.
2. This direction shall come into force from the date of its issuance.
3. The word `or Biochemistry_ in clause i) of sub-para (i) of para 5 shall be deleted.
4. The title of the subject `Electronics (Instrumentation)_ be substituted as `Electronics_ wherever occur in the Ordinance.
5. Following shall be the eligibility criteria for admission to M.Sc. Part-I Semester-I for the subjects - (i) Pharmaceutical Chemistry, (ii) Biotechnology, (iii) Computer Science.

- (a) for admission to M.Sc. Pharmaceutical Chemistry a candidate shall have offered Chemistry or Industrial Chemistry or Biochemistry as a subject of study and examination at the B.Sc. Degree.
- (b) following shall be the eligibility for admission to M.Sc. Semester-I (Biotechnology) -
- (i) B.Sc. in any discipline of Life Sciences, Bio Sciences or Bachelor's Degree in Agriculture, Veterinary and fishery Sciences, Pharmacy, or Bachelor of Medicine and Bachelor of Surgery (M.B.B.S.) or Bachelor of Dental Surgery or equivalent examination recognized by Sant Gadge Baba Amravati University are eligible to appear in entrance test as given in para (iii) below.
 - (ii) The student should have minimum 50% marks as aggregate in the degree course.
 - (iii) The student will have to pass entrance examination for admission in M.Sc. Semester-I (Biotechnology) as per the Sant Gadge Baba Amravati University rules.
- (c) following shall be the eligibility for admission to M.Sc. Semester-I (Computer Science) -
- i. A person who has passed the Degree of Bachelor of Science of this university with Computer Science / Computer Application (Vocational) as on the subjects.
OR
 - ii. A person who has passed B.A. / B.Sc. with Mathematics plus Post Graduate Diploma in Computer Science of this University.
OR
 - iii. A person who has passed a Degree of Bachelor of Computer Science.
6. The following subject be inserted in para 9) of the Ordinance after Sr.No. `15. Bioinformatics_`
`16. Computer Software,
17. Computer Science
18. Biotechnology, and
19. Pharmaceutical Chemistry.
7. A person who desire to improve the division obtained by him/her at M.Sc. examination shall be eligible for improvement of division under the provision of Ordinance No.6 of 2008. However, for improvement of division he/she shall have to offer the core courses only. In no case he/she shall be allowed for improvement of division/grade/CGPA by offering General Interest Course.

8. The number of papers and marks allotted to each subject and the minimum marks which an examinee must obtained in order to pass the examination shall be as indicated in Appendices, appended with the Regulation.
9. The classification in reference to the class/division/grade to be awarded to the examinee shall be as per the Table-III (Equivalence to Class / Division to CGPA) of para No.IX, appended to the Regulation.
10. As soon as possible after the examination, but not later than 30th, June following, the B.O.E. shall publish a list of successful examinees arranged in Division as mentioned in Table-III (Equivalence to Class / Division to CGPA) of para No.IX, appended to the Regulation. The names of examinees passing the examination as a whole in the minimum prescribed period and obtaining the prescribed number of places in each subject in the division as per Table-III of the Regulation shall be arranged in order of merit as provided in the Examinations in General Ordinance No.6.

Amravati
Date : 21/6/2010

Sd/-
(Dr.Kamal Singh)
Vice-Chancellor

DIRECTION

No. :39/ 2011

Date :23.8.2011

Subject : Corrigendum to Direction No. 26/2010

Whereas, the Direction No.26 of 2010 in respect of Scheme of Choice Based Credit System (CBCS) and awarding Grades to the Post Graduate students in the faculty of Science is in existence.

AND

Whereas, the Academic Council in its emergent meeting held on 28.5.2010 vide item No.36 has approved the decision regarding introduction of scheme for C.B.C.S. and Awarding grades to the P.G. students in the faculty of Science under Ordinance No.4 of 2008..

AND

Whereas, in sub-para V of para 3, under Direction No.26 of 2010, there shall be Programme Committee and the duties of the Programme Committee shall be to remove the difficulties if any faced during implementation of C.B.C.S. and report it to Hon`ble Vice-Chancellor for further action and any other matter as it think fit for the effective implementation of C.B.C.S.

AND

Whereas, the Programme Committee in its meetings held on 14.7.2011, 20.7.2011, 30.7.2011 & 9.8.2011 has recommended necessary corrections in the above Direction which will be effective from the academic session 2011-12. The minutes of the Programme Committee was accepted by Hon`ble Vice-Chancellor on dated 22.8.2011.

AND

Whereas, it is necessary to carry out the corrections in the above said Direction immediately.

Now, therefore, I, Dr.Mohan K.Khedkar, Vice Chancellor of Sant Gadge Baba Amravati University, in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act., 1994, do hereby direct as under:

1. This Direction may be called `Corrigendum to Direction No.26/2010.
2. This direction shall come into force from the date of its issuance.
3. (A) In Direction No.26/2010 in respect of Scheme of Choice Based Credit System (CBCS) and awarding Grades to the Post Graduate students in the faculty of Science following paras be corrected as follows :

- i) In para II, sub para (i) of para 3 in the fifth line after the words :less than` the figure, sign, and words :72 (52 core and elective)` be substituted by the figures, sign, and words :88(64 core and elective)`
- ii) In para VI: the title `Departmental Committee_ be replaced as `Programme Monitoring_ and Para 1 be completely deleted. Instead of this, the new para should be `Every P.G. programme of the University/College shall be monitored by the Head of the Department of the University/College of the concerned subject. _
- iii) The para VII shall be substituted as given below -
`VII. Grievance Redressal
All the grievances regarding Internal Assessment shall be settled by H.O.D. or the teacher of the department nominated by H.O.D. /Principal _.
- iv) In para IX : Table I: the grades in column No.2 shall be substituted as under -

"O	by	AA
A+	by	AB
A	by	BB
B+	by	BC
B	by	CC
C+	by	CD
C	by	DD"
- v) **In para X :**
 - i) In the first line the word :Grade` be added after the word :awarded` and before the word :points`.
 - ii) In third line the words :obtained in each subject` be substituted by the words :obtained in Core and Elective courses of the subject`
- vi) **In para XI :**
 - In sub para (i) in the first line the word `Head of the Department` be inserted after the words & sign `each course, _ and before the words `every teacher _.
 - The sentence `Normally the teacher concerned may conduct three written sessional examinations spread periodically during the semester and select best two for contributing to the final marks_ shall be deleted.
 - Sub para (ii) & (iii) be deleted completely.

- Sub para (iv) be renumbered as sub para (ii) and the word `teacher_ in the second line of the original sub para (iv) be substituted by the words `Head of Departments_.
 - Sub para (v) be renumbered as sub para (iii). In original sub para (v) the words `grade points and grades_ be deleted.
 - Sub para (vi) be deleted completely.
- vii) The word :Minimum printed below the table in Appendix A, B, C, D, G, and H, shall be deleted.
- viii) Following special explanatory Note be added below the table in Appendix-D, H, L, and P respectively.
Special Explanatory Note :- At the end of IVth semester, the students/examinee who accumulated atleast 88 credits (out of these 88 credits, 64 credits must be on core and elective course) and who has put in the minimum residence time shall be eligible to receive the degree in the subject he/she has admitted_.
- (B) The students should have accumulated 28 credits of M.Sc. Part-I, Sem-I & II taken together for admission to III Semester and should have completed the term of M.Sc. Part-I (Semester-I & II) satisfactorily.

Amravati
Date : 22/8/2011

Sd/-
(Mohan K.Khedkar)
Vice-Chancellor

DIRECTION

No. : 25 / 2012

Date : 29/6/2012

Subject : Corrigendum to Direction No.26/2010 and 39/2011

Whereas, the Direction No.26 of 2010 in respect of Scheme of Choice Based System (CBCS) and awarding Grades to the Post Graduate Students in the faculty of Science is in existence.

AND

Whereas, University has issued corrigendum to Direction No.26 of 2010 vide Direction No.39 of 2011 on dated 23.8.2011.

AND

Whereas, in sub-para V of para 3, under Direction No.26 of 2010, there shall be Programme Committee and the duties of the Programme Committee shall be to remove the difficulties if any faced during implementation of C.B.C.S. and report it to Hon `ble Vice-Chancellor for further action and any other matter as it think fit for the effective implementation of C.B.C.S.

AND

Whereas, the Programme Committee in its meeting held on 1st March, 2012 and 18th April 2012 has recommended necessary corrections in the above said Directions which shall be effective for 2011-12 session and the minutes of the Programme Committee was accepted by the Hon `ble Vice-Chancellor.

AND

Whereas, the Academic Council in its meeting held on 13.1.2012, vide item No.14(5) F) R-3, I) R-2 & R6 has accepted additional eligibility criteria for Admission to M.Sc. (Zoology), Direct admission to M.Sc. Part-II (Computer Science) for the students who have passed the degree of M.Sc. (Computer Software), and revised syllabi of M.Sc. (Computer Science), which is to be implemented from the Academic Session 2012-13.

AND

Whereas, it is necessary for carryout the corrections in the above said Direction immediately.

Now, therefore, I, Dr.Mohan K.Khedkar, Vice Chancellor of Sant Gadge Baba Amravati University, in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act., 1994, do hereby direct as under:

1. This Direction may be called `Corrigendum to Direction No.26/2010 and 39/2011_.
2. This direction shall come into force from the date of its issuance.

3. In Direction No.26/2010 in respect of Scheme of Choice Based System (CBCS) and awarding Grades to the Post Graduate Students in the faculty of Science, following corrections shall be carried out-

- A) i) In para 5th, the words and brackets `Degree of विज्ञान स्नातक (Bachelor of Science)_ shall be substituted as `Degree of विज्ञान पारंगत (Master of Science)_
 ii) The clause (i), of sub-para (II) of para 3 shall be deleted.
 iii) The clause (i), of sub-para (II) of para 3 shall be renumbered as para (i_) and new para (ii) shall be added as follows.

`Minimum total credits that students shall have to accumulate in all four semesters for receiving the M.Sc. degree core subject shall be as shown in the table given as under -

Subject/s	Minimum total credits (Core Elective and GIC)
All subjects other than Mathematics, Computer Science & Biotechnology	104
Computer Science	119
Biotechnology	150
Mathematics	100

- B) i) Under Table-III (Equivalence of Class/Division of CGPA) of Para IX,
 (a) the figures shown :7.49~, :5.99~, and :5.49~ against Sr.Nos.3, 4 & 5 in Column No.2 (CGPA) be substituted by the figures :7.50~, :6.00~, and :5.50~ respectively.
 (b) Following sub-para be added before the para :X`.

`Declaration of Merit List :- Merit list of M.Sc. (C.B.C.S.) examination shall be prepared from the examinee who have successively cleared minimum total credits including GIC as shown in the table assigned in the first attempt.

- ii) Special Explanatory note shown under Appendix-D, H, I, L and P shall be deleted.
 The note No.(2) printed under Appendix-A, B, C, D, E, F & H shall be substituted as follows-
 `If the student has not scored minimum marks or minimum grade points mentioned in column No. 8 and if the student scores minimum marks or minimum grade points in either theory or internal assessment then he/she will be declared to have cleared either of the head_.

4. In Direction No.39 of 2011, under para IX), in Table-I & II, under column No.2, i.e. `Grade Points_ and `Final Grade_ shall be substituted respectively as under.

`O	by	AA
A+	by	AB
A	by	BB
B+	by	BC
B	by	CC
C+	by	CD
C	by	DD_

5. As the revised syllabi has been accepted by the Academic Council, for the subject Computer Science of four theory papers to each semester therefore the Scheme of Examination for M.Sc. Semester-I to IV shall be as per Appendices-A, B, C & D appended to Direction No.26 of 2010, which is to be implemented for Semester-I from Winter-2012, Semester-II from Summer-2013, Semester-III from Winter-2013 & Semester-IV from Summer-2014 respectively.
 6. The students passing B.Sc. Agriculture with specialization Antomology and Fisheries shall be eligible for admission to M.Sc. Zoology with specialization Antomology and Fisheries respectively.
 7. The student having Degree of M.Sc. (Computer Software) shall be eligible for directly admission to M.Sc. Part II (Semester III) (Computer Science) in the faculty of science within the jurisdiction of sant Gadge Baba Amravati University, Amravati. The average percentage of Marks of M.Sc. (Computer software) and percentage of marks of M.Sc. (Computer Science) shall be considered to award class / Grade for awarding the degree of M.Sc. (Computer Science).

Amravati
 Date : 28/6/2012

Sd/-
 (Mohan K.Khedkar)
 Vice-Chancellor

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI
DIRECTION**

No. : 7 of 2014

Date: 07/05/2014

Subject : Corrigendum to Direction No.25 of 2012

Whereas, Direction No.25 of 2012 in respect of Corrigendum to Direction No.26/2010 and 39/2011 in the Faculty of Science is in existence in the University.

AND

Whereas, the Academic Council in its meeting held on 17.2.2014 vide item No.22 2) E) R-2 while considering the recommendations of Faculty of Science has approved the recommendation regarding award of M.Sc. (Computer Science) degree.

AND

Whereas, the matter is required to be regulated by framing the Ordinance and making of an Ordinance may likely to take some time.

AND

Whereas, the changes are to be made applicable from the Academic Session 2014-15.

Now, therefore, I, Dr.J.A.Tidke, Vice-Chancellor of Sant Gadge Baba Amravati University, Amravati in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act, 1994, do hereby direct as under:

- 1) This Direction may be called, `Corrigendum to Direction No.25 of 2012, Direction, 2014_
- 2) This Direction shall come into force w.e.f. the date of its issuance.
- 3) In Direction No.25 of 2012, in Para 7., the lines `The average percentage of Marks of M.Sc. (Computer software) and percentage of marks of M.Sc. (Computer Science) shall be considered to award class / Grade for awarding the degree of M.Sc. (Computer Science)_ be substituted by the lines **`The class / Grade for awarding the degree of M.Sc. (Computer Science) shall be awarded on the basis of performance at M.Sc. Part-II (Computer Science) only.**

Date : 3/5/2014

Sd/-
(Dr.J.A.Tidke)
Vice-Chancellor
Sant Gadge Baba Amravati University

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI
DIRECTION**

No. : 8 of 2014

Date : 07/05/2014

Subject :Corrigendum to Direction No. 14 of 2009 in respect of Examinations leading to the Degree of विज्ञान पारंगत (Master of Science) (Four Semester Degree Course).

Whereas, Ordinance No.4/2008 in respect of Examinations leading to the Degree of विज्ञान पारंगत (Master of Science) (Four Semester Degree Course), Ordinance, 2008, in the Faculty of Science is in existence in the University.

AND

Whereas, Direction No. 14 of 2009 in respect of Examinations leading to the Degree of विज्ञान पारंगत (Master of Science) (Four Semester Degree Course) in the Faculty of Science is in existence in the University.

AND

Whereas, the Academic Council in its meeting held on 17.2.2014 vide item No.22 2) E) R-1 while considering the recommendations of Faculty of Science has approved the B.C.A. degree holders of this University are eligible for admission to M.Sc. (Computer Software) course.

AND

Whereas, the matter is required to be regulated by framing the Ordinance and making of an Ordinance may likely to take some time.

AND

Whereas, the changes are to be made applicable from the Academic Session 2014-15.

Now, therefore, I, Dr.J.A.Tidke, Vice-Chancellor of Sant Gadge Baba Amravati University, Amravati in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act, 1994, do hereby direct as under:

- 1) This Direction may be called, `Corrigendum to Direction No. 14 of 2009 in respect of Examinations leading to the Degree of विज्ञान पारंगत (Master of Science) (Four Semester Degree Course) Direction 2014. _
- 2) This Direction shall come into force w.e.f. the date of its issuance.

- 3) In Direction No. 14 of 2009 in respect of Examinations leading to the Degree of विज्ञान पारंगत (Master of Science) (Four Semester Degree Course), in para 3., after the lines ` A person who has passed the Degree of Bachelor of Science with Post Graduate Diploma in Computer Science of this University OR ` following lines be inserted

`The Candidates having B.C.A. degree of this University shall be eligible to take admission to M.Sc. Part-I (Computer Software) course OR `

Date : 3/5/2014

Sd/-
(Dr.J.A.Tidke)
Vice-Chancellor
Sant Gadge Baba Amravati University

**Syllabus Prescribed for
M.Sc Part I Microbiology (Semester I)**

THEORY

Paper I	Microbial Techniques	100 (80 + 20*) Marks
Paper II	Microbial Enzymology	100 (80 + 20*) Marks
Paper III	Microbial Physiology and Photosynthesis	100 (80 + 20*) Marks
Paper IV	Environmental Microbiology	100 (80 + 20*) Marks

PRACTICAL

Practical I	Soil Microbiology	100 Marks
Practical II	Analytical Biochemistry and Instrumentation	100 Marks

M. Sc Part I Microbiology (Semester II)

THEORY

Paper V	Biostatistics, Bioinformatics and Computer Applications	100 (80 + 20*) Marks
Paper VI	Enzyme Technology	100 (80 + 20*) Marks
Paper VII	Microbial Metabolism	100 (80 + 20*) Marks
Paper VIII	Environmental Microbiology and Extremophiles	100 (80 + 20*) Marks

PRACTICAL

Practical III	Environmental Microbiology and Biodiversity	100 Marks
Practical IV	Microbial Enzymology, Biostatistics and Computer Applications	100 Marks

M. Sc Part II Microbiology (Semester III)

THEORY

Paper IX	Molecular Biology	100 (80 + 20*) Marks
Paper X	Virology	100 (80 + 20*) Marks
Paper XI	Fermentation Technology	100 (80 + 20*) Marks
Paper XII	Immunology	100 (80 + 20*) Marks

PRACTICAL

Practical V	Fermentation Technology	100 Marks
Practical VI	Immunology and Medical Microbiology	100 Marks

M. Sc Part II Microbiology (Semester IV)

THEORY

Paper XIII	Biotechnology	100 (80 + 20*) Marks
Paper XIV	Clinical Virology	100 (80 + 20*) Marks

Paper XV	Microbial Technology	100 (80 + 20*) Marks
Paper XVI	Medical Microbiology	100 (80 + 20*) Marks

PRACTICAL

Practical VII	Applied Microbiology and Biotechnology	100 Marks
Project	Project Work	100 Marks

*** Internal assessment marks for theory Paper**

Notes:

The practical schedule of M.Sc. (Microbiology) should be as follows:

- Each practical in M.Sc. Part I should be of 8 hours duration per week (4 hrs /day for two consecutive days).
- Each practical in M.Sc. Part II (Practical II, project work & I) should be of 8 hours duration per week (8 hrs/days) for two days).
- Atleast 70% practicals should be performing during each semester.
- Examination of each practical should be at least for 10 Hr. (Split over two days)

M.Sc. Part I (Semester I) (MICROBIOLOGY) EXAMINATION

PAPER-I

MICROBIAL TECHNIQUES

- Unit-I : **Biological Relevance of pH and Buffers:-** The pH depends ionization of amino acids and proteins. Isoionic and isoelectric points. Effects of the pH change on non-protein protoplasmic components. The pH and metabolic reactions involving proton.
- Unit-II : **Absorption and Emission of Radiation:** Principles laws of absorption of radiation, visible ultraviolet and infrared Spectrophotometry. Absorption spectra, fluorescence, fluorometry, flame photometry, NMR, ESR.
- Unit III : **Isotopic Tracers techniques in Biology:-** Stable and radioactive isotopes, preparation, labeling, detection and measurement of isotopes. Dilution technique, Kinetics of radioactive disintegration.
- Unit-IV : **Chromatography:** Paper, Column, thin layer, Gas, Ion exchange and affinity chromatography, Gel filtration.
- Unit-V : **Electrophoresis:** Moving boundary, Zone (paper, gel etc.) electrophoresis. Immunoelectrophoresis, Isoelectric focussing.

PAPER-II
MICROBIAL ENZYMOLOGY

Unit-I : GENERAL INTRODUCTION :

- a) Introduction of Enzymology, Various terminologies, Properties of enzymes.
- b) Enzymes as catalyst.
- c) Enzyme activity units.

- Unit II:**
- a) Enzyme isolation and purification - Importance of purification, Methods of Purification and fractionation.
 - b) Criteria of purity of enzymes - Tests of homogeneity.
 - c) Classification, of enzymes - IUB nomenclature.
 - d) Constitutive, Inducible and marker enzymes.

Unit-III: ENZYME KINETICS:

- a) Importance of Kinetic Study
- b) Effect of Enzyme concentration on progress curves.
- c) Effect of pH and Temperature.
- d) Effect of Substrate concentration - Concepts of ES complex, Steady state and Rapid state equilibrium kinetics, Derivation of Henry - Michaelis - Menten equation of rectangular hyperbola, Significance of Vmax and Km, Transformation of H.M.M. equation to a straight line equation, Construction of Lineweaver - Burk Plot, Single and Double reciprocal plots, Limitations of H.M.M. equation, Sigmoidal saturation kinetics, Co-operatively of an enzyme, Hill's equation, steady kinetics (Haldane and Briggs equation).
- e) Bisubstrate enzyme kinetics.

- Unit- IV**
- a) Types of inhibitors (reversible and irreversible), Kinetics of enzyme inhibition (competitive, non-competitive, uncompetitive and mixed inhibitors), Graphical presentation of inhibition effects.
 - b) Kinetics of reversible reactions (Haldane's relationship)
 - c) Mechanism of action of lysozyme.
 - d) Enzyme activators, Co-enzymes and Co-factors in enzymatic catalysis.

Unit-V: MECHANISM OF ENZYME ACTION :

- a) Concept of enzyme and substrate specificity.
- b) Chemistry of active Centre, chemical modification by active site directed reagents.
- c) Factors affecting catalytic efficiency of enzymes-covalent proximate, orientation, distortion or strain, acid-base and nucleophilic effects.

- d) Various theories of mechanism of enzyme action.
- e) Mechanism of action of lysozyme.

PAPER-III
MICROBIAL PHYSIOLOGY AND PHOTOSYNTHESIS

- Unit-I : Membrane Transport :** Structure and organization of biological membranes. Types of cellular transport, Passive, facilitated, Active, Group translocation, membrane bound and binding protein transport systems. Carrier models. Liposomes. Ion transduction NaK⁺, ATPase.

- Unit II: Energy metabolism:** ATP cycle, Free energy, standard free energy change, conventions in biochemical energetic, Calculation of DG. Standard free energy of hydrolysis of phosphate, compounds, Reservoirs of high-energy phosphate groups, Energy rich bonds, Biological energy transducer.

- Unit-III : Bacterial and Mitochondrial respiration:** Respiratory chain in mitochondria and bacteria, Oxidation-reduction enzymes. Respiration linked proton translocation.

- Unit- IV : Oxidative phosphorylation:** Coupling of oxidative phosphorylation to electron transport. Uncouplers, inhibitors, Reactions of oxidative phosphorylation, Mechanisms of oxidative phosphorylation. Chemical coupling, Conformational coupling and chemiosmotic coupling mechanism

- Unit -V : Microbial photosynthesis:** Structure of photosynthetic pigments, Primary photochemistry PS I & PS II and electron transport. CO₂ fixation in bacterial photosynthesis, Anoxygenic and oxygenic photosynthesis, Halobacterial photosynthesis

PAPER-IV
ENVIRONMENTAL MICROBIOLOGY

- Unit-I : An Introduction :** Definition of environment, Interaction between environment and biota, Concept of the habitat in biosphere, Food Chain, Ecosystem, Community, homeostasis and ecosystem management.

Concept of sustainable development of ecosystem: Definition and Need of Sustainable developments. Role of bacterial technology in achieving sustainable development. Improvement and restoration of barren/degraded land. Pollution control, Renewable source of energy and fuel using microorganisms, biodiversity and its conservation

- Unit-II : **Advancement in Biogeochemical cycles :**
Nitrogen cycle : Symbiotic and non-symbiotic :N² fixation, Mechanism of nitrogenase, cross inoculation group and host specificity, energy input/output ratio of :N² fixation process in crop production, Biochemistry of Nitrate reduction.
- Unit -III : **Phosphorus cycle :** Significance of :P⁵ element, Occurrence and solubilization in nature, role of phosphobacter and mycorrhizae in crop production.
Carbon cycle - General aspects, generation and decay of detritus :C¹⁴ compounds, features of plant cell wall polysaccharides, cellulose & lignin degrading microorganisms, mechanism of enzymes and its products. Carbonic anhydrase and its role in carbon cycle.
Sulphur cycle - Significance of :S³² compound, microbial sulphur metabolism, sulphur oxidizing bacteria and mechanism, distribution of sulphur bacteria in nature, Biochemistry of sulphate reduction.
Selenium cycle - Significance and occurrence, metabolism, deficiency and toxicity.
- UNIT-IV : **Biochemistry and Microbiology of acid mine drainage:** Process of biochemistry, Iron oxidizing bacteria, Microbiology and Biochemistry of Metal and Metalloid transformation-ecological succession and control. Transformation of mercury, arsenic lead and tellurium. Biotransformation of pesticides.
- Unit V **Biodeterioration :** Concept of biodeterioration. Biodeterioration of Wood, Metal, pharmaceutical products and Stone Work.
Bioleaching: Introduction, application of bacterial leaching, leaching techniques, prospective of bioleaching.

PRACTICAL-I
Soil Microbiology

1. Study of antagonism in microorganism from soil.
2. Isolation of soil microorganisms.
3. Isolation, Identification, Enumeration of Nitrogen fixing microorganism from soil, rhizosphere, phyllosphere and root nodule.
 - a) Isolation of *Azotobacter* spp and *Azospirillum*
 - b) Isolation and cultivation of *Rhizobium* from soil and roots nodules.
 - c) Nodulation of legume roots - Leonard jar experiment.
 - d) Isolation of cyanobacteria
 - e) Isolation of phosphobacteria from soil.

4. Estimation of nitrogen by kjeldhal method.
5. Preparation of biofertilizer/Biopesticides, enumeration of titer inoculum
6. Application of bioinoculant through seed, seedling and soil test under pot condition.
7. Isolation and microscopic examination of iron and sulphur bacteria.

PRACTICAL-II
ANALYTICAL BIOCHEMISTRY AND INSTRUMENTATION

1. Estimation of sucrose in presence of glucose.
2. Determination of pKa of amino acids.
3. Estimation of proteins by biuret method.
4. Estimation of protein by Folin-Ciocalteu method.
5. Ultraviolet spectroscopy of proteins.
6. Absorption spectrum of p-nitro phenol
7. Paper chromatography of amino acids.
8. Paper chromatography of sugars.
9. Paper chromatography of purine and pyrimidine bases.
10. Separation of proteins by paper electrophoresis.
11. Separation of protein by gel electrophoresis.
12. Separation of pigments by adsorption chromatography.
13. Thin layer chromatography.
14. Estimation of DNA.
15. Estimation of RNA.

Distribution of marks in University Practical Examination:

1. Long Experiments	-	15 marks.
2. Short Experiment	-	10 marks
3. Viva-voce examination	-	05 marks
4. Spotting	-	05 marks
5. Practical record book	-	05 marks
6. Internal Assessment	-	10 marks

Total - **50 marks**

M.Sc PART I (MICROBIOLOGY) EXAMINATION

(Semester –II)

PAPER-V

**BIostatistics, Bioinformatics
 AND COMPUTER APPLICATIONS.**

UNIT-I : Biostatistics :

- a) **Introduction:** Definition of Statistics, Statistical application in Biology, Types of statistics used in biology, sample statistics, test statistics, parametric Vs non-parametric

- b) **Sample and Sampling:** Introduction, selection of sample or sampling, theory-qualitative sample, random sample, non-random sample.
- c) **Graphical distribution of data:** Collection of data, classification of data, tabulation of data, graphic representation of data, diagrammatic representation of data
- d) **Measures of Central tendency:** Measures of central tendency, Mathematical averages, - arithmetic mean, Geometric mean, Harmonic mean, Average mean- Median and Mode.
- e) **Measures of Dispersion:** Definition, Range, Mean deviation, standard deviation, Standard error, Coefficients of variability, degree of freedom, confidence limit.

- Unit II:**
- a) **Test of Significance:** Standard error of mean, standard error of standard deviation, student's t-test, chi-square test.
 - b) **Probability:** Definitions, types of probabilities, Rule of probabilities, Random variable, probability distributions, theoretical probability distributions.
 - c) **Correlation:** Meaning of correlation, Definition, Kinds, properties of coefficient of correlation, method of studying.
 - d) **Regression:** Introduction. Difference between correlation and regression, objects of regression analysis, kinds of regression analysis, linear regression, regression equation, coefficient
 - e) **Vital statistics:** Introduction, definition, methods of obtaining vital statistics, principles, measurements of population, measures of vital statistics, measurements of Mortality, life table.

UNIT-III : Computer Fundamentals:

Basics of Computers, In-put and Out-put devices. Computer graphics. PC based software packages, Computer application in Microbiology/ Biology. Computer's role, Modern computers, personnel computers, hardware, and software, Internet, Modem, freeware, Usenet, file transfer protocol, HTML, Browsers, Home page, URL, Search Engine, IP address.

UNIT IV: Bioinformatics :

- a) Introduction, Definition, Importance, Analytical Approach, Application, Bioinformatics as tool, Role of bio and Chemoinformatics in drug designs, Bioinformatics in life sciences, Studying bimolecular structures.
- b) Biological Data base: Sequence database, Nucleic acid database, gene bank, proteins sequence data base, Swiss port, searching sequence data base, non reductant data base, Low annotation data base, specialized sequence data base, structure

data base, motif database, proteome data base, Other data base

- c) Sequence analysis:

Unit V : Bioinformatics Tools and Application

- a) Tools for Bioinformatics: Pair wise alignment, Dotplots, scoring matrices, Blosum Matrices, PAM matrix, Gap penalty, Alignment Algorithms EMBOSS,
- b) Proteins structure predictions: Secondary structure predictions, Tertiary structure Prediction, comparative modeling, folds recognition, Ab-initio prediction, Modeler, RASMOL.
- c) Software in Bioinformatics: C/C, BioPerl, Biojava, BIOXML, BioCorba, BioPython, BioDas, BioML, Oracle.
- d) Emerging areas in Bioinformatics: DNA microarrays, Functional Genomics, Comparative Genomics, Pharmacogenomics, cheminformatics, Medical informatics, Neural networks, phylogeny, whole cell stimulation, Human genome project.

PAPER-VI

ENZYME TECHNOLOGY

Unit-I : MECHANISM OF ENZYME ACTION :

- a) Enzyme activators, Co-enzymes and Co-factors in enzymatic catalysis.
- b) Concept of enzyme and substrate specificity.
- c) Mechanism of action of lysozyme.

Unit-II : CONTROL OF ENZYME ACTION :

- a) Regulation of enzyme activity-Feed-back control, enzyme introduction and repression, covalent modification.
- b) Multienzyme complexes and their significance in metabolic control.
- c) Membrane bound enzyme in metabolic regulation.

Unit III:

- d) Isoenzymes and their metabolic significance.
- e) Allosterism - allosteric enzymes and Co-operativity.
- f) Covalently modulated regulatory enzymes.

Unit IV: COMPARTMENTATION AND IMMOBILIZATION OF ENZYMES:

- a) Compartmentation of enzyme and substrate and its significance, Shuttle systems.
- b) Naturally occurring Activators, Inhibitors and Co-enzymes.
- c) Methods of enzyme immobilization, Industrial advantages. Immobilized multi-enzyme system.
- d) Kinetics of immobilized enzymes.
- e) Enzyme probes.

Unit V: ENZYME TECHNOLOGY:

- a) **Immobilization of Microbial enzymes:** Methods viz, adsorption, covalent bonding, entrapments and membrane confinement and their analytical, therapeutic and industrial application, Properties of immobilized enzymes.
- b) **Enzyme engineering:** Chemical modification and site - directed mutagenesis to study the structure, function relationship of industrially important enzymes.
- c) **Application of microbial enzymes:** Microbial enzymes in textile, leather, wood industries and detergents, enzyme in clinical diagnostics, Enzyme sensor for clinical processes and environmental analyses, Enzymes as therapeutic agents.

PAPER-VII**MICROBIAL METABOLISM**

UNIT-I : **Carbohydrate metabolism :** EMP, ED, HMP, and phosphoketolase pathways in different microorganism. Fate of pyruvate. Gluconeogenesis.

Tricarboxylic acid cycle: Discovery, Intracellular location, Reactions of the cycle. Amphibolic nature. Anaplerotic reactions, Glyoxylate pathway.

UNIT II : **Aerobic metabolism of C1 Compounds:** Oxidation of methane, methanol, formaldehyde and formate. Ribulose pathways, Serine pathway, Xylulose monophosphate pathway.

UNIT-III : **Nucleotide metabolism:** Biosynthesis of purine and pyrimidine nucleotides, biosynthesis of deoxyribonucleotides, Regulation of nucleotide synthesis. Catabolism of nucleotides. Formation of coenzyme nucleotides. Inhibitors of nucleotide synthesis.

UNIT IV **Microbial metabolism of aromatic compounds:** Ortho cleavage pathway, meta cleavage pathway, Gentisate pathway, reductive catabolism.

Catabolism of aromatic amino acids : Tyrosine, Tryptophan, phenylalanine

Lipid metabolism : Biosynthesis of fatty acids, triacylglycerol, phosphoglyceride, sphingomyeline and sphingolipids. Oxidation of saturated and unsaturated fatty acids.

UNIT-V : **Protein metabolism:** Assimilation of inorganic nitrogen, **Biosynthesis of amino acids:** Branched chain amino acids, Aromatic amino acids, Sulphur containing amino acids, Basic amino acids.

Catabolism of amino acids: Glutamine, glutamate,

Aspartate, Asparagine, L-alanine, D-alanine, proline, Serine, Glycine, Arginine, polyamines, Valine, Leucine and Isoleucine, Threonine, Lysine, Methionine, Cysteine.

PAPER-VIII**ENVIRONMENTAL MICROBIOLOGY AND EXTREMOPHILES**

UNIT-I : **Recalcitrant organic compounds and concept of biomagnification:** Definition of recalcitrant organic compounds and their presence in natural ecosystem, concept and consequences of biomagnification, biomagnification of chlorinated hydrocarbons and pesticides. Biodegradation of recalcitrant and toxic chemicals.

UNIT II : **Eutrophication, and its management:** Eutrophication, Microbial changes induced by organic and inorganic pollutants, role of phosphorus and nitrogen in eutrophication, process and control of eutrophication.

UNIT III : **Extremophiles** - acidophilic, alkalophilic thermophilic, barophilic and osmophilic microbes - mechanisms and adaptation. Halophiles - membrane variation - electron transport - application of thermophiles and extremophiles.

UNIT-IV : **Water Microbiology**

a) **Water treatment Process,** Disinfections, kinetics of disinfections, factors affecting disinfecting drinking water, Halogens, (Chlorine, Chloramines, Chlorine di-oxide, Bromine and iodine) ozones, metal ions, Ultraviolet disinfections,

b) **Water distribution systems,**

c) **Concept of indicator organisms,** Total coliform, MTD, MPN, MFT, P-A test, TTC, Fecal coliform, Fecal streptococci, Clostridium perfringens, Heterotrophic plate count, Bacteriophages, other indicator organisms, Standards and Criteria for indicators

UNIT V **Waste water Management:** Introduction to primary, secondary and tertiary treatment, activated sludge process, trickling filters, principles of anaerobic digestion, Methane formation with respect to waste treatment, Oxidation pond and stabilization pond, application of sewage, Aerated lagoons. Biochemistry of nitrate and sulphate reduction with a special reference to waste treatment.

PRACTICAL-III**ENVIRONMENTAL MICROBIOLOGY AND BIODIVERSITY**

- 1 Isolation of *Salmonella* from polluted water.
2. Isolation of phage from sewage water.

3. Assay of bacteriophages.
4. Demonstration of human enteric viruses.
5. Enumeration of coliform and faecal *Streptococci* by MF/MPN technique.
6. Examination and estimation of water for:
 - a) Ammonical nitrogen
 - b) nitrate
 - c) nitrite
 - d) dissolved oxygen
 - e) chlorides
 - f) sulphates
 - g) Chemical oxygen demand
 - h) biochemical oxygen demand
 - i) phosphates
 - j) calcium
 - k) magnesium
 - l) hardness
 - m) Alkalinity
 - n) solids-total dissolved & suspended
7. Enrichment of chemolithotrophs, methylotrophs, thermophiles, halophiles and acidophiles.
8. Enrichment and isolation of aliphatic hydrocarbon, phenol and parathion degraders
9. Study/Educational tour and submission of report.

PRACTICAL-IV

MICROBIAL ENZYMOLOGY, BIOSTATISTICS AND COMPUTER APPLICATION

1. Assay of following microbial enzymes.
 - a) Amylase
 - b) Lipase
 - c) Protease
 - d) Invertase
2. Isolation and purification of certain microbial enzymes such as: protease, amylase, invertase by salt fractionation, dialysis, ion exchange.
3. Evaluation of kinetic constants of the purified enzymes.
4. Effect of different parameters on enzymes activity such as:
 - a) pH
 - b) temperature
 - c) time
 - d) Enzyme concentration.
5. Effect of inhibitors on enzyme activity.
6. Fluidized bed column reactor using immobilized whole cell to study catabolism.
7. Immobilization of enzymes.
8. Students seminar and submission of report.
- b) BIOSTATISTICS:**
9. Organisation of data - frequency distribution.
10. Summarization of data -p describing a sample :
 - Measures of central tendency - arithmetic mean, mode, median.(for grouped data)
 - Measures of dispersion - variance and standard deviation.
11. Estimation of confidence interval for a normally distributed population.

12. Hypothesis testing - t-test, chi -square test, F-test.
13. Histograms.

D) COMPUTER SCIENCE AND BIOINFORMATICS :

- 14) Computer operations getting acquainted with different parts of computers.
Handling WINDOWS and Internet, E-mail and Internet. Use of CD ROM for literature search.
- 15) Accessign databases for nucleic acids and proteins.

Distribution of marks in University Practical Examination:

1.	Long Experiments	-	15 marks.
2.	Short Experiments	-	10 marks
3.	Viva-voce examination	-	05 marks
4.	Spotting	-	05 marks
5.	Practical record book	-	05 marks
6.	Internal Assessment	-	10 marks
Total		-	50 marks

M.Sc PART II (MICROBIOLOGY) EXAMINATION

(Semester –III)

paper-IX

Molecular biology

- Unit-I : Nucleic Acids :** Importance of nucleic acid in living systems, general composition of nucleic acids, purine and pyrimidine bases, tautomeric forms of bases, reactions of purines and pyrimidines, structure of nucleosides and nucleotides, deoxynucleotides, cyclic nucleotides and polynucleotides. Watson and Crick model for DNA. Different types of DNA and RNA
- Unit- II DNA Replication:**
- i) Enzymes of DNA replication in prokaryotes and eukaryotes, replication mechanisms in prokaryotes, eukaryotes, and phages.
 - ii) DNA repair mechanism
- Unit-III: a) Genetic recombination:** Mechanism of genetic recombination, Transformation, Transudation, Conjugation and Transposable elements
- b) Genetics and Molecular organization:** Genes concept, genome, Multigene families, Pseudogenes, split genes, overlapping genes, genetic code

- d) **Gene mutation:** Insertion deletion, frame shift and suppressor mutation, chemical and physical agents

Unit-IV: Protein Synthesis:

- a) **Transcription:** RNA polymerases in prokaryotes and eukaryotes, process of transcription, concept of promoters and promoters types, enhancers and silencers and other regulatory elements, post transcriptional processing of tRNA, mRNA and tRNA, transcripts. Post transcriptional modification, spliceosome assisted and self-splicing of RNA transcripts. RNA dependent synthesis of RNA and DNA.
- b) **Translation:** Protein synthesis, Translational process and control of translation, post-translational modification (covalent modification, phosphorylation, glycosylation, mythelation etc. protein targeting and degradation, non-ribosomal polypeptic synthesis Processing of RNA.

Unit-V : Regulation of gene expression: Gene regulation in prokaryotes - operon concepts (Lac operon and trp, arabinose operon), Negative & Positive Control, Sigma factor, Post translational regulation, etc.

Gene regulation in eukaryotes- Regulation at transcriptional and translational level, by gene rearrangement

**PAPER-X
VIROLOGY**

- Unit-I :**
- a) **Introduction to Virology:** Historical aspects: nature of viruses; origin and evolution of viruses, terminology, differentiation with other microorganisms.
- b) **General properties of Viruses:** Morphology, size, host specificity, viral structure, shape, Chemical properties, Susceptibility to physical and chemical agents, Viral Haemagglutination,
- c) **Replication:** Mechanism of virus adsorption and entry into host cell including genome replication, and m-RNA production by animal virus, mechanism of RNA synthesis, mechanism of DNA synthesis, transcription mechanism and post transcriptional processing, translation of virus, protein s, assembly, exit and maturation of progeny virions, multiplication of Bacteriophages.
- d) Viral assay, viral genetics, Nomenclature of viruses.

Unit- II : Virus-host Interaction: Epidemiology, pathogenesis, Host response to virus Infections, Laboratory diagnosis of viral infection, Immunoprophylaxis, chemophylaxis and chemotherapy of viral diseases.

Interferons and Antiviral Agents: Definition, types of interferons; Nomenclature and classification of interferon. Types of inducer, induction of interferon. Antiviral effect of interferon; Molecular basis of antiviral state: Antiviral protein(s) (AVPS): ds RNA dependent pathways and ds RNA independent pathways. Interference not mediated by interferon (intrinsic factors).

UNIT III : Laboratory Diagnosis of Viral Infections: Microscopy, Cultivation of Viruses: Animal inoculation, chick embryo and tissue-cultures (MKC, Human Embrogenic Kidney cell culture, Human Amnion cell culture). Serology, detection of viral proteins and genetics material

UNIT IV : Structure, Pathogenesis, Laboratory Diagnosis & immunology of viruses: Pox virus, Herpes viruses, Adenoviruses Picorna viruses,

UNIT V : Structure, Pathogenesis, Laboratory Diagnosis & immunology of viruses: Orthomyxoviruse, Paramyxoviruses, Arboviruses, Rubella, Arenaviruses, Rabdoviruses, Hepatitis virus. Miscellaneous virus

PAPER-XI

FERMENTATION TECHNOLOGY

UNIT-I : **Bioreactors:** Design and type of fermentors, unit operation and techniques, batch and continuous fermentations, evolution of bio-kinetics constants. Significance of bio-kinetic constants, Computer control of fermentation process.

UNIT II :a) Industrial production: Penicillin, streptomycin, and tetracycline.

- b) **Anticancer drug:** interferons, anthracycline, L-apspariginas es. Biotechnological application for the production of rare biological molecules, antibiotics, vaccines, steroids, hormones and diagnostic kits

Unit-III : Food and beverage production.

- a) Cottage & cheddar cheese, Yoghurt and *Dahi*
- b) Mycotoxin production
- c) Oriental food fermentations: 1) Koji 2) Soya Sauce 3) Miso,
- d) Single cell proteins, mycoproteins.
- e) Types of different alcoholic beverages and production of whisky.

UNIT IV: Food Technology:

- a) Starter culture for food industries,

- b) Production and preservation of following fermented foods:
- Soya souse fermentation by moulds,
 - Fermented vegetables ~ Sauerkraut
 - Fermented Meat ~ Sausages
 - Production and application of Bakers Yeast
 - Application of microbial enzymes in food industries.
- c) Food borne infection and intoxications, bacterial with examples of infective and toxic types: *Clostridium*, *Salmonella*, *Shigella*, *Staphylococcus*, *Compylobacter*, *Listeria*.
- d) **Quality assurance:** Microbiological quality of standard of food, Government regulatory practices and policies. FDA, EPA, HACCP, ISI.

Unit-IV: A) Biomass Production :

- i) **Bacterial biomass- production:** a) *Bacillus megatherium* b) *Acinebacter cerificans*.
- ii) **Fungal biomass production:** *Paecilomyces varioti* by Pekilo process & *Candida utilis* from hydrocarbon.
- B) Prebiotics and probiotics**
- Importance of probiotics
 - Sources of Prebiotics
 - Probiotics organisms
 - Desirable characteristics
 - Benefits of probiotics consumption

**PAPER-XII
IMMUNOLOGY**

- Unit-I :** **Basic Immunology-** Anatomic organization of the immune system cell types and organs. Effect of mechanisms involved in specific and nonspecific immune mechanisms. characters. Immune Response- primary, Secondary, Immunological memory.
- Unit- II** **Antigens, and Immunogenicity,** variation in antigenic Antibody and Immunoglobulins- Structure and functions of IgG, IgA, IgM, IgD, & Ig E., Antigen-Antibody reactions.
- Unit-III :** **Clinical Immunology** - Complement system; classic and alternate pathways and functions,. Cell mediated immunity. Immunological tolerance and Immunosuppression. Tumors Immunological. Autoimmunity and Autoimmune diseases,
- Unit- IV :A)** Hypersensitivity, Immune deficiency diseases, MHC class Molecules.

- B) Conventional vaccines, peptide vaccine, subunit vaccine, genetically engineered vaccines, production and application of lymphokines. Antibody diversity, Immunogenetics.

Unit-V : Immunobiotechnology & Hybridoma Technology:

Immuni zation of animals, isolation of stimulated spleen cells, myeloma cell lines used as fusion partners, fusion method, detection and application of monoclonal antibodies,

**PRACTICAL-V
APPLIED MICROBIOLOGY**

a) Applied microbiology

- Isolation of antibiotic producing organism from soil.
- Microbiological assay of antibiotics and purification by ion-exchange resin.
- Determination of k_{la} for fermenter.
- Preparation of yoghurt, koji, cheese. Idli
- Preparation of Flavor and aroma.
- Solid state fermentation of some product.
- Microbiological assay of amino acids .
- Microbiological assay of vitamins.

b) Plant tissue culture:

- Preparation of media for plant cell culture.
- Callus from explants.
- Haploid cell culture.
- Proto-plast culture.
- Educational tour and submission of report.

**PRACTICAL-II
IMMUNOLOGY AND CLINICAL MICROBIOLOGY**

- Diagnostic methods for isolation and Identification of pathogenic microorganisms from the following specimens:
(a) Blood (b) Urine (c) Cerebrospinal fluid (d) Throat (Swabs)
(e) Sputum (f) faeces (g) Pus and wound (infection) fluid.
- Isolation and identification of following pathogenic bacteria:**
(a) *Staphylococcus aureus* (b) *Streptococcus pyogenic*
(c) *Streptococcus pneumonia* (d) *Salmonella typhi* and *paratyphi*
A.B.C. (e) *Shigella* Species (f) *Escherichia coli* (g) *Proteus vulgaris*
(h) *Pseudomonas aeruginosa* (i) *Vibrio cholera* (j) *Mycobacterium tuberculosis* (k) *Clostridium titanicae*
- Serology:**
a) VDRL Test b) RPR test c) Kahn test d) Widal test
e) C-Reactive protein f) Anti streptomycin-o g) R.A. Factor

- h) ELISA test i) Surface visual B-96 test (ELISA)
j) Latex agglutination test (pregnancy test)
- 4. Diagnostic Immunology:**
- Double diffusion methods of ouchterlony
 - immuno-electrophoresis
 - Quantitative determination of plasma protein by immunoelectrophoresis.
 - Single radial immunodiffusion.
 - Estimation of antigen-antibody response by immunodiffusion technique.
 - Estimation of antigen-antibody response by immunoelectrophoresis.
- 5. Preparation of monoclonal antibodies.**
- 6. Hematology:**
- Estimation of HB, b) PCV c) Blood cell counts W.B.C. & R.B.C.
 - ESR e) blood smear examination f) bleeding time g) clotting time
 - prothrombin time i) prothrombin determination j) Lab. diagnosis of leukaemias.
- 7. Study of medical Parasitology:**
- E. histolytica* b) *Trypanosomes*
 - Leishmania and d) Plasmodium
- 8. Stool Examination for:**
- Ova, cysts of intestinal parasite blood cell and pus cells b) Occult blood, c) Characteristics of the stool in amoebic and bacillary dysentery.
- 9. Antibiotic and chemotherapeutic agents:**
- Antibiotic sensitivity test.
 - Assay of antibiotic level in the body fluids.
- 11. Routine examination of urine.**
- 12. Student seminar and submission of report.**

Distribution of marks in University Practical Examination:

1. Long Experiments (At least two)	-	15 marks.
2. Short Experiments	-	10 marks
3. Viva-voce examination	-	05 marks
4. Spotting	-	05 marks
5. Practical record book	-	05 marks
6. Internal Assessment	-	10 marks
Total	-	50 marks

M.Sc Part II (Semester IV)
Paper XIII
BIOTECHNOLOGY

Unit-I : Genetic Engineering

- Enzymes used in recombinant DNA technology:** Endonucleases, ligases, Enzymes to modify DNA molecules.
- Vectors:** Plasmids, plant vector, bacteriophages, cosmids, phagmides, animal viruses, plants viruses, special vectors.

UNIT II : Genes cloning in prokaryotes & Eukaryotes: Isolation of gene, Methods of gene transfer, Selection and screening of recombinant DNA, nucleic acid hybridization and dot curves, southern, northern and western blotting techniques, dot and slot blots, colony hybridization.

UNI III : Cloning strategies:

- Cloning from m-RNA and genomic DNA, synthesis of gene, gene probes, gene banks, gene libraries, mapping of gene, DNA sequencing, RFLP, DNA finger printing, site direct mutagenesis.
- Polymerase chain reaction & gene amplification.

Unit-IV : Plant Biotechnology:

- Culture media and plant cell culture
- Tissue culture, micropropagation and somaclonal variation
- Production and use of haploid cell culture
- Protoplast culture, regeneration and somatic hybridization
- Gene transfer method in plants, transgenic plants and animals.

Unit-V : Application of Biotechnology:

- Application in agriculture, plants and animal improvement.
- Enzyme biotechnology
- Protein engineering, immunotoxins and drug designing
- Metabolic engineering for over production of metabolites.
- Use of microbes in industry and agriculture
- Application to medical sciences, gene therapy, genetic counseling, diagnosis of diseases and phenomenon of ageing.
- Control of environmental pollution, recovery of minerals and restoration of degraded lands

PAPER-XIV**CLINICAL VIROLOGY**

- Unit-I :** **Plant Viruses:** Classification, life cycle and replication of tobacco mosaic virus (TMV), PVX, PVY, CMV, TSWV, CaMV, Cynophages, Mycoviruses
- Unit-II :** **Bacterial Viruses:** Life cycle, Structure and replication of following RNA and DNA phages: Ox 174 phage, T4 phage; Lambda phage. (Lyric and glycogenic Cycle); Ft phage; MS2, f2, QB phages and Mud phage and O6 phage.
- Unit- III :** a) **Oncogenic Viruses (Tumor Viruses) :** Classification of viruses characteristics of virus transformed cell or tumor cell.
i) DNA - Containing Tumor Viruses :
ii) RNA - Containing Tumor Viruses : Retroviruses (oncornaviruses) .
- Unit- IV :** a) **AIDS viruses: Retro viruses, HIV**
- Unit- V :** **Viroids and Prions.**

PAPER-XV**MICROBIAL TECHNOLOGY**

- Unit - I :** Isolation and screening of microorganisms, maintains of isolates/ strains, Inoculum developments, sterilization, strain improvement, process development, Downstream processing, In situ recovery of products. General scale up procedure
Solid-state fermentations
Manufacturing cost estimation
Principal and general consideration in down stream processing.
- Unit-II:** a) **Fermentation of acids:** Aspartic acid, L glutamic acid and Gluconic acid.
b) **Modern trends in Microbial Productions:** Bioplastic (PHB, PHA) Biopolymer (Dextran, alginates, xanthan, Pullulan)
- Unit- II** **Fermentation Of enzymes and Amino acids:** Amylase, Protease. Riboflavin, cyanocobalamine,
- Unit- III :** **Enzyme biotechnology:** Immobilization of enzymes - (glucose -isomerase) Methods, bioreactors and application in industry. Enzyme electro catalysis. Biosensors- Bioelectodes, Optrons, Immunological biosensors.
- Unit-IV :** **Fuel Biotechnology:** Biofuels, Energy crops, Biogas, Bioethanol, Biobutanol, Biodiesel, Biohydrogen.

Unit- V : Biofertilizers and Biopesticides.

- a) Basic concept: PSM, N₂ Fixer, S-solubilizers etc, K-solubilizers
b) Biomass production
c) Formulation (Carrier based, dried, liquid, and mixed inoculum)
d) Application methods
e) Inoculation quantity concept.
f) Biopesticides: Bacterial, fungal, viral etc.
g) Biocontrol mechanism,
h) Preparation and application of Biopesticides

PAPER-XVI**MEDICAL MICROBIOLOGY**

- Unit-I :** **Pathogenic bacteria and laboratory diagnosis:**
Staphylococci, Streptococci including pneumococci, Mycobacterium tuberculosis and M. leprea
- Unit-II** **Pathogenic bacteria and laboratory diagnosis:**
Escherichia, Klebsiella, Proteus, Salmonella, Shigella, Pseudomonas, Bordetella, Heamophilus, Vibrio, Camphylobacter, Treponema, Borrelia, Leptospira, Corynebacteria, Mycoplasma and Rickettsia.
- Unit-III** **Pathogenic fungi and their laboratory diagnosis:**
Microsporium, Trichophyton, Epidermophyton, Candida albican, Cryptococcus neoformans, Blastomyces dermatitidis and Histoplasma capsulatum.
- Unit- IV** **Parasites and their laboratory diagnosis:**
Entamoeba histolytica, Leishmania donovani, Trypanosoma spp., Plasmodia species, Taenia saginata, Taenia solium Echinococcus granulosus, Hymenolepsis nana, Ascaris lumbricoides, Enterobius vermicular and Wuchereria bancrofti.
- Unit V :** **Clinical Microbiology:** Normal microbial flora of human body, sore throat and pneumonia, UTI, Diarrahaial diseases, Meningitis, Bacterimia, septicimia, Infective Endocarditis, PUO, STD, Hospital acquired infections, , Prophalaytic imuunization, antimicrobial therapy, Antimicrobial sensitivity testuing, Hospital waste management, Vechicals and vectors.

PRACTICAL-VII
APPLIED MICROBIOLOGY AND BIOTECHNOLOGY
RECOMBINANT DNA TECHNOLOGY

- 1) Agarose gel Electrophoresis
- 2) Restriction Digestion of DNA
- 3) DNA Ligation
- 4) DNA Molecular size Determination
- 5) DNA Fingerprinting
- 6) Southern hybridization
- 7) Restriction Mapping
- 8) In vitro Transcription
- 9) Southern Blotting
- 10) Northern Blotting
- 11) Plasmid preparation
- 12) Genomic DNA isolation.
- 13) Gene Cloning
- 14) Bacterial Gene expression.
- 15) Bacterial Transformation
- 16) Bacterial Conjugation
- 17) Bacterial Transduction
- 18) Whole Blood DNA extraction.
- 19) Educational tour and submission of report.

Project work (Marks 50)

Distribution of marks in University Practical Examination:

1. Long Experiments (At least two)	-	15 marks.
2. Short Experiments	-	10 marks.
3. Viva-voce examination	-	05 marks
4. Spotting	-	05 marks
5. Practical record book	-	05 marks
6. Internal Assessment	-	10 marks
Total	-	50 marks

Distribution of marks in Project work Examination:

1. Valuation project	-	40 marks
1. Internal Assessment	-	10 marks
Total	-	50 marks

Project Work -

Examination of Project Work :

1. The examination should be held at the centres of practical examination.
2. There shall be panel of examiners including Head of the department and the Supervisor of the Student.
3. There should be at least 2 to 3 external examiners for a batch of up to 10 Students or 3 to 5 external examiners for a batch of more than 10 Students.
4. The Students should submit the project reporty within 20 days after the last/final theory paper in University examination.
5. The date of Viva-voce examination on project work should be within the 30 days after the completion of theory examination

Distribution of marks in Project work examination:

1. Evaluation of Project	20 marks
2. Viva--voce (Jointely by internal and external examiners)	20 markts
3. Internal Assessment	10 marks
Total :	50 marks

Books recommended for M.Sc. Part-I & Part-II (Microbiology)

1. Biophysical Chemistry - Upadhyay & Nath (Himalaya Pub.)
2. Practical Biochemistry - Plummer (TMH Pub.)
3. Principal of Biochemistry - Lehninger (CBS Pub.)
4. Practical Biochemistry - Jayraman (Wiley Estern Pub.)
5. Physical Biochemistry - Morrison (Oxford)
6. Enzyme - Dixon & Webb
7. Fundamentals of Enzymology - Lewis (Oxford)
8. Bacterial metabolism - A.H. Rose
9. Biochemistry - West & Toad
10. Out line of Biochemistry - Corn & Stump. (Wiley Eastern Pub.)
11. Soil Microbiology - Alexander (Wiley Eastern Pub.)
12. Genes VIII - Lewin (Oxford)
13. Element of Biotechnology - P.K. Gupta. (Rastogi Pub.)
14. Fundamentals of Biotechnology - Purohit & Mathur (Agro Bot. Pub.)
15. Essentials of molecular biology - Freifelder D. (Narosa Pub.)
16. A textbook of biotechnology - Duby (S. Chand Pub.)
17. Molecular Biology - Freifelder D. (Narosa Pub.)
18. Microbial Genetics - Freifelder D. (Narosa Pub.)

19. Text Book of Molecular Biology - Shastry & Other (Macmillan)
20. Hand Book of Tissue Culture (ICAR Pub.)
21. A textbook of Biotechnology - H.D. Kumar (E.W. pub.)
22. Basic Biotechnology Rev. Iganacimuthu (TMH Pub.)
23. Plant viruses - Mandahar (S. Chand & Co.)
24. Microbiology Lewis. (Harper)
25. Microbiology - Fundamentals & Application - Purohit. (Agro Botanical Pub.)
26. Industrial Microbiology - Casida (Wiley Eastern pub.)
27. Press Scott and Dunn's Industrial Microbiology.
28. Microbiology - Anantnarayan & Panikar (Orient Longman)
29. A text book of Microbiology, P. Chakraborty (Central Pub.)
30. Medical Microbiology - Ichhapunani & Bhatia (J.P. Brothers)
31. Essential of Medical Mycology - Evans & Genitals (Churchill and Livingston)
32. Genetics by Strickbeger (Prentice Hall)
33. A short textbook of recombinant DNA technology Watson. (Black Well)
34. Molecular Biotechnology - Prime Rose - (Black Well.)
35. Immunology by Shetty - (Wiley Eastern Pub.)
36. Molecular biology of genes. Watson - (Begamin Cumming))
37. Recombinant DNA technology - Rodriguez (Begamin Cumming)
38. Advances in molecular genetics. Puhlar. (Begamin Cumming)
39. Molecular cloning - A lab manual. (Cold spring harbor lab pub.)
40. Concept of molecular biology - Rastogi (Wiley Eastern Pub.)
41. Genetic Engineering - Sandhy Mitra (Macmillan)
42. Elementary Microbiology Vol. I Vol. II (Fundamental of microbiology and microbial world) Ed. by H.A. Modi. (Akta Prakashan)
43. Applied microbiology. Ed. by H.A. Modi. (Akta Prakashan)
44. Environmental Microbiology. Ed. by H.A. Modi (Akta Prakashan)
45. Fundamentals of Dairy Microbiology by J.B. Prajapati (Akta Prakashan)
46. Bio-Fertilizer. By Vyas & Modi (Akta Prakashan)
47. Biochemistry. By D. Das (Academic Pub.)
48. Biophysics & Biophysical Chemistry. By D. Das. (Academic Pub.)
49. Modern Immunology. By A. Das Gupta (Jaypee Pub.)
50. A textbook of microbiology by P. Chakraborty (New Central Book Agency)
51. Principal of gene manipulation by Old & Prim Rose (black well pub.)
52. Agricultural microbiology by Rangaswami & Bagyaraj (PHI)

53. An introduction to recombinant DNA by A.E.H. Emery (ELBS)
54. Concepts in Biotechnology by D. Bakasubramuniam and other (University Press.)
55. Introduction to genetics Engineering by D.S.T Nicholl (Cambridge)
56. Genetics by P.K. Gupta (Rastogi Pub.)
57. Genetics by Sandhya Mitra (TMH)
58. Applied plant biotechnology by Iganacimuthu (TMH)
59. Immunodiagonostics S.C. Rastogi (Wiley Eastern Pub.)
60. Immunology by Roitt. (Black well)
61. A textbook of Microbiology. R.C.Dubey and D.K.Maheshewari. (S.Chand & Company)
62. Genetics - A.V.S.S. Sambamurty (Narosa Pub.)
63. Concept of Molecular Biology. P.S. Varma & V.K. Agrawal. (S.Chand & Company)
64. General Microbiology S.B. Sullia and S. Shantharam. (Oxford & IBH)
65. Modern Concept of Biotechnology. H.D.Kumar (Vikas Pub.)
66. Fundamentals of Enzymology - Price and Steven (Oxford Sci.Pub.)
67. Gene VII - Lewis (Oxford Science Publication)
68. Molecular Cell Biology, Berk, Lipursky, Baltimore, Darnell and Matsudaira (W.H. Freeman and Company)
69. Biotechnology - Rhem and Reead
70. Standard method s of Biochemical analysis - S.R. Thimmaiah (Kalyani Publisher).
71. Laboratory Manual of Bacterial Genetics - Institute of Microbial Technology - Chandigarh.
72. A textbook of Industrial Microbiology - Wulf Crueger and Annekiese Cruger (Panima Publishing Corporation)
73. An Introduction to electrophoresis - K. Anbalgan (The Electrophoresis Institute, Salem Dist.S. India.)
74. Waste water microbiology - Gabrian Bitton (John Wiley & Sons)
75. Environmental Microbiology - Ralph Mitchell (John Wiley and Sons).
76. Microbial Biotechnology - Fundamentals of applied Microbiology - Alexander N. Glazer, and Hiroshi Nikoidu (W.H. Freeman and Company)
77. Gene structure and expression - John D. Hawkins (Cambridge University Press)
78. Biotechnology - John G. Smith, (Cambridge University Press)
79. Plant Biotechnology - S. Ignacimuthu S.J. (Oxford and IBH, New Delhi)
80. Advanced molecular biology - R.M.Twyman (Viva book Pvt.Ltd.)

81. Introductory Microbiology - J.Heritage, E.G.V. Evans and R.A.Killington (Cambridge University Press)
82. General Microbiology - Schiegel (Cambridge University Press)
83. Gene Structure - Hawkins (Cambridge University Press)
84. Modern Concepts of Biotechnology - H.D.Kumar, (Vikas Publishing Pvt.Ltd.)
85. A textbook of Microbiology - R.C.Dubey and D.K.Maheshewari (S.Chand & Company)
86. Biotechnology - Applications and Research - Edited by Paul Cheremisinoff and Robert Ouellete (Technomic Pub.Co.Inc.)
87. Basic and Clinical Immunology - Daniel Stites, Abba Terr & Tristram Parslow (Prentice Hall International INC)
88. A Text Book of Biochemistry with Clinical correlation - Edited by Thomas Devlin (John Wiley and Sons, INC).
89. Microbiology Laboratory - Fundamentals and Application, George Wistreich (Prentice Hall)
90. Microbiology - A Laboratory Manual - James Cappucino and Natalic Sherman (The Benjamin / Cummings Pub.Co.Inc.)
91. Foundations in Microbiology - Kathleen Talaro & Arthur Talaro (Wm.C. Brown Publishers)
92. Principles of Microbiology - Ronald Atlas Mosby.
93. Fundamentals of Microbiology - Alcamo (Benjamin / Cummings Pub.Co.Inc.)
94. Sale and Molecular Biology - Concepts and experiments - Gerald Karp (John Wiley and Sons, INC).
95. Cellular and Molecular Immunology - Abul Abbas, Andrew Lichman & Jordan Pober (W.B.Saunders Co.)
96. Biochemistry-Zubay (Wm C.Brown Publishers)
97. Life-An Introduction to Biology - Beck, Liem & Simpson (Harper Collins Publishers)
98. Genetics - A.V.S.S. Sambamurthy (Narosa Publication)
99. Water Pollution - V.P.Kudesia, (Pragati Prakashan Meerut)
100. Physicochemical Examination of Water, Sewage and Industrial waste - N. Maniwasakam (Pragati Prakashan, Meerut)
101. Textbook of Biochemistry - O.P.Agrawal, G.R.Agrawal (Goel Publishing House, Meerut)
102. Textbook of Medical Mycology - Jagdish Chander (Interprint, New Delhi)
103. An introduction to Plant tissue and Cell culture - N.C.Kumar (Emkay Publication Delhi)
104. Short Protocols in Molecular Biology - Edited by Ausubel, Brent, Kingston, Moore, Seidman, Smith and Struhl (John Wiley and Sons)

105. Molecular Cell Biology - Darnell, Lodish and Baltimore, (Scientific American Books)
106. Technological Applications of Biocatalysts - Published on behalf of Open University and University of Greenwich (Butterworth-Heinemann).
107. Microbiology-Principle and Explorations - J.G.Black (John Wiley and Sons)
108. Techniques for engineering Genes - Published on behalf of Open University and University of Greenwich (Butterworth-Heinemann).
109. Biotechnological Innovations in Energy and Environmental management - Published on behalf of Open University and University of Greenwich (Butterworth-Heinemann).
110. Medical Microbiology- Mims, Playfair, Roitt, Wakelin and Williams (Mosby)
111. Principles of Enzymology for the Food Sciences (John Whitaker, Marcel Dekker, Inc.)
112. Biostatistics - A Foundation for analysis in Health Sciences - W.D.Daniels, John wiley and Sons.
113. Basic Statistics - C, Dunn
114. How Computers Works - Ron White, Techmedia.
115. How the Internet works - Preston Gralla, Techmedia.
116. Bioinformatics - 1998 - Baxevanis
117. Bioinformatics - 2000 - Haggins & Taylor OUP.
118. Fundamentals Biostatistics- Sadguru Prakash, Emkay Publication, New Delhi.
119. Bioinformatics for Beginners - Dr.K.Mani & N.Vijayraj (Kalai Kathir Achchagani Pub. Coimbatore)
120. Instant Notes - Bioinformatics - West head, Parish and Twyman (Viva Publication) New Delhi.
121. Schaum's Outlines - Biochemistry, Kuchel & Ralston (TMH Edition)
122. Schaum's outlines - Microbiology (TMH Edition)
123. Schaum's outlines - Molecular and cell Biology (TMH Edition)
124. Principles of Genetics - R.H.Tamarin (TMH Edition)
125. Biotechnology DNA - Protein A Laboratory project in molecular Biology. Thiel, Bissen & Lyons (TMH Edition)
126. General Enzymology, Kulkarni and Deshpande, Himalaya Publishing House.
127. Modern Approaches to Soil and Agriculture and Environmental Microbiology, Shiva Aithal and Nikhilesh Kulkarni, Himalaya Publishing House.
