SAMRAT ASHOK TECHNOLOGICAL INSTITUTE

(Engineering College), VIDISHA M.P.

(An Autonomous Institute Affiliated to Barkatullah Vishvavidhyalaya, Bhopal)

DEPARTMENT OF APPLIED CHEMISTRY

Subject Code	AC 101	Subject Name	ADVANCED PHYSICAL CHEMISTRY

Marks Allotted				Duration of Theory Paper	Weekly Contact Hours	
Theory						
Maximum Marks		Minimum Marks			L	T
End Sem	Sessional	End Sem	Sessional	3 Hours	3	1
80	20	21*	12			

Total Minimum in Theory* 40% = 128

Syllabus Description	Hrs.
UNIT I – CHEMICAL THERMODYNAMICS: Introduction. First Law of Thermodynamics: Concept of Internal Energy and Enthalpy. Joule Thomson effect, Applications. Kirchhoff's equation and its applications. Second Law of Thermodynamics: Carnot theorem and Carnot cycle. Physical Concept of Entropy. Gibb's Helmholtz equation and its applications. Thermodynamic derivation of law of mass action. Vant Hoff's isotherm, Vant Hoff's isochore. The Clapeyron Equation. Third Law of Thermodynamics: Statement of Third Law of Thermodynamics, Residual Entropy, Clausius Clapeyron Equation. Numericals. Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
UNIT II – CHEMICAL KINETICS Introduction. Order and molecularity of reaction. Determination of reaction mechanism. Arrhenius equation. Effect of temperature on rate constant. Energy of activation. Collision and transition state theories of rate constants. Enzyme kinetics. Catalysis, theories of catalysis. Numericals Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
UNIT III – PHOTOCHEMISTRY Photochemical reactions and its kinetics, photostationary state. Difference between Thermochemical and Photochemical reactions. Laws of Photometry. Beer's Law, Stark Einstein law. Quantum Yield or Quantum Efficiency. Photosensitisation. Photochemical Equilibrium. Excitation of Electrons (Jablonski diagram). Luminescence. Examples of Photochemical Reactions. Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
UNIT IV- ELECTROCHEMISTRY AND ENERGY STORAGE SYSTEMS **Electrochemistry:** Introduction, EMF of cell, Single electrode potential-Derivation ofNernst equation, Numerical problems based on Nernst Equation (E, E^{o}&E_{cell}).Electrochemical series and applications. **Energy storage Systems:** Introduction, Classification of batteries (primary, secondary and reserved batteries). Construction, working and applications of Li-ion batteries. Advantages of Li-ion battery as an electrochemical energy system for electric vehicles. Recycling of Lithium-ion batteries by directcycling Method. Brief introduction of Na- ion battery. Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8

UNIT V- ADSORPTION AND ADSORPTION ISOTHERMS: Introduction. Physical and chemical Adsorption. Adsorption Isotherm. Freundlich Adsorption Isotherm. Langmuir Adsorption Isotherms. BET equation. Adsorption by solids from solutions. Gibb's Adsorption Equation. Applications of Gibb's Adsorption Equation. Applications of Adsorption. Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
Total Hours	40

TEXT BOOKS:

- Physical Chemistry – Thomas Engel & Philip Reid
- Principles of Physical Chemistry – Puri, Sharma & Pathania
- A text book of Physical Chemistry (Vol-II) – K. L. Kapoor.
- Chemical Kinetics and Catalysis – Richard Mishel
- Chemical Kinetics – Keith J Laidler.
- A text book of Physical Chemistry (Vol-V) – K. L.Kapoor.
- Organic Photochemistry – James H. Coxon, B. Halton

- **REFERENCE BOOKS:**
- Chemical Kinetics" by K J Laidler.
- Chemical Engineering Kinetics" by J M Smith.
- Chemical Reaction Engineering" by O Levenspiel.
- Elements of Chemical Reaction Engineering" by H S Fogler.

List/Links of e-learning resource

- https://researchguides.stevens.edu/ch321.
- Researcher Academy

Recommendation by Board of studies on	8.3.2022 (Tuesday)
Approval by Academic council on	16.6.2022 (Thursday)
Subject handled by department	Applied Chemistry

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DEPARTMENT OF APPLIED CHEMISTRY

Subject Code	AC 102	Subject Name	CHEMISTRY OF MATERIALS & PROCESSES	
Marks Allotted			Duration of Theory Paper	Weekly Contact Hours
Theory				L / T
Maximum Marks		Minimum Marks		
End Sem	Sessional	End Sem	Sessional	
80	20	21*	12	3 Hours / 3 / 1

Total Minimum in Theory* 40% = 128

Syllabus Description	Hrs.
UNIT I – WATER TECHNOLOGY, FUELS & COMBUSTION **(A) Water Technology:** Sources, Availability, impurities in Water, Types of hardness, Units of hardness. Defects in boiler due to Hard water. External Treatment (Lime-soda, Zeolite & Ion exchange resin method) & Internal Treatment of Boiler feed water. Numerical Problems. **(B) Fuels & Combustion:** Characteristics of fuels. Classification of fuels, Calorific Value, HCV, NCV. Proximate and ultimate analysis of coal. Numerical problems. Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
UNIT II – UNIT PROCESSES& UNIT OPERATIONS Introduction. Unit processes and Unit operations with examples. Study of Drying, Evaporation, Crystallisation, Filtration, Mixers, Grinders, Agitators. Techniques of Nitration, Sulphonation, Halogenation, Alkylation, Hydrolysis, Hydration etc. Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
UNIT III – AGROCHEMICALS & FERTILIZERS Introduction to Plant nutrients. Bio chemical nutrient Function. Classification of Fertilizers. Manufacture of Ammonia, Urea, Super phosphate, Bio Fertilizer. Pesticides and Insecticides. Manufacture of DDT, BHC, Gammaxene, Malathion, Parathion. Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
UNIT IV- LUBRICANTS, DYES **(A) Lubricants:** Introduction, Classification &functions, Mechanism of lubrication, Lubricating oils, grease, semisolid lubricant and solid lubricants. Properties of lubricating oils with significance: Viscosity Index, Flash point, Fire point, Aniline point, Cloud & pour point, Steam Emulsion Number (S.E.N), Numerical problems. **(B) Dyes:** Classification of dyes on the basis of their structure and application. Theory of colour and constitution. Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
UNIT V- ENERGY & GREEN ENERGY SOLUTION FOR FUTURE Introduction. Energy resources scenario in world and in India. Classification of Energy resources. Green Energy Fuels – Solar energy, Bio Diesel, Wind Energy, Hydrogen Cell etc Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
Total Hours	40

TEXT BOOKS:

- Engineering Chemistry – Jain & Jain – Dhanpat Rai &Company Pvt. Ltd, New Delhi.
- A Text Book of Engineering Chemistry – S.S. Dara – S. Chand Publication, Delhi.
- Engineering Chemistry- Shashi Chawla, Dhanpat Rai &Company Pvt. Ltd, Delhi.
- Engineering Chemistry – Uppal – Khanna Publishers.
- A Text book of Engg. Chemistry- Agarwal, C.V, Murthy C.P, Naidu, BS Publication, Hyderabad.
- B. Sivasankar, Engineering Chemistry 1 st Edition, Mc Graw Hill Education (India), 2008
- O.G. Palanna, McGraw Hill Education (India) Private Limited, 9 th Reprint, 2015
- Industrial Chemistry by Reegel Pub.Reihhold Publisher Co.
- Unit Process in Organic Syhterio by R.H.Groggins Pub.Mc Graw Hill Science in Chemical engg.
- Engineering Chemistry by P.C.Jain & Monika Jain Pub.Dhanpat Rai Pub.Co.New Delhi.

REFERENCE BOOKS:

- Modern Methods of Organic Synthesis – William Carruthers, Iain Coldham
- Organic Synthesis the disconnection approach – Stuart Warren.

List/Links of e-learning resource

- pellack@iastate.edu.
- Materials Science and Engineering for the 1990s.
- Materials Science and Engineering: Forging Stronger Links

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DEPARTMENT OF APPLIED CHEMISTRY

Subject Code	AC 103	Subject Name	CORROSION & PROTECTION OF METALS		
Marks Allotted			Duration of Theory Paper	Weekly Contact Hours	
Theory					
Maximum Marks		Minimum Marks		L	T
End Sem	Sessional	End Sem	Sessional	3 Hours	3	1
80	20	21*	12			

Total Minimum in Theory* 40% = 128

Syllabus Description	Hrs.
UNIT I – PRINCIPLES INVOLVED IN CORROSION Concept of free energy, Dissolution processes, Electrochemical Equilibria, Nernst's theory of metal electrode potential, Potential of highly reactive metals, Zero potential electrode, types of corrosion cells, Over voltage, Polarisation electrode behaviour of various metals, Cathodic reactions and anodic reactions Electrode potential, electrical work and free energy relationship. Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
UNIT II – CORROSION AND ITS CONTROL Introduction, Dry or chemical corrosion, Wet or electrochemical corrosion, Mechanism of wet Galvanic corrosion, Concentration cell corrosion, Underground or soil corrosion, Pitting corrosion, Intergranular corrosion, Waterline corrosion, Stress corrosion, Microbiological corrosion, Erosion corrosion, Factors influencing corrosion, corrosion control, Pourbiax Diagram (pH – Potential). Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	
UNIT III– APPROACH OF CORROSION Fundamentals of corrosion, types of corrosion, chemistry and mechanism of corrosion, factors involved in corrosion process, Factors affecting corrosion, Classification and theories of corrosion. Thermodynamics and kinetics of corrosion reactions, Characteristics of environments (atmosphere, water, soil, chemical food stuffs, fused salts, microbial etc) in corrosion process, Corrosion fatigue, Testing and Measurement of corrosion Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
UNIT IV – PASSIVITY OF METALS, INHIBITORS AND PASSIVATORS Concept of Passivity and passivation, Types and theory of passivity, Mechanism of film nucleation and film growth, Break down passivity, passivation by electrical external current and chemical oxidising agents, inhibitors and passivators types. General principles governing inhibition, mechanism of inhibition. Cathodic protection and anodic protection problems and limitations. Advantages and disadvantages of Cathodic and anodic protection. Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
UNIT V- COATINGS, PERFORMANCE AND EVALUATION Principle of prevention of corrosion, preparation of metal surfaces for coatings, Method of applying metal coatings, Electroplating techniques used for nickel, cadmium, chromium plating, Inorganic and non metallic coatings, Mechanism of film formation and application of oxide coatings of ferrous surfaces, Vitreous enamel coatings, pigments used in coatings, wash	8

primer system, evaluation of priming pigments, factors influencing evaluation of paints, varnishes, enamels and lacquers, Functions of paint ingredients Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	
Total Hours	40

TEXT BOOKS:

- N. Perez, *Electrochemistry and Corrosion Science*, Kluwer Academic Publishers, Norwell, Mass, USA, 2004.
- E. Protopopoff and P. Marcus, *ASM Handbook Volume 13A: Corrosion*, ASM International, Materials Park, Ohio, USA, 2003.
- J. O'M. Bockris and A. K. N. Reddy, *Modern Electrochemistry*, vol. 2, Plenum/Rosetta Edition, New York, NY, USA, 1973.
- D. J. G. Ives and G. J. Janz, *Reference Electrodes*, Academic Press, New York, NY, USA, 1961.
- H. Gerischer, "Principles of Electrochemistry," in *CRC Handbook of Solid State Electrochemistry*, P. J. Gellings and H. J. M. Bouwmeester, Eds., p. 19, CRC Press, Boca Raton, Fla, USA, 1997.

REFERENCE BOOKS:

- Concise Inorganic Chemistry - J. D. Lee.
- Inorganic Chemistry -Meissler & Tarr.
- Mechanism of Inorganic Reactions – Fred Basolo, Ralph G. Pearson.

List/Links of e-learning resource

- View at: Google Scholar.
- **https://doi.org/10.1155/2010/756950.**

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DEPARTMENT OF APPLIED CHEMISTRY

Subject Code	AC 104	Subject Name	BASIC ANALYTICAL CHEMISTRY

Marks Allotted				Duration of Theory Paper	Weekly Contact Hours	
Theory						
Maximum Marks		Minimum Marks			L	T
End Sem	Sessional	End Sem	Sessional	3 Hours	3	1
80	20	21*	12			

Total Minimum in Theory* 40% = 128

Syllabus Description	Hrs.
UNIT I – GENERAL INTRODUCTION Importance, Applications and Scope of Analytical Chemistry, Classification of Analytical methods (Classical and Instrumental), Selection of method for analysis, Sampling – Definition and purpose of sampling, Various techniques involved for Sampling of Gases, Liquids and Solids. Safety measures in Analytical laboratory. Definitions of seven base units, Derived units, conversion between units, significant figures. Numericals. Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
UNIT II– BASIC CONCEPTS AND INTRODUCTION TO VOLUMETRIC METHODS **(A) Chemical Concentrations:** Mole, Equivalent weight, molar mass, calculations in grams and moles, solutions and their concentrations, molar concentration, Normal concentration, Percent concentration, Parts Per Million (ppm), Parts Per Billion (ppb), Volume ratio for dilution procedures. **(B) Volumetric Methods:** Definition of terms: Titrant, Titrand, Analyte, End point and Equivalence point, Indicator, Standard Titrant, Primary Standard and Secondary Standard, Titration, Classification of Titration reactions. Numericals. Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
UNIT III – ERRORS AND STATISTICAL TREATMENT IN CHEMICAL ANALYSIS Introduction. Errors, Accuracy and Precision. Types and classification of errors. Constant and proportionate errors. Methods of minimizing errors. Introduction to Statistical treatment of data, Grouping of data, Histogram and Frequency polygon, Measures of Central tendency and dispersion, Gaussian distribution curve, Mean and Standard deviation, Confidence limits and Confidence intervals. Testing for significance, Statistical tests of data (F test, t test, Q test for bad data, the method of least squares), Rejection of a result, Graphical presentation of results. Numericals. Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
UNIT IV-TITRIMETRIC ANALYSIS-I (ACID BASE TITRATIONS AND PRECIPITATION TITRATIONS) **(A) Acid-Base titration:** Theory of acid base indicators, Theory of acid-base titration, Titration Curves, Titration of strong acid-strong base, weak acid-weak base, strong acid-weak base with titration curve and choice of indictors. **(B) Precipitation Titration:** Titration curve for precipitation reaction, end point detection, Mohr's method and Volhard's method. Tutorial: Involvement of faculty and students in identifying the Engineering applications, doubts and explanations. Numericals.	8

UNIT V- TITRIMETRIC ANALYSIS-II (REDOX TITRATIONS & COMPLEXOMETRIC TITRATIONS) **(A) Redox Titration:** Theoretical basis of Redox volumetric analysis involving (i) Potassium Permanganate (ii) Potassium dichromate and (iii) Iodine. **(B) Complexometric Titration:** Theory of Complexometric Titration, Indicators for EDTA titration, Types of EDTA titration-Direct and Back titration. Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations. Numericals. Tutorial: Involvement of faculty and students in identifying the applications, doubts and explanations.	8
Total Hours	40

TEXT BOOKS:

- D. A. Skoog et al. Fundamentals of Analytical Chemistry.
- M. Otto. Chemometrics: Statistics and Computer Applications in Analytical Chemistry.
- Manz and H. Becker, Eds. Microsystem Technology in Chemistry and Life Sciences.
- R. Willoughby et al. A Global View of LC/MS: How to Solve Your Most Challenging Analytical Problems.
- G. Christian. Analytical Chemistry: Solutions Manual.

REFERENCE BOOKS:

- Instrumental Method – Skoog, Holler & Crouch.
- Dean. Analytical Chemistry Handbook.
- G. W. Ewing. Analytical.
- Instrumentation: A Laboratory Guide for Chemical Analysis.
- D. Harvey. Modern Analytical Chemistry.
- J. N. Miller. Modern Analytical Chemistry.
- T. J. Bruno. Spectroscopic Methods.

List/Links of e-learning resource

- NIST Chemistry Webbook
  http://webbook.nist.gov
- {Analytical Chemistry Springboard from Umeå University}
  http://www.anachem.umu.se/jumpstation.htm

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DEPARTMENT OF APPLIED CHEMISTRY

Subject Code	AC 105	Subject Name	PRACTICAL CHEMISTRY	
Marks Allotted			Duration of Practical Examination	Weekly Contact Hours
Practical				
Maximum Marks		Minimum Marks		
End Sem	Sessional	End Sem	Sessional	
80	20	40	12	8 Hours / 12

Syllabus Description

Suggested List of Practicals (Minimum 12 Experiments be performed):

1. Introduction to chemistry lab, Safety Measures, Calibration of glass-wares i.e. Chemical balance, burette, pipette, measuring cylinders.
2. To determine strength of unknown Ferrous Ammonium Sulphate $FeSO_4.(NH_4)_2SO_4.6H_2O$ (Mohr's Salt) solution by titrating it against intermediate Potassium Dichromate ($K_2Cr_2O_7$) solution using Di Phenyl Amine(DPA) (internal indicator). [Redox Titration]
3. To determine strength of FAS solution by titrating it against intermediate Potassium permanganate ($KMnO_4$)solution. (Self Indicator). [Redox Titration]
4. To determine strength of unknown Ferrous Ammonium Sulphate $FeSO_4.(NH_4)_2SO_4.6H_2O$ (Mohr's Salt) solution by titrating it against intermediate Potassium Dichromate ($K_2Cr_2O_7$) solution using potassium ferricyanide indicator (External Indicator). [Redox Titration]
5. Determination of strength of Fe in steel using DPA indicator.
6. To determine Temporary, Permanent and Total Hardness in given sample of water by E.D.T.A. method.[Complexometric Titration]
7. To determine strength of Sodium Carbonate and Sodium Bicarbonate in given alkaline solution by titrating with standard HCl using phenolphthalein and Methyl Orange indicators. [Acid Base Titration]
8. To determine strength of Sodium Carbonate and Sodium hydroxide in given alkaline solution by titrating with standard HCl using phenolphthalein and Methyl Orange indicators. [Acid Base Titration]
9. To determine alkalinity in given water sample using Phenolphthalein and Methyl Orange indicators. [Acid Base Titration]
10. To determine acidity in given water sample using Phenolphthalein and Methyl Orange indicators. [Acid Base Titration]
11. To determine free CO_2 in given water sample. [Acid Base Titration]
12. To determine strength of unknown $CuSO_4$ solution by titrating it against intermediate sodium thiosulphate (Hypo) solution using starch as final indicator. [Iodometric Titration]
13. Determination of strength of Cu in electric wire.
14. Determination of strength of Cu in (1) Brass and (2) Bronze sample.
15. To determine the chloride content of the given sample of water using silver nitrate solution with potassium chromate solution as an indicator.[Precipitation Titration]
16. Any other experiment set by department

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