DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Curriculum under Choice Based Credit &

Grading System

M.Sc.

Physical Chemistry

Semester–III & IV

run at college level from the

Academic Year 2015-16 & onwards

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Department of Chemistry

Revised Syllabus

M.Sc. III and IV Semester Physical Chemistry

Effective from June 2014

11.06.2015

Professor & Head
Dept. of Chemistry
Babasaheb Ambedkar
Marathwada University,
Aurangabad-431004.

Effective from June 2014

The following will be the structure for revised syllabus for M. Sc. Physical Chemistry III & IV semester effective from June 2014.

Semester	Paper Nos.	Title of Paper	Durations (hr)	Max. Marks	Credits
III- Semester	CHE-313	Structural elucidation by spectral methods	60	50	4
	CHEP- 314	Solid State Chemistry	60	50	4
	CHEP: 315	Thermodynamics	60	50	4
	CHEP -316	Advanced Electrochemistry	60	50	4
IV semester	CHEP: 417	Nano Chemistry	60	50	4
	CHEP -418	Macromolecules and Biophysical Chemistry	60	50	4
	CHEP -419	Surface and Magnetochemistry	60	50	4
	CHEP-420	Chemical Dynamics and Catalysis	60	50	4
III and IV semester Laboratory Course	CHEP - 421	Laboratory Course (Physical)	135	50	4.5
	CHEP - 422	Laboratory Course (Physical)	135	50	4.5
	CHEP - 423	Laboratory Course (Physical)	135	50	4.5
	CHEP - 424	Project Work (Physical)	135	50	4.5

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Department of Chemistry

M. Sc. III Semester Physical Chemistry

Solid State Chemistry

Paper CHEP-314

Lectures:60 **Credits: 04**

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1 Solid State Reactions: **12 L**

General Principles, Classification, Wagner reaction mechanism, Laws governing nucleation, Growth of nuclei, Improving reactivity of solids, coprecipitation as a precursor to solid state reactions, Kinetics of solid state reactions, factors affecting the reactivity of solid state reactions. General principles of growing single crystals, General conditions for crystal growth, solvent properties and saturated solutions, methods for growing crystals, slow evaporation, slow cooling, variation on slow evaporation and slow cooling, solvent diffusion, reactant diffusion, sublimation and seed crystals.

2 Imperfections in solids: **12 L**

Perfect and imperfect crystal, Point defects, Stiochiometric defects, Schottky and Frenkel defects. Thermodynamics of their formation, colour centers.Nonstoichiometric defects. Metal excess and metal deficiency defects. Line imperfections, edge dislocation and screw dislocation, Burger's circuits. Surface imperfection, grain boundries and stacking faults.

3 Semiconductors and their devices: **12L**

Intrinsic and extrinsic semiconductors, semiconductors materials and their fabrication, semiconductors devices p-n junctions, properties of p-n junctions, semiconductors diode as rectifier, Filters circuits, Zener diode as avoltage stabilizer, transistors transistor as an amplifier

Super conductivity: conventional super conductors, organic super conductors (organic metals), fullerence, high temperature super conductors, organic charge transfer complexes Applications.

4 Theories of solid state and properties of solids: **12 L**

Free electron theory, Counduction by free electrons, Band theory, refinement to simple band theory, band structure of metals. Insulator and semiconductors.

Generation of x-rays, interaction of x-rays with matter, scattering and diffraction, Bragg's law, Miller indices, General instrumentation, Bragg's method, single crystal method, Debye-Scherrer method, Identification of unit cells from systematic absences, x-ray intensities and structure determination, structure factor and its relation to electron density and intensity, Phase problem. Indexing of lattice planes in a cubic system, structure of NaCl and KCl, Avogadro's number from cubic lattice dimensions, applications of x-ray diffraction.

5 Ceramics: **12 L**

Introduction, major component of ceramics, clays, silica, feldspar, clay minerals, classification of clay minerals, properties of clay minerals, pillared clays, principal of pillaring, variety of pillaring species, modification of pillared clays, preparation of pillared clays, catalytic applications.

Reference Books

1. Solid State chemistry and its Applications-A. R. West (John Wiley and sons)
2. 2 Principles of Solid State –H.V. Keer (Wiley Eastern Limited)
3. Material science and Engineering-V.Raghavan (prentice Hall of India)
4. Principles of Electronics- V.K.Metha (S.Chand and co.)
5. Engineering chemistry –P.C. Jain and M. Jain (Shanpat Rai and Sons)
6. Industrial chemistry –B.K. Sharma (Goel publishing House)
7. Selected topics in solid state physics vol.12 The growth of crystals from liquids
8. J.C. Brice, North Hollond/American Elesvier(1973)
9. Chemistry of imperfect crystal-F.A. Krogen
10. Crystals and Crystal Growing, Alan Holden and Phylis Singer, Anchor Books Doubleday, New York, 1960

11. X-ray Structure Determination A Practical Guide, 2nd edition George H. Stout and Lyle H. Jensen, John Wiliey & Sons, New York, 1989.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Department of Chemistry

M. Sc. III Semester Physical Chemistry

Thermodynamics

Paper CHEP-315

Lectures: 60 **Credits: 04**

Statistical Thermodynamics

Unit I Introduction **12hrs**

Ensembles-canonical, grand canonical and micro canonical Combinatorial problems, Thermodynamics probability and most probable distribution, Stirlings approximation, distribution laws, the law of equipartition of energies. Quantum statistics- Max Well-Boltzmann, Bose-Einstein and Fermi-Dirac, limit and applicability of various distribution laws.

Unit II Molecular Partition function **12hrs**

Partition function, Expression for translational, rotational, vibrational and electronic partition functions, Third law of thermodynamics and partition function, Numerical problems.

Unit III Application to chemical systems **12hrs**

Partition function and Thermodynamic functions, Sackur-Tetrode equation (derivation), determination of equation of state of an ideal gas. Internal rotation, residual entropies, heat capacity of solids: Einstein model, Debye modification (model), characteristic temperature, statistical mechanics of solutions ideal and nonideal.

Unit IV Applications to quantum systems **12hrs**

Nuclear spin statistics, ortho and para nuclear states, ortho and para hydrogen.Fermi energy, Fermi energy of electron gas in metals, Plancks distribution law and radiation, Bose-Einstein degenerate gas (He gas).

Unit V Irreversible Thermodynamics **12hrs**

Postulates, entropy production in heat, entropy production in matter flow, entropy production in chemical reactions, Onsager's theory, microscopic reversibility and Onsager's reciprocity, stationary states and entropy production, Prigogine's principle of minimum entropy, application to thermoelectric effects-Seeback and Peltier effect.

Books Suggested:

1) Statistical Thermodynamics, Donaid A. Mc Qurrie, Harper & Row, New York 1973.
2) Statistical Thermodynamics, M.C. Gupta, Wiley Eastern Ltd. New Delhi.
3) Elements of Statistical Thermodynamics, L. K. Nash Addison Wesley, Menlo Park, 1972.
4) Physical chemistry, P. W. Atkins, ELBS
5) Non Equilibrium Thermodynamics, Progogine Kalyani Publication.
6) Thermodynamics and Non Equilibrium Thermodynamics, Gurudeep & Raj.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Department of Chemistry

M. Sc. III Semester Physical Chemistry

Advanced Electrochemistry

Paper CHEP-316

Lectures: 60 **Credits: 04**

Unit -1: Oxidation - Reduction Systems: **12 Hrs.**

Oxidation potentials, reversible ox-red systems, determination of standard ox-red potentials, variation of ox-red potential, ox-red equilibria, ox-red systems in analytical chemistry, ox-red indicators, two stage ox-red , semiqinone formation constant. Numericals.

Unit-2: Bio- electrochemistry and Electrocatalysis : **12 Hrs.**

Donnan membrane equilibrium, membrane potential, theories of membrane potential,introduction to electrocatalysis, relative power of electrocatalysts, mechanism of electrocatalysis, bioelectro catalysis, immobilization, application of enzymes on electrodes.

Unit-3: Electrodeposition : **12 Hrs.**

Introduction , the electrogrowth of metals on electrodes , the reaction pathway for electro deposition ,surface diffusion of ions , cathodic deposition of metals from solutions , factors affecting cathodic deposition of metals , electrochemical dissolution and passivity of metals , anodic dissolution of metals , film and adsorption theories of passivity.

Electroplating of metals, mechanism, throwing power of an electroplating bath , factors affecting throwing power , typical electrodeposition processes , applications of electroplating of metals . Numericals.

Unit-4: Polarisation and Overpotentials : **12 Hrs.**

Polarisation , concentration polarization , decomposition potentials ,over voltage ,hydrogen , oxygen and metal overvoltages ,types of overvoltages , factors affecting overvoltages ,experimental determination of decomposition potential and overvoltage, Tafels theory and Tafel equation , simultaneous deposition of metals .Numericals .

Unit -5: Conversion and storage of electrochemical energy: **12 Hrs.**

Introduction of storage cells, fuel cells, solar cells Types of storage cells (batteries) ,measure of cell performance , charging and discharging , introduction of classical batteries , modern batteries –zinc-air , nickel-metal oxide and lithium batteries.

Brief history of fuel cells, efficiency of fuel cells, hydrogen-oxygen fuel cell, phosphoric acid fuel cell, direct methanol and biochemical fuel cells; Solar cells introduction, principle and working of solar cells, advantages.

Reference Books :

1) Modern Electrochemistry, Vol 1,2A and 2B, John O" M Bokris

2) An Introduction to Electrochemistry, Samuel Glasstone.

3) Theoretical Electrochemistry, L.Antropov.

4) Advanced Physical Chemistry, Gurtu and Gurtu.

5) Principles of Physical Chemistry, Puri,Sharma and Pathania.

6) Text Book of Physical Chemistry, S. Glasstone

7) Physical Chemistry, Robert J. Silbey.

8) Physical Chemistry, G.K.Vemulapalli.

9) Physical Chemistry, Maron and Pruton.

10) Physical Chemistry, P.W. Atkins

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Department of Chemistry

M. Sc. IV Semester Physical Chemistry

Nanochemistry

Paper CHEP-417

Lectures: 60 **Marks : 50** **Credits: 04**

I) General introduction & synthesis of nanomaterials by physical methods: [12]
Objective of study, synthesis of nanoparticles by physical method, mechanical methods-high energy ball milling, melt mixing, method based on evaporation, physical vapour deposition with consolidation. Ionized cluster beam deposition. Laser vaporization, Laser pyrolysis, sputter diposition, electric arc deposition, Chemical Vapour Deposition (CVD).

II) **Synthesis of Nanomaterials by Chemical Methods [12]**
Introduction, colloids and colloids in solution, interaction of colloids and medium, colloids in vacuum, colloids in medium, effect of charge on colloids, stearic repulsion, synthesis of colloids, growth of nanoparticles, synthesis of metal and semiconductor nanoparticles by colloidal route, Langmuir-Blodgett (L-B) method, sol gel method, electrochemical method.

III) Analysis Technique : [12]
Introduction, microscopes, electron microscopes,SEM, TEM, Scanning probe microscope (SPM), Scanning Tunnelling microscope, Atomic force microscope, X-ray diffraction, UV-visible and IR spectroscopy.

IV) Properties, types and application of Nanomaterials: [12]

i) Properties of nanomaterials – Mechanical, electrical, optical, magnetic, semiconductor.
ii) Some special nanomaterials – Carbon nanotubes, porous silicon, Arogels, Zeolites.
iii) Application – Electronic, energy automobiles, sport and toys, textile, cosmetics, domestic appliances, biotechnology, medical, space, defence & environment.

V) Thin films: [12]
Introduction, deposition by chemical reactions, deposition by electrochemical reaction, chemical vapor deposition of inorganic Thin films, chemical etching.

Reference Books:

1) Nanotechnology: Principles and practices- Sulabha K. Kulkarni (capital Pub. Co.)
2) NANO- The next revolution –Mohan Surendra Rajan(Natioinal book Trust, India)
3) The British Glass Website- Types of Glass://www.britiglass.org.uk.
4) Fundamental of Nanotechnology – Gabor L. Hornyak, John J. Moore, Harry F. Tibbals, Joydeep Dutta.

5) Recent advances in the liquid phase synthesis of Inorganic Nanoparticles- B. LCushing, V. L. Kolesmichenko & C.J.O".Connor Chemical Review 104, 3893-3946.(2004)
6) Hand book of Thin film technology- H. R. Khan.
7) Thin film phenomenon- K. N. Chopra. Mcgrawa Hill publication
8) Material Science deposition & structure –Milton.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Department of Chemistry

M. Sc. IV Semester Physical Chemistry

Macromolecules and Biophysical Chemistry

Paper CHEP-418

Lectures: 60 **Marks : 50** **Credits: 04**

Chapter 1. Fundamentals of Biological Macromolecules.

Chemical bonds in biological systems; Properties of water; Thermodynamic principles in biological systems; Properties and classification of amino acids; Structures of nucleic acids, Protein structure and function, Properties of nucleosides and nucleotides, Composition of nucleic acids, Electrophoresis, Factors affecting on Electrophoretic Mobility; Types of Electrophoresis; Free electrophoresis and Gel electrophoresis; Electrophoresis in genetic analysis; DNA Sequencing and DNA foot Printing.

Chapter 2. Macromolecules.

Introduction, Formation of synthetic high polymers classification, Polymerization reactions: Chain and Step. Average molecular weight, Number average weight, Methods of determination of molar masses of polymers; Viscosity, Osmometry, Molar mass of charged macromolecules, Donnan membrane equilibrium, Ultracentrifugation, light scattering, Diffusion.

Chapter 3. Chemistry of Polymerization.

Chain polymerization: free radical polymerization, ionic polymerization, co-ordination polymerization, Ziegler-Natta catalysts.

Step Polymerization: polycondensation, polyaddition, ring opening, electro chemical polymerization, group, Transfer polymerization, Polymerization techniques.

Chapter 4. Kinetics of Polymerization:

Free radical chain polymerization, Anionic polymerization, Cationic polymerization, Copolymerization, Free radical copolymerization, Ionic copolymerization, Copolycondensation.

Chapter 5. Electronically Conducting Polymers.

Introduction, Theories of electronic conduction; Band theory of conduction, Hopping conduction, Super conduction, Mechanism of conduction, Doping mechanism, p-type, n-type,

auto doping, Stimuli sensitive (smart) polymers, pH and temperature sensitive smart polymers, Applications: Photovoltaic devices, Sensors, LED and Solar cells, Electro chemical devices, Batteries etc.

Recommended Texts:

1. Cantor, C. R. and Schimmel Biophysical Chemistry Vols. 1-3, W. H. Freeman (1980).
2. Lehninger, A.L., Nelson, D. L. and M. M. Lehninger, Principles of Biochemistry 4th Ed., W. H. Freeman (2004).
3. U. Satyanarayana; Biochemistry.
4. Upadhyay; Biophysical Chemistry.
5. L. Stryer, Biochemistry, 5th Edition, (2002) Freeman and Co. New York.
6. D. Voet, J. G. Voet, Biochemistry 3rd Edition (2004), Wiley International Publication.
7. D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry 3rd Edition (2002) McMillan North Publication.
8. Polymer Science. By V. R. Gowariker, N. V. Viswnathan, Jayadev Sreedhar.
9. Polymers and Resins. By Brage Golding.
10. Electrical Properties of Polymers. By Tony Blythe and David Bloor.
11. Self doped conducting polymers. By Michael S. Freund and Bhavana Deore.
12. Polymer Science and Technology. By Premamoy Ghosh.

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Department of Chemistry

M. Sc. IV Semester Physical Chemistry

Surface and Magnetochemistry

Paper CHEP-419

Lectures: 60 **Marks : 50** **Credits: 04**

Unit-1: Surface chemistry : **[12hrs]**

Adsorption, adsorption isotherms ,Langmuirs unimolecular theory of adsorption statistical derivation of Langmuirs adsorption isotherm , BET theory of multilayer adsorption ,derivation of BET equation, determination of surface area of adsorbent ,heat of adsorption and its determination

Unit-2: Colloidal state of matter : **[12hrs]**

Introduction to colloids, classification, properties, specific properties like,electrical properties, charge on colloidal particals, origin of charge, electrical double layer, electrokinetic properties,electrophoresis, electroosmosis, streaming potential, sedimentation potential, determination of size of colloidal particals, applications of colloids, Numericals.

Unit-3: Introduction to magnetochemistry : **[12hrs]**

Definition of magetic properties, types of magnetic behaviour, sources of paramagnetism, Pascals constants and it's applications, Determination of magnetic susceptibility. Numericals.

Unit-4: Valence theories : **[12hrs]**

Valence bond theory, crystal field theory, octahedral, tetrahedral, square planar, trigonal bipyramidal and square pyramidal stereorio chemistries, John -Teller effect. Magnetic properties based on crystal field model. Limitations of crystal field theory. Molecular orbital theory.

Unit-5: Dielectric Materials: **[12]**

Polarization, Temperature and frequency effects, electric breakdown, ferroelectric materials, problems

REFERENCES:

1. K.J.Laidler, J.H.Meiser and B.C. Sanctuary, Physical Chemistry, Houghton Mifflin Company, New York, 2003.
2. A.W. Adamson, Physical Chemistry of Surfaces, 4 th edition, Interscience, New York, 1982.
3. G.K.Vemulapalli, Physical Chemistry, Printice Hall of India.
4. Gurtu and Gurtu , Advanced Physical Chemistry.
5. S.Glasstone, Text book of Phycal Chemistry.
6. Gurdeep and Raj, Advanced Physical Chemistry.
7. A.R.West, Solid State Chemistry and its Applications, John Wiley and Sons, 2003(reprint 2009)
8. H.V.Keer, Principles of Solid State.
9. A.Earn Shaw, Introcuction to Magnetochemistry, Academic Press.
10. J.Sharma, Magnetochemistry.
11. R.I.Dutta and Syamal, Elements of magnetochemistry.
12. Oliver Kahn,Molecular Magnetism, VCH Weinheim(1993)
13. S. Pahari, Physical Chemistry ,vol.II.
14. Puri, Shrma, Pathania, Principles of Physical Chemistry.
15. Charles Kittle, Introduction to Solid State Physics 7 th edition, John Wiley and Sons,2004 (reprint 2009)

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Department of Chemistry

M. Sc. IV Semester Physical Chemistry

Chemical Dynamics and Catalysis

Paper CHEP-420

Lectures: 60 **Marks : 50** **Credits: 04**

Unit-1: Kinetics of Complex Reactions:

Opposing or reversible reactions, parallel and competative reactions, consecutive reactions, chain reactions, branched chain reactions and explosions, hydrogen-oxygen reactions, kinetics of polymerization-step wise and free radical polymerization Effect of temperature on rates of simple and complex reactions. Numericals

Unit-2: Reactions in solution:

Diffusion controlled reactions, substitution and correlation effect, Hammet equation, Taft effects, compensation effect. Electron transfer reactions, proton transfer reactions. Ion dipole and dipole-diople interactions. Influence of pressure on rate in solution. Numericals

Unit-3: Photochemical Reactions:

Introduction,low of photochemical equivalence, photocatalytic reactions, types of photocatalytic reactions, photooxidation, photoreduction, photosensitization, photocatalytic degradation. Chemiluminescence, photosynthesis. Numericals

Unit-4: Homogeneous Catalysis:

Introduction, mechanism of catalysis, Acid-base catalysis, effect of pH on rate constant. Micellar catalysis, enzyme catalysis, factors governing rate of enzyme reactions, kinetics of enzyme catalysed reactions.Autocatalysis and oscillatory reaction, Lotka-Volterra mechanism, the brusselator, the eregonator, bistability, chemical chaos. Numericals

Unit-5: Surface reactions and Heterogeneous catalysis:

Unimolecular surface reactions, bimolecular surface reactions, effect of temperature on heterogeneous reactions, transition state theory and the rates of surface reactions, theory of heterogeneous catalysis, structure of solid surfaces, absolute rates of desorption's, electronic

theories of chemistorption and heterogeneous catalysis. Preparation and characterization of catalysts, applications.

Reference Books

1.	Chemical kinetics	E.S.Laidler pearson Education
2.	Chemical kinetics and Reaction dynamics	Bul Houston
3.	Chemical kinetics and Reaction Mechanism	F-Wilkinson-VanNostral Reinhdd
4.	kinetics and Mechanism Of Chemical Transformations	J. Rajaram Macmillan India Ltd J.C.Curiacose.
5.	Atkins physical chemistry	Atking and Oxford University press D.Paula
6.	Physical chemistry	Berry, Rice, Ross Oxford University press
7.	Physical chemistry-principles And Appllication in Biological Sciences	Tinoco, Sauer Pearson Education.
8.	Physical chemistry	W.J.Moore.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

DEPARTMENT OF CHEMISTRY
Physical Chemistry Laboratory Course
M. Sc. III and IV Semester
(Effective from June 2014)

CHEP-421 Laboratory course (Physical)

Duration : 135 Hr **Marks 50** **Credits : 4.5**

Spectroscopy

1) To determine the indicator constant pK_{in} of an indicator by using half height method (Bromo cresol purpule) (DVJ-200)
2) To determine the stability constant of metal complex between 5-SSA and Fe^{+3} with help of Job's curve and Bent and French method (for weak complex)(DVJ-204)
3) To determine the concentration of Fe(II) and Cu(II) by spectrophotometric titration with EDTA.
4) To investigate the effect of ionic strength on pKa of bromo cresol green and thus determine pK_{in} (DVJ-211)
5) To investigate the reaction kinetics between $K_2S_2O_8$ and KI by spectrophotometrically (TKC-223)
6) To determine simultaneously the dichromate and permagnate ions in the given solution.

Polarimetry

7) Determine the percentage of two optically active substances in a mixture.(TKC-194)
8) To investigate the complex ion formation between Fe(II) and thiocynate ion.
9) To study Kinetics of hydrolysis of sucrose by Hammett-Zuckerman approach.(DVJ)
10) Investigate the effect of substitution of chloride ions on rate constant of inversion of cane sugar by using mono, di and trichloro acetic acid as catalyst.

Refractometry

11) Determine the refractive indices of series of solution of a salt and determine the concentration of the salt in the given unknown solution.

12) Determine the molar refraction of ethyl, propyl and butyl acetate and show the constancy of contribution to the molar refraction made by CH_2 group.
13) Determine the molar refraction of methyl acetate, ethyl acetate, n-hexane and carbon tetrachloride and calculate the atomic refraction of C, H and Cl atoms.
14) Study the variation of refractive indices with composition of mixture of carbon tetrachloride and ethyl acetate and determine the composition and molar refraction of the given unknown mixture.

Viscosity

15) Determine the variation of viscosity with composition of I) ethanol-water, II) methanol-ethylidene chloride, III) nitric acid- chloroform and and conform the formation of compound.(TKC-250)
16) Determine the molecular weight of macromolecules.(TKC-251)
17) Determine the iso-electric point of gelatin and examine the effect of aging by viscometric methods.(DVJ-29)

Flame Photometry

18) Estimation of Na, K, Li & Ca by flame photometry.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

DEPARTMENT OF CHEMISTRY
Physical Chemistry Laboratory Course
M. Sc. III and IV Semester
(Effective from June 2014)

CHEP-422 Laboratory course (Physical)

Duration : 135 Hr **Marks 50** **Credits : 4.5**

Potentiometer

1) Titrate ferrous ammonium sulphate with cerric sulphate and find out formal redox potential of Fe^{+2}/Fe^{+3} and Ce^{+3}/Ce^{+4} system
2) Titrate potentiometrically phosphoric acid solution against NaOH and calculate pK_1, pK_2 and pK_3 of the acid.
3) Titrate potentiometricaly NaCl solution against $AgNO_3$ and find out the concentration of NaCl and hence determine the solubility product of AgCl.
4) To determine the standard free energy changes ΔG° and equilibrium constant for reaction $Cu + 2Ag^+ \longrightarrow Cu^{++} + Ag$ (TKC-167)
5) Determine the activity coefficient of silver ions using a concentration cell without transference.(TKC-154)

pH metry

6) To determine the proton-ligand stability constant of an organic acid and the metal-ligand stability constant of its complex by pH measurements.(TKC-176)
7) Determine the Hammett constant of a given substituted benzoic acid by pH measurements.(TKC-170)
8) Determine the pH values of various mixtures of sodium acetate and acetic acid in aqueous solution and hence find out the dissociation constant of the acid.(TKC-173)
9) To determine the hydrolysis constant of aniline hydrochloride by pH measurements. (TKC-174)

Conductometry

10) To determine the thermodynamic dissociation constant of weak acid conductometrically.
11) Investigate the kinetics of basic hydrolysis of ethyl acetate conductometrically.
12) Conductometric titration of a mixture of strong acid, weak acid and a salt.(DVJ)
13) To determine the degree of hydrolysis and hydrolysis constant of sodium acetate conductometrically.
14) To determine the ΔG, ΔH and ΔS of silver benzoate by solubility product method.
15) Determine the amount of trichloroacetic acid, monoacetic acid and acetic acid in a given solution by conductometric titration against sodium hydroxide solution.

Magnetochemistry

16) To determine the magnetic susceptibility and number of unpaired electrons in given compound.
17) Verification of Weidemann's law using nickel chloride solution.

Surface Tension

18) Study the effect of surfactant (n-propyl alcohol) at various concentrations on the surface tension of water and hence determine the limiting cross sectional area of alcohol molecule by stalagmometer.
19) Determine the parachor of a solid by stalagmometer.
20) To study the effect of surfactant on surface tension of water by parachor of a solid by stalagmometer.

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DEPARTMENT OF CHEMISTRY
Physical Chemistry Laboratory Course
M. Sc. III and IV Semester
(Effective from June 2014)

CHEP-423 Laboratory course (Physical)

Duration : 135 Hr **Marks 50** **Credits : 4.5**

Section(A):

Chemical Dynamics

1) Investigate the influence of ionic strength on the rate constant of the reaction between $K_2S_2O_8$ and KI.(TKC-335)
2) Determine the order of a reaction by I) substitution method, (II) fractional change method and (III) differential method.
3) Investigate the reaction between bromic acid and hydrochloric acid.(TKC-335)
4) To investigate the reaction between H_2O_2 and KI kinetically.
5) Investigate the kinetics of iodination of acetone.

Phase equalibria

6) Determine the critical solution temperature of phenol and water in presence of 1) 1% NaCl 2) 0.5% naphthalene 3) succinic acid
7) Construct the phase diagram of three-component system containing ethanol benzene and water.
8) Determine the equilibrium constant of the tri-iodide formation in aqueous solution by distribution method.
9) Study the influence of ionic strength on the solubility of $CaSO_4$ and hence determine its thermodynamic solubility product and mean ionic activity.
10) Determine the formula of the complex formed between cupric ion and ammonia by distribution method.

11) Study the variation of solubility of Ca $(OH)_2$ in presence of NaOH solution and hence determine the solubility product at room temperature.

Adsorption

12) Investigate the adsorption of acetic / oxalic acid by activated charcoal and test the validity of Freundlich and Langmuir's isotherm.

Thermodynamics

13) Determine the partial molar volume of ethanol and water in a given composition by density measurements.

14) To determine heat of neutralization of strong acid and heat of ionization of weak acid calorimetrically.

15) To determine the integral heat of solution of KNO_3.

16) To determine the heat of dissociation of benzoic acid in water.

17) To determine heat of precipitation of $BaSO_4$.

18) Determine the energy of activation of the reaction between potassium persulphate and potassium iodide.

19) Study the rate of reaction between ethyl bromo-acetate and sodium thiosulphate kinetically.

Turbidimetry

20) Determine the molecular weight of a given polymer by turbidimetry

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

DEPARTMENT OF CHEMISTRY
Physical Chemistry Laboratory Course (Project Work)
M. Sc. III and IV Semester
(Effective from June 2014)

CHEP-424 Project Work (Physical)

Duration: 135 Hr **Marks 50** **Credits: 4.5**

In this course the students are expected to complete one project, the title of project should be finalized after discussion with their respective project guide.

The scheme of marking is as follow:

A) Project Work: **30 marks**

1. Literature survey
2. Finalization of Project Title
3. Experimental Work
4. Material Characterization and Interpretation of data
5. Conclusion
6. References

B) Project Report: **20 marks**

1. Project report preparation
2. Project presentation
3. Viva- Voce

SCHEME OF MARKING

For paper CHEP (Pr)-421, CHEP (Pr)-422 & CHEP (Pr)-423

Record book & Viva: 05

	Experiment (I)		Experiment II
1)	Observation :	10	08
2)	Calculation:	05	04
3)	Graph:	05	04
4)	Accuracy & Result:	05	04
	Total:	25	20

NOTE: STUDENT WILL NOT BE ALLOWED FOR PRACTICAL EXAMINATION IF HIS/HER RECORD BOOK IS NOT COMPLETED AND CERTIFIED.