SEMESTER -3 (Physical Chemistry)
Advanced Physical Chemistry
CHE(P) 501

Unit I : Gaseous state of matter (MMM)

Van-der-Waals equation for real gases, Barometric distribution law, Maxwell's law of distribution of molecular velocities, Evaluation of constants, Effect of temperature, significance of Maxwell's law and its experimental verification; Maxwell distribution as energy distribution, Average, root mean square and most probable velocities, simplified distribution law, Equipartition of energy and quantization.

Unit II : Vibrational Spectroscopy (UP)

(i) IR spectroscopy : Vibrations in diatomic molecules, simple harmonic oscillator model, vibrational energies, force constant, bond strength and bond length, Morse potential energy diagram, anharmonisity in vibrations, selection rules, vibration rotation spectroscopy, P.Q.R. branches, normal modes of vibrations, vibrations in polyatomic molecules, group frequencies, overtones, hot bands Instrumentation for IR spectroscopy, applications of IR spectroscopy.

(ii) FT-IR spectroscopy: Principles, techniques and applications.

(iii) Raman spectroscopy : Raman effect, quantum and classical view, pure vibrational and pure rotational Raman spectra, Raman spectra for combined motion, instrumentation and applications of Raman spectroscopy.

Unit III: Solid state of matter (UP)

Electrically conducting solids, super conductors, factors affecting superconductivity, magnetic properties, BCS theory of super conductors, organic and inorganic superconductors. Optical properties of solids-photoconduction and photoelectric effect.

Magnetic properties of solids-Behaviour of solids in magnetic field, effect of temperature (curie and curie-weiss laws), ferromagnetics and paramagnetics, quantum theory of paramagnetic cooperative phenomena-magnetic domains, hysteresis.

Unit- IV: Electronic spectroscopy of molecules (MMM)

Electronic spectra of diatomic molecules, concept of potential energy curves for bonding and antibonding molecular orbitals, selection rules, Frank-condon principle, π, η ,σ molecular orbitals, their energy levels and respective titrations.

UV region: electronic transitions, chromophores and oxochromes, Bathochromic and hypochromic shifts, hypochromic and hyperchromic shift

References

1. *Introduction to physical chemistry-Glasstone*
2. *Physical chemistry- Atkins*
3. *Advanced physical chemistry- Gurdeep Raj*

4. *Physical chemistry- N.B.Singh, Shiva Saran Das, A.K.Singh (newage international publication),2009*
5. *Advanced physical chemistry –J.N.Gurtu and A. Gurtu, pragati prakashan, 2008*
6. *Molecular spectroscopy –C.N.Banwell*
7. *Introduction to Molecular spectroscopy : G.M. Barrow MacGraw Hill*
8. *Basic principles of spectroscopy –R.Chang, McGraw Hill*
9. *Instrumental methods of analysis-Skoog & West*
10. *Molecular spectroscopy –Gurdeep Raj*
11. *Instrumental methods of analysis- B.K.Sharma*
12. *Physical methods of chemistry –R.S. Drago*
13. *Theory and applications of UV-spectroscopy- H.H.Jaffe and M.Orchin*
14. *N.B.Hannay : Solid state chemistry*
15. *A.R.West- solid state chemistry and its applications, John Wiley- 1987*
16. *Chemistry of solids –L.V.Azaroff*
17. *Principles of solid state- H.V.Keer*
18. *Solids state chemistry- C.N.R.Rao*
19. *Fundamentals of photochemistry- K.K.Rohtagi, Mukherjee, Wiley-Eastern Ltd.,*
20. *AGilbert-J.B.Baggott, Essentials of molecular photochemistry, Blackwell scientific, oxford, 1991*
21. *N.J.Turro-Modern molecular photochemistry, University science books, 1991*
22. *Crystallography and crystal chemistry- F.D. Bloss*
23. *Elements of x-ray diffraction, B.D. cullity, Addision – Westey publication Co. London.*
24. *X-ray diffraction methods, E.W. Nuffield, John-wiley and sons, Inc,N.Y.*
25. *X-ray structure determination-A practical guide (G.H.Stout, L.H.Jensen, Mcmillan co. London)*
26. *Methods in X-ray crystallography- J.W.Jeffery, Acad. Press, London*

SEMESTER -3 (Physical Chemistry)
Selected topics in Physical Chemistry
CHE(P) 502

Unit I : Transport phenomena in gases

Transport properties, thermal conductivity, viscosity of gases, kinetic molecular theory of gas viscosity, mean free path, molecular collisions in a single gas and in a mixture of gases, triple collisions, collisions with a wall, Knudsen flow, molecular diameter, diffusion, effusion.

Unit II : Diffraction techniques (UP)

Production of x-rays, x-ray diffraction, Bragg's law, Diffraction from crystals, methods in x-ray crystallography-powder method, Laue method, Debye-scherrer method, identification of crystalline compounds. Neutron and electron diffraction-scattering intensity, scattering angle, wierl equation, measurement techniques, low energy electron diffraction (LEED), applications.

Unit III: Photochemistry (UP)

Introduction, photochemical equivalence, quantum yield, photochemical reactions and kinetics, photosensitization, effect of temperature on photochemical reactions, fluorescence and phosphorescence and factors affecting them, applications of photochemistry-photosynthesis.

Unit IV: Visible spectroscopy (MMM)

Introduction, maximum wavelength, location and significance, molar absorptivity, Lambert-Beer's law, regression, corelation coefficient, limitations and significance, ringbom plot applications pK determination, analysis of mixture, complex formation etc.

References

27. *Introduction to physical chemistry-Glasstone*
28. *Physical chemistry- Atkins*
29. *Advanced physical chemistry- Gurdeep Raj*
30. *Physical chemistry- N.B.Singh, Shiva Saran Das, A.K.Singh (newage international publication),2009*
31. *Advanced physical chemistry –J.N.Gurtu and A. Gurtu, pragati prakashan, 2008*
32. *Molecular spectroscopy –C.N.Banwell*
33. *Introduction to Molecular spectroscopy : G.M. Barrow MacGraw Hill*
34. *Basic principles of spectroscopy –R.Chang, McGraw Hill*
35. *Instrumental methods of analysis-Skoog & West*
36. *Molecular spectroscopy –Gurdeep Raj*
37. *Instrumental methods of analysis- B.K.Sharma*

38. *Physical methods of chemistry –R.S. Drago*
39. *Theory and applications of UV-spectroscopy- H.H.Jaffe and M.Orchin*
40. *N.B.Hannay : Solid state chemistry*
41. *A.R.West- solid state chemistry and its applications, John Wiley- 1987*
42. *Chemistry of solids –L.V.Azaroff*
43. *Principles of solid state- H.V.Keer*
44. *Solids state chemistry- C.N.R.Rao*
45. *Fundamentals of photochemistry- K.K.Rohtagi, Mukherjee, Wiley-Eastern Ltd.,*
46. *AGilbert-J.B.Baggott, Essentials of molecular photochemistry, Blackwell scientific, oxford, 1991*
47. *N.J.Turro-Modern molecular photochemistry, University science books, 1991*
48. *Crystallography and crystal chemistry- F.D. Bloss*
49. *Elements of x-ray diffraction, B.D. cullity, Addision – Westey publication Co. London.*
50. *X-ray diffraction methods, E.W. Nuffield, John-wiley and sons, Inc,N.Y.*
51. *X-ray structure determination-A practical guide (G.H.Stout, L.H.Jensen, Mcmillan co. London)*
52. *Methods in X-ray crystallography- J.W.Jeffery, Acad. Press, London*

SEMESTER -3 (Physical Chemistry)
Polymer Chemistry
CHE(P) 503

Unit I : Polymer molecular weight

Concepts of mass, number, viscosity and sedimentation average molecular weights, polydispersity and molecular weight distribution, measurements of molecular weights, end group, viscosity, light scattering, osmotic and ultracentrifugation method. Gel permeation chromatography, polymer fractionation, the practical significance of molecular weights.

Unit II : Structure and properties of polymers

Polymer chains, chain configuration of macro molecules, microstructures based on the chemical and geometrical structures, crystal structures of the polymers, crystalline melting point (tm) and glass transition temperature (tg), effect of chain flexibility and other steric factors, molecular weight, chain branching , cross linking etc. on tm and tg.
Mechanical properties of polymers-tensile strength, impact strength, shear, stress stain viscosity, viscoelastic behaviour of polymers, mechanical models of viscoelastic behaviour, deformation behaviour of polymeric materials, stress-strain relationship for different types of polymers.

Unit III : Reactions of vinyl polymers

(i) Introduction, functional group reactions
(ii) Ring opening reactions
(iii) Cross linking reactions-Vulcanization, radiation cross linking, photochemical cross linking, cross linking through labile functional groups, ionic cross linking.
(iv) Block and graft copolymer formation
(v) Degradation-chemical, thermal and photo degradation

Unit IV: Polymer solutions

Polymer dissolution process, thermodynamics of polymer dissolution, deviations from Raoults law, flory-Huggins theory of entropy and enthalpy of mixing, nature of polymer molecules in solution.

References

1. *Polymer chemistry –Flory*
2. *Polymer science –Hiemenz*
3. *Polymer science- V.R. Gowariker, N.V. Viswanathan & J.Sreedhar, Wiley-Eastern*
4. *Text book of polymer science-F.W. Billmayer*
5. *Vontemporary polymer chemistry- H.R.Alcock, F.W.Lambe, Prentice Hall*
6. *Introduction to polymer science and technology-An SPE text book, H.S.Kaufman, J.J.Faleetta, Wiley-Interscience publication 1977*
7. *Polymer chemistry-An introduction, M.P.Stevens-oxford univ. press, Indian ed.*
8. *Principles of polymer science, Bhahadur & N.V.Sastry-Narosa publication*
9. *Thermal techniques of analysis- Dwarkin*
10. *Polymer processing D.H.Morton-Jones, champman and Hall Inc.*
11. *Principles of polymer system R.S.Schwartz, S.H.Gardman*
12. *Polymer process engineering- R.G.Griskey*
13. *High temperature resistance polymers, A.H.Frazer, Intersci. Publication.*
14. *Flame retardant polymers-M.Lewin, S.N.Atlas, E.M.Pearce, Plenum press*
15. *Specialty polymers-R.W.Dyson*
16. *Polymer characterization- E.Shroder, Hanser publication*
17. *Polymer chemistry- B.K.Sharma, Krishna prakashan, meeraut*
18. *Physical chemistry of polymers-A.Tager, Mir publication, Moscow*
19. *Mechanical properties of solid polymers-I.M.Ward, Wiley-Inter scie, John-Wiley, N.;Y.*
20. *Electrical properties of polymers-Ed.D.A.Seanor, Acad. Press, N.Y.*

SEMESTER -3 (Physical Chemistry)
Catalysis and its industrial applications-1
CHE(P) 504

Unit – I :

Introduction, mode of action of catalysts, classification – homogeneous and heterogeneous catalysis, comparision between them, basic features, mechanism, intermediate steps and kinetics of homogeneous and heterogeneous processes. Langmuir-Hinshelwood and Eley –Rideal mechanism of heterogeneous catalytic processes, activation process and activated adsorption in heterogeneous catalysis, Taylor's theory of active centres, role of crystal defects in heterogeneous catalysis, catalyst concepts, its performance, catalyst deactivation, poisoning and regeneration, autocatalysis, phenomenon

Unit – II :

Preparation and characterization of catalysts synthesis of zeolites, pillard clays, metal complexes, oxides, membranes etc., characterization by SEM, EDAX, XRD, XPS, electron microscopy, gas adsorption etc. techniques.

Some examples of homogeneous catalysis like acid-base catalysis etc.

Some examples of heterogeneous catalytic processes used at industrial scale like production of ammonia, methanol, formaldehyde etc.

Application of heterogeneous catalysis for environmental protection and energy production.

Unit – III : Enzyme catalysis

Structural classification of enzymes- mechanism and kinetics of enzyme catalysed reactions, enzyme cofactors, enzyme-substrate complex concept, Michaelis-Menton model, binding sites, active sites and types of enzyme specificities, maximum rate and maximum rate constant of enzyme catalytic process, dependence of rate of enzyme catalytic process on temperature, pH etc., significance of activation energy and free energy in biomedical reactions.

Unit – IV :

Application of enzyme technology for environmental, medical, agricultural, and industrial benefits. Synthesis of fine chemicals and intermediates, drugs, etc. using enzyme technology.

Reference Books:

1. *Introduction to the principles of heterogeneous catalysis. J.M.Thomas and W.J.Thomas, Acad.press, London, 1967*
2. *Chemical kinetics and catalysis G.M.Panchenkov and V.P.Lebedev., Mir publication, 1976*
3. *Fine chemicals through heterogeneous catalysis. Ed.by. R.A.Sheldon, H.Van Bekkem, 2001, Wiley-VCH.*
4. *Theory of adsorption and catalysis-A.Clark*

5. *Homogeneous catalysis-mechanisms and industrial applications-S.Bhaduri, D.Mukesh, 2000*
6. *Enzyme catalysis in organic synthesis (vol I, II, III)*
7. *Enzyme mixtures and complex biosynthesis, Ed. By S.K.Bhattacharya, 2007.*
8. *Biocatalysis-fundamentals and applicationsA.S.Bommarius, B.R.Riebel, 2004.*
9. *Phase transfer catalysis – fundamentals, applications and industrial prospective-C.M.Starks, C.L.Liotta, 1994, Chapman Hall, N.Y.*
10. *Phase transfer catalysis- E.V.Dehmlow, S.S. Dehmlow, 1993-VCH,Weinheim*
11. *Handbook of phase transfer catalysis-Y.Sasson, R.Neumann, 1997*
12. *Phase transfer catalysis-ed. By Halperm M.B., 1997.*
13. *Industrial catalysis- A practical approach, (2nd ed) J.Hagen, Wiley-VCH,2006.*
14. *Nanoparticle catalysis-D.Astrue, 2007.*
15. *Nanoparticles, buildings blocks of nanotechnology, Rotello V. Kluwer Acad / ptenum publication, N.Y.2004*
16. *Nanoscale materials in chemistry- ed. By Klabunde K.J.John-wiley, N.Y. 2001*
17. *The chemistry of nanomaterials : Synthesis, properties and applications ed. By. C.N.R.Rao, A. Miiller and A.K.Cheetham, wiley-VCH ,2004*

SEMESTER -3 (Physical Chemistry - Practicals)
CHE(P)505 & 506 (PR)

I. Spectrophotometry
   1. Composition of given mixture
   2. Estimation of Cu^{2+} and Ni^{2+} by EDTA.
   3. Formula & Stability constant of a complex between Fe^{3+} and salicylic acid/KCNS.
   4. Adsorption of methylene blue on charcoal
   5. Indicator constant of an acid-base indicator
   6. Decomposition of the complex between Ce(IV) and N-phenylantranilic acid

II. Potentiometry
   1. Solubility product of silver halides
   2. Determination of alkali metals (Li, K, Na) in mixed solvent
   3. Dissociation constants of dibasic acids (oxalic, malonic, succinic)
   4. Formula and stability constant of a complex between silver and ammonia /copper and ammonia
   5. ΔG, ΔH, ΔS, and equilibrium constant for the reaction between metallic zinc and copper ions / lead ions.

6. Acidic and basic dissociation constants of aminoacid and its isoelectric point by pH-metry.

III. Conductometry /pH metry

1. Degree of hydrolysis of aniline hydrochloride by conductormetry and pH metry.

IV. Kinetics

1. Autocatalytic reaction between $KMnO_4$ and oxalic acid
2. Reaction between acetone & iodine
3. Oxidation of ethanol by Cr(VI)
4. Photosensitization of chemical reaction between $HgCl_2$ and ammonium oxalate by ceric ions.
5. Carbonyl/amine value of resin
6. Melting point, storing time and gel time of phenolic resins

V. Polymer Chemistry

1. Determination of molecular weight of a polymer by viscometry
2. Determination of glass transition temperature & melting temperature of a polymer by DTA technique.

SEMESTER -4 (Physical Chemistry)
Advanced Physical Chemistry
CHE(P) 507

Unit I : Elecrochemistry and polarography (MM)

Ion-solvent interaction, free energy change due to ion-solvent interaction, electrical double layer, theories of structures of electrical double layer- Helmholtz- perrin theory, Guoy-chapman theory and its limitations, stern's theory.

Polarography theory, Ilkovic equation, half wave potential and its significance, relation between half wave potential and diffusion coefficients, effect of pH on polarogram, study of complex formation, applications.

Unit II: Magnetic Resonance Spectroscopy (UP)

(i) Nuclear magnetic resonance spectroscopy, Principles-Nuclear spin, nuclear resonance, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, spin-spin coupling and coupling constant, spin de-coupling, Instrumental techniques and application of NMR.

(ii) FT-NMR spectroscopy- Principles, techniques and applications

(iii) ^{13}C- NMR spectroscopy- principles, techniques and applications.

Unit III: Statistical thermodynamics (UP)

Partition functions-translational, rotational, vibrational, electronic partition functions, calculation of thermodynamic properties in terms of partition function, internal energy,

entropy, enthalpy, free energy calculations, partition function and equilibrium constant, statistical calculation of entropy of monoatomic gas-Sackur-Tetrode equation.

Unit- IV: Kinetics of fast reactions (MM)

General features of fast reactions, study of fast reactions by flow method, flash photolysis, pulse radiolysis, shock tubes, relaxation method, temperature and pressure jump method, NMR method.

References

1. *Electrochemistry –Glasstone*
2. *Modern Electrochemistry Vol I & II, J.D.M. Bockris, A.K.N.Reddy*
3. *Electrochemical methods Fundamental and applications –A.J.Bard, L.R. Faulkner, John wiley and sons, N.Y.*
4. *Introduction to Magnetic resonance, A. Carrington and A.D.Maclachalan*
5. *Molecular spectroscopy by C.N.Banwell*
6. *Statistical thermodynamics by M.C.Gupta*
7. *Statistical thermodynamics-L.K.Nash*
8. *Statistical mechanics – D.A. McQuarie, viva book pvt. Ltd., New Delhi ,2003*
9. *Essentials of nuclear chemistry-H.J.Arnikar, Wiley Eastern, 1987*
10. *Introduction to nuclear scince- M.W. Sarton, East West edition*
11. *Introduction to nuclear and radiochemistry, G.Friedlander, T.W. Kennedy, E.S.Macia, J.W.Miller, John Wiley, 1981*
12. *Principles of radiochemistry, G.W.A. Newton, V.J.Robinson, Macmilan Education Ltd.*
13. *Nuclear chemistry-A.Vertes abd I.kiss*
14. *An introduction to liquid state – P.A. Egelstaff, Acad, press*
15. *The dynamic liquid state, A.F.M. Barton, Longman.*
16. *The liquid state J.A. Pryde*
17. *Significant liquid structures. H.Eyring, M.S. John*

SEMESTER -4 (Physical Chemistry)
Selected topics in Physical Chemistry
CHE(P) 508

Unit I : Nuclear and radio chemistry (UP)

Nuclear models-shell model, liquid model, Ferni-gas model, collective model, nuclear reactions- energetics of nuclear reactions, Fission and fusion reactions, spallation, fragmentation, stripping and pick up reactions.

Applications of radioactivity, Neutron activation analysis, isotopic dilution analysis, radiometric titrations, applications in different areas.

Unit II : Electron Spin Resonance (ESR) and Mossbauer spectroscopy (UP)

(i) ESR spectroscopy –electron spin, spin energy levels, hyperfine splitting, zero field splitting and Kramer's degeneracy, measurement techniques and applications.

(ii) Mossbauer spectroscopy: Mossbauer effect, relative line width, Doppler shift, recoil energy, factors affecting mossbauer spectra chemical shift, Quadrupole interactions, Magnetic interactions, Measurement techniques and applications.

Unit III : Liquid state of matter (MM)

Liquids as dense gases and disordered solids, internal pressure and its significance, equation of state, critical constants, internal forces in liquids, radial distribution function and molecular distribution function, supercooled and ionic liquids, transport properties, liquid crystals- mesomorphic behaviour, thermotropic liquid crystals, types of liquid crystals, nematic, smectic and cholesteryl, optical properties.

Unit IV : Quantum statistics and heat capacity (UP)

Fermi- Dirac statistics, distribution law and applications to metal, Bose-Einstein statistics, distribution law and application to helium, Relation between Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics, Heat capacity behaviour of solids, Dulong- Petit's law, Einstein model its drawbacks, Debye modification and its limitations.

References

18. *Electrochemistry –Glasstone*
19. *Modern Electrochemistry Vol I & II, J.D.M. Bockris, A.K.N.Reddy*
20. *Electrochemical methods Fundamental and applications –A.J.Bard, L.R. Faulkner, John wiley and sons, N.Y.*
21. *Introduction to Magnetic resonance, A. Carrington and A.D.Maclachalan*
22. *Molecular spectroscopy by C.N.Banwell*
23. *Statistical thermodynamics by M.C.Gupta*
24. *Statistical thermodynamics-L.K.Nash*
25. *Statistical mechanics – D.A. McQuarie, viva book pvt. Ltd., New Delhi ,2003*
26. *Essentials of nuclear chemistry-H.J.Arnikar, Wiley Eastern, 1987*
27. *Introduction to nuclear scince- M.W. Sarton, East West edition*
28. *Introduction to nuclear and radiochemistry, G.Friedlander, T.W. Kennedy, E.S.Macia, J.W.Miller, John Wiley, 1981*
29. *Principles of radiochemistry, G.W.A. Newton, V.J.Robinson, Macmilan Education Ltd.*
30. *Nuclear chemistry-A.Vertes abd I.kiss*

31. *An introduction to liquid state – P.A. Egelstaff, Acad, press*

32. *The dynamic liquid state, A.F.M. Barton, Longman.*

33. *The liquid state J.A. Pryde*

34. *Significant liquid structures. H.Eyring, M.S. John*

SEMESTER -4 (Physical Chemistry)
Polymer Chemistry-2
CHE(P) 509

Unit I : Polymer characterization techniques (UP)

(i) Thermal techniques- Thermogravimetry (tg), Differential thermal analysis (DTA) and differential scanning calorimetry (DSC)- their principles and instrumentation and applications. Similarities and differences in DTA & DSC.

(ii) Microscopic techniques: Light microscopy, Dark field and bright field illumination, transmitted light microscopy, polarized light microscopy, phase constant microscopy, reflected light microscopy, scanning electron microscopy, their principles, instrumentation, differences and applications to polymer characterization.

(iii) X-ray techniques- principles, instrumentation, and applications to polymer characterization.

Unit II : Polymer processing (UP)

Plastic, elastomers and fibres, Compounding, processing techniques: calendaring, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermofoaming, foaming, reinforcing, fibre spinning.

Unit III: Polymer modifications (UP)

Physical and chemical modifications, modification through copolymerization, polymer blending and post reactions like hydrolysis, halogenation, sulfonation, nitration, cross linking etc. suitable examples.

Unit IV: Speciality polymers-synthesis, properties & applications (MM)

(i) Conducting polymers
(ii) Thermally stable polymers
(iii) Block and graft polymers
(iv) Polymers for medical applications
(v) Biodegradable polymers
(vi) Flame retardant polymers
(vii) Plastics

References

1. *Polymer chemistry –Flory*
2. *Polymer science –Hiemenz*
3. *Polymer science- V.R. Gowariker, N.V. Viswanathan & J.Sreedhar, Wiley-Eastern*

4. *Text book of polymer science-F.W. Billmayer*
5. *Vontemporary polymer chemistry- H.R.Alcock, F.W.Lambe, Prentice Hall*
6. *Introduction to polymer science and technology-An SPE text book, H.S.Kaufman, J.J.Faleetta, Wiley-Interscience publication 1977*
7. *Polymer chemistry-An introduction, M.P.Stevens-oxford univ. press, Indian ed.*
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9. *Thermal techniques of analysis- Dwarkin*
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13. *High temperature resistance polymers, A.H.Frazer, Intersci. Publication.*
14. *Flame retardant polymers-M.Lewin, S.N.Atlas, E.M.Pearce, Plenum press*
15. *Specialty polymers-R.W.Dyson*
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20. *Electrical properties of polymers-Ed.D.A.Seanor, Acad. Press, N.Y.*

SEMESTER -4 (Physical Chemistry)
Catalysis-2
CHE(P) 510

Unit I – Phase transfer catalysis

Definition, principles, mechanism, types of phase transfer catalysts- quaternary ammonium and phosphonium salts, crown ethers, their structures and properties, basic steps in phase transfer catalysis, anion transfer and anion activation, structural factors affecting the distribution of anions between aqueous and organic phases, liquid-liquid phase transfer catalysis, solid-liquid phase transfer catalysis.

Unit – II

Some industrial phase transfer catalytic processes like alkylation, cynation, dehydro-halogenation, oxidation, aldol condensation etc., advantages of PTC in industrial applications.

Unit – III Nanocatalysis

Introduction, classification of nanomaterials, preparation and characterization, different types of nanostructures-nanoparticles, nanoclusters, nanowires, nanorods, nanofilms, nanotubes, C-nanotubes etc., chemical activity, selectivity and specificity of nanocatalyst,

role of size, shape and surface area of nanoparticles in catalysis. Techniques to determine these properties like TEM, AFM, XRD, electron microscopy, BET-method.

Unit –IV

Applications of nanocatalysis in pharmaceutical, in synthesis of fine chemicals, in medicine, for protection of environment etc.

Reference Books:

18. *Introduction to the principles of heterogeneous catalysis. J.M.Thomas and W.J.Thomas, Acad.press, London, 1967*
19. *Chemical kinetics and catalysis G.M.Panchenkov and V.P.Lebedev., Mir publication, 1976*
20. *Fine chemicals through heterogeneous catalysis. Ed.by. R.A.Sheldon, H.Van Bekkem, 2001, Wiley-VCH.*
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22. *Homogeneous catalysis-mechanisms and industrial applications-S.Bhaduri, D.Mukesh, 2000*
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24. *Enzyme mixtures and complex biosynthesis, Ed. By S.K.Bhattacharya, 2007.*
25. *Biocatalysis-fundamentals and applicationsA.S.Bommarius, B.R.Riebel, 2004.*
26. *Phase transfer catalysis – fundamentals, applications and industrial prospective-C.M.Starks, C.L.Liotta, 1994, Chapman Hall, N.Y.*
27. *Phase transfer catalysis- E.V.Dehmlow, S.S. Dehmlow, 1993-VCH,Weinheim*
28. *Handbook of phase transfer catalysis-Y.Sasson, R.Neumann, 1997*
29. *Phase transfer catalysis-ed. By Halperm M.B., 1997.*
30. *Industrial catalysis- A practical approach, (2nd ed) J.Hagen, Wiley-VCH,2006.*
31. *Nanoparticle catalysis-D.Astrue, 2007.*
32. *Nanoparticles, buildings blocks of nanotechnology, Rotello V. Kluwer Acad / ptenum publication, N.Y.2004*
33. *Nanoscale materials in chemistry- ed. By Klabunde K.J.John-wiley, N.Y. 2001*
34. *The chemistry of nanomaterials : Synthesis, properties and applications ed. By. C.N.R.Rao, A. Miiller and A.K.Cheetham, wiley-VCH ,2004*

SEMESTER -4 (Physical Chemistry - Practicals)
CHE(P)511 & 512 (PR)
dissertation/industrial training

Common guidelines for industrial training and dissertation for all the four branches of specialisation ie. Inorganic, Organic, Physical and Analytical

Industrial training Guidelines

i. **Maximum Marks :100**

ii. Each student has to undergo 3 weeks industrial training under the supervision of a faculty from the concerned department.

iii. The industry may be located in Ahmedabad, Gujarat or any where in India.

iv The students has to submit a report on the training obtained from the industry which may include (a) introduction about the industry (b) various activities of the industry (c) the process which are used in the industry (d) the products of the industry and (e) summary and conclusion

v The report submitted by each student would be assessed by the departmental committee comprising of the Head of the Department and the supervising teachers and two senior faculty of the department.

Dissertation – Guidelines

i. **Maximum Marks :100**

ii. Each student has to carry out a project under the supervision of a faculty from the concerned department.

iii. The project can be carried out either in the department or in any other industry, institute or organizations located in Ahmedabad, Gujarat or any where in India.

iv. The topics of the dissertation can be selected from any of the four branches of chemistry ie Organic, Inorganic, Physical or Analytical. The topic can be related to (a)synthesis, purification, characterisation, application of organic compounds or (b)metal complexes preparation and applications or (c)physical studies of various systems (d) method development and validation (e) green chemistry (f) nanomaterials preparation and applications (g) functionalised supramolecules (h) studies on corrosion (i) photo chemistry (j) electro analytical methods. (k) environmental analysis and decontamination .

v. Each student has to submit a dissertation on the topic of their study comprising of (a)an introduction on the topic along with literature survey and justification for the selection of the topic (b) materials and methods (c) methodology (d) results and discussion and finally (e) summary and conclusion along with the references.

vi. Each student has to give a midterm presentation of their work at the department.

vii. Dissertation would be examined by the supervising teacher and external examiner. The viva voce of the dissertation would be conducted by the same external examiner. The maximum marks for the examinations would be 70marks out of which 20 marks are for viva and 50 marks for the studies done by the student and for the presentation of the studies. The internal marks of 30 would be given by the supervising teacher.

The total marks for industrial training + Dissertation = 200 Marks