

MAHARSHI DAYANAND SARASWATI UNIVERSITY,
AJMER

पाठ्यक्रम

SYLLABUS

SCHEME OF EXAMINATION AND
COURSES OF STUDY

FACULTY OF SCIENCE

M.Sc. APPLIED CHEMISTRY

M.Sc. SEMESTER I & II

(w.e.f. 2019-20)

M.Sc. SEMESTER III & IV

(w.e.f. 2020-21)



ALKA PUBLICATIONS

Purani Mandi, Ajmer

NOTICE

1. Change in Statutes/Ordinances/Rules/Regulations Syllabus and Books may, from time to time, be made by amendment or remaking, and a candidate shall, except in so far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change. **The decision taken by the Academic Council shall be final.**

सूचना

1. समय-समय पर संशोधन या पुनः निर्माण कर परिनियमों/अध्यादेशों/नियमों / विनियमों / पाठ्यक्रमों व पुस्तकों में परिवर्तन किया जा सकता है, तथा किसी भी परिवर्तन को छात्र को मानना होगा बशर्ते कि विश्वविद्यालय ने अन्यथा प्रकार से उनको छूट न दी हो और छात्र ने उस परिवर्तन के पूर्व वर्ष पाठ्यक्रम को पूरा न किया हो। विद्या परिषद द्वारा लिये गये निर्णय अन्तिम होंगे।

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M.D.S.U. Syllabus / M.Sc. Applied Chemistry / 3 M.Sc. APPLIED CHEMISTRY (2018-20)

SEMESTER-I (2018-19)

S. No.	Course Code	Titles of the Course	L-T-P	No. of credits	Max. Marks: 50			
					Univ. exam	Int. exam	Total	
1.	MIAC 01-CC-01	General Chemistry-I	3-1-0	4	40	10	50	
2.	MIAC 02-CC-02	General Chemistry-II	3-1-0	4	40	10	50	
3.	MIAC 03-CC-03	Spectroscopy-I	4-1-0	5	40	10	50	
4.	MIAC 04-CC-04	Spectroscopy-II	4-1-0	5	40	10	50	
5.	MIAC 05-CP-01	Practicals	0-0-18	12	100	00	100	
TOTAL				36	30	260	40	300

M.Sc. APPLIED CHEMISTRY (2018-20)

SEMESTER-II (2018-19)

S. No.	Course Code	Titles of the Course	L-T-P	No. of credits	Max. Marks: 50			
					Univ. exam	Int. exam	Total	
1.	M2AC06-CC-05	Environmental Chemistry	4-1-0	5	40	10	50	
2.	M2AC07-CC-06	Computer Programming for Chemists	3-1-0	4	40	10	50	
3.	M2AC08-CC-07	Diffraction methods and Spectroscopy	4-1-0	5	40	10	50	
4.	M2AC09-CC-08	Catalysts and Enzymes	3-1-0	4	40	10	50	
5.	M2AC10-CP-02	Practicals	0-0-18	12	100	00	100	
TOTAL				36	30	260	40	300

M.Sc. APPLIED CHEMISTRY (2018-20)

SEMESTER-III (2019-20)

S. No.	Course Code	Titles of the Course	L-T-P	No. of credits	Max. Marks: 50			
					Univ. exam	Int. exam	Total	
1.	M3AC11-CC-09	Separation Techniques	4-1-0	5	40	10	50	
2.	M3AC12-CC-10	Analytical Methods	4-1-0	5	40	10	50	
3.	M3AC13-CC-11	Chemical Analysis	3-1-0	4	40	10	50	
4.	M3AC14-CC-12	Principles of Chemical Engineering	3-1-0	4	40	10	50	
5.	M3AC15-CP-03	Practicals	0-0-18	12	100	00	100	
TOTAL				36	30	260	40	300

M.Sc. APPLIED CHEMISTRY (2018-20)

SEMESTER-IV (2019-20)

S. No.	Course Code	Titles of the Course	L-T-P	Max. Marks: 50			
				No. of credits	Univ. exam	Int. exam	Total
1.	M4AC16-ET-21A/21B	Polymer Chemistry-I/ Polymer Chemistry-II	4-1-0	5	40	10	50
2.	M4AC17-ET-22A/22B	Industrial Chemistry-I/ Textile Chemistry	3-1-0	4	40	10	50
3.	M4AC18-ET-23A/ 23B	Pharmaceutical-I/ Chemistry Pharmaceutical-II Chemistry	4-1-0	5	40	10	50
4.	M4AC19-ET-24A/24B	Industrial Chemistry-II Material Characterization	3-1-0	4	40	10	50
5.	M4AC20-EP-01	Practicals	0-0-18	12	100	00	100
TOTAL			36	30	260	40	300

M.Sc. SEMESTER EXAMINATION

M.Sc. APPLIED CHEMISTRY

Scheme of Examination

- The maximum Marks of each year examination will be 600 and 1200 will be total maximum marks for the two years examination. Each year there will be two Semesters of 300 marks each.
- There will be four papers in each Semester. Each paper will have maximum marks of 50 and of 3 hours duration. There will be one Practical Examination of 6 hours duration with maximum 100 marks.
- There shall be 16 papers in all (Four papers in each Semester and four Semesters in all). Each theory paper shall be of three hours duration having 50 marks. Out of 50 marks, 20% marks i.e. 10 marks in each paper shall be of internal assessment based on test, seminars and project work in each paper.
- Scheme of Examination in Individual Semester and distribution of marks in each paper will be as under:

Curriculum & Scheme of Examination for M.Sc. Applied Chemistry
Semester Number
and Course Nomenclature

Total Marks

Semester-I

MIAC01-CC-01	General Chemistry-I	40
MIAC02-CC-02	General Chemistry-II	40
MIAC03-CC-03	Spectroscopy-I	40
MIAC04-CC-04	Spectroscopy-II	40
Internal Assessment (10 marks for each paper)		40
MIAC05-CP-01	Practicals	100
Total= 300		

Semester-II

M2AC06-CC-05	Environmental Chemistry	40
M2AC07-CC-06	Computer Programming For Chemists	40
M2AC08-CC-07	Diffraction Methods & Spectroscopy	40
M2AC09-CC-08	Catalysts & Enzymes	40
Internal Assessment (10 marks for each paper)		40
M2AC10-CP-02	Practicals	100
Total= 300		

Semester-III

M3AC11-CC-09	Separation Techniques	40
M3AC12-CC-10	Analytical Methods	40
M3AC13-CC-11	Chemical Analysis	40
M3AC14-CC-12	Principles of Chemical Engineering	40
Internal Assessment (10 marks for each paper)		40
M3AC15-CP-03	Practicals	100
Total= 300		

Semester-IV

M4AC16-ET-21A/21B	Polymer Chemistry-I/Polymer Chemistry-II	40
M4AC17-ET-22A/22B	Industrial Chemistry-I/Textile Chemistry	40
M4AC18-ET-23A/23B	Pharmaceutical-I Chemistry/ Pharmaceutical-II Chemistry	40
M4AC19-ET-24A/24B	Industrial Chemistry-II/Material Characterization	40
Internal Assessment (10 marks for each paper)		40
M4AC20-EP-01	Practicals	100
Total= 300		
Grand Total = 1200		

GRADE POINTS

Grade	Mark m out of 100	Grade Points	Grade	Mark m out of 100	Grade Points
O	$m \geq 95$	10	E	$35 \leq m < 45$	4
O	$85 \leq m < 95$	9	F	$25 \leq m < 35$	3
A	$75 \leq m < 85$	8	F	$15 \leq m < 25$	2
B	$65 \leq m < 75$	7	F	$05 \leq m < 15$	1
C	$55 \leq m < 65$	6	F	$m < 05$	0
D	$45 \leq m < 55$	5			

AWARD OF CLASS

CGPA	Class
CGPA < 4	Fail
$4 < \text{CGPA} < 5$	Pass Class
$5 < \text{CGPA} < 6$	2 nd Class
$6 < \text{CGPA} < 7$	1 st Class
CGPA > 7	Distinction

Grade Point Average = $\frac{\sum(\text{credit} \times \text{Grade Points})}{\text{Total credits}}$

Equivalent Percentage = CGPA \times 10

Cumulative Grade Point Average (CGPA) is computed as

$\text{CGPA} = \frac{\sum(\text{Credit} \times \text{Grade Points})}{\text{Total semesters credits}}$

Note: The formula for Equivalent Percentage in the I, II and III Semester marksheets should be read as Equivalent Percentage = CGPA \times 10 instead of Equivalent Percentage = CGPA \times 9.5

M.SC. APPLIED CHEMISTRY SEMESTER I EXAMINATION**MIAC01-CC-01GENERAL CHEMISTRY-I**

Duration: 3 hours

Maximum Marks : 40

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8marks) is compulsory and contains 8 questions (20 words each). Each question is of

one mark. Part B (8 marks) is compulsory, contains four questions, at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I**Electrochemical Phenomenon and Quantum Mechanics**

Redox Systems, electrochemical cells and electrochemical reactions, electrochemical series, Hydrogen electrode.

Primary cells and Secondary cells, cell characteristic and cell capacity, types of plates and Separators and their significance in lead cells, Batteries for space. Fuel cells, Photovoltaic effect.

Corrosion and its control - Definition and its significance, types of corrosion, factors affecting controlling methods of corrosion.

Basic Principles of Quantum Mechanics: Postulates, Schrodinger Equation to some model systems viz. Harmonic oscillator and hydrogen atom, particle in a one - dimensional box

Unit-II**Crystals defects and Non-stoichiometry**

Perfect and imperfect crystals, intrinsic and extrinsic defects - point defects, line and plane defects with explanation. Thermodynamics of Schottky and Frenkel defect formation, colour centers, non-stoichiometry and defects.

Group Theory: Symmetry elements, point groups, character tables, selection rules, applications.

Unit-III**STEREOCHEMISTRY**

Molecular dissymmetry and optical activity, properties of enantiomers, diastereo-isomers, racemic modifications, resolution, prochirality, stereogenic centre, stereospecificity, stereoselectivity, chemoselectivity, chemospecificity, regioselectivity and regiospecificity, stereoselective synthesis, asymmetric synthesis.

Book Suggested:

1. Modern Electrochemistry Vol. I & II (Plenum Publishers): J O M Bockris & A K N Reddy
2. Atkin Physical Chemistry (Oxford University Press, New York): Atkin P & Paula J D
3. Physical Chemistry (Pergaman Press, Oxford, London): Moelwyn-Hughes E A
4. Physical Methods in Chemistry (Saunders College): R S Drago

5. Essentials of Crystallography: M. A. Wahab Springer 2008
6. Crystallography and Crystal Structure : G.D. Arora: Sarup & Sons, New Delhi, 1st Edn. 2000
7. Corrosion Engineering: M.G. Fontane & N.D. Green, McGraw Hill Company N.Y.
8. Corrosion & Corrosion Control: H.H. Uhlig, John Wiley & Sons Inc
9. Advanced Physical Chemistry: Gurtu and Gurtu, Pragati Prakashan
10. Solid State Chemistry: V K Selvaraj
11. Stereochemistry by Patapov
12. Stereochemistry by D. Nasipuri

MIAC02-CC-02 GENERAL CHEMISTRY-II**Duration: 3 hours****Maximum Marks : 40**

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8 marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions, at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I

Adsorption and Miscelles : Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), BET equation (without derivation) for estimation of surface area, Gibbs adsorption isotherm.

Surface active agents, classification of surface active agents, micellization, thermodynamics of micellization, critical micellar concentration (CMC), factors affecting the CMC of surfactants.

Unit-II**Chemical Thermodynamics and Elements of Statistics**

Law of Thermodynamics, Spontaneity and Equilibria, temperature and pressure dependence of thermodynamic quantities, Le Chatelier Principle, thermodynamics of ideal and non-ideal gases and solutions, partition functions and their relation to thermodynamic quantities

Data Analysis: Mean and Standard deviation, absolute and relative errors, linear regression, correlation coefficient

Unit-III**Analysis of Ores and Alloys.**

Sampling and pretreatment of Ores and Alloys, Care of platinum vessels, composition and analysis of Hematite, Pyrolusite, Galena, Ilmenite,

Wolframite, chrome ores.

Books Suggested:

1. Analytical Methods for ores and Minerals, ISBN 978-81-89866-54-9/2009, TBA (B.H. Khawas)
2. A Laboratory Manual of Metals and Alloys Vol-II ISBN 978-81-907462-4-3/2009, (S.M. Ashraf, Sharif Ahmad, Ufana Rauaz)
3. Chemical & Instrumental Analysis of Ores Minerals & Ore Dressing Products, IBM Nagpur
4. A Text Book of Physical Chemistry by Samuel Glasstone. Pub. Maxmillian Student Edition.
5. Physical Chemistry, Gordon M. Barrod Pub. International Science Edition McGraw Hill
6. A Text Book of Physical Chemistry, Irs N Levis Pub. McGraw Hill Int. Book Co.
7. Physical Chemistry, Gurdeep Raj & Chatwal Pub. Goel Pub. Meerut
8. Text Book of Physical Chemistry, Negi & Anand Pub. Wiley E. Ltd.
9. Physical Chemistry, I.N. Levine, 5th Edition (2002), Tata McGraw Hill Pub. Co. Ltd., New Delhi.

MIAC03-CC-03: SPECTROSCOPY-I**Duration: 3 hours****Maximum Marks : 40**

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8 marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions, at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I**Atomic Spectroscopy**

Energies of atomic orbitals, term symbols and L-S and J-J Coupling, spectra of hydrogen atom and alkali metal atoms.

Molecular Spectroscopy

Molecular orbitals and its energy levels, Franck Condon Principle, electronic spectra of diatomic and polyatomic molecules, Paschen-Back effect, Zeeman effect, Spectra of transition metal complexes, charge transfer spectra.

Unit-II**Infrared Spectroscopy**

Review of linear harmonic oscillator, vibrational energies of diatomic

molecules, zero point energy, force constant and bond strengths, vibrations of polyatomic molecules. Selection rules, normal modes of vibrations, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, 2DNMR (COSY, HETCOR, NOESY, DEPT, APT, NEPT)

Unit-III**Nuclear Magnetic Resonance (NMR) Spectroscopy**

Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, deshielding, spin-spin interactions, factors influencing coupling constant 'J', Classification (AX, AB, ABX, AMX, ABC, A₂B₂ etc.) spin decoupling, basic ideas about instrument, Applications of NMR, ¹³CNMR- carbon chemical shift, carbon effect, assignment techniques.

Books Suggested:

1. Molecular Spectroscopy : Jag Mohan : Springer 2008
2. Application of Absorption Spectroscopy of Organic Compounds: Dyer : Eastern Economy Editions
3. Inorganic Spectroscopy & Related topics : Frinza Hammer, Sarup& Sons 2008
4. A Handbook of Molecular Spectroscopy, 2005, PoojaBhagwan
5. Spectroscopic Identification of organic compounds, R.M. Silverstein, C.G. Bassler& T.C. Morrill, John Wiley & Sons N.Y.
6. Fundamentals of Molecular Spectroscopy, G.M. Namme; Mc Craw Hill Company N.Y. 1972
7. Introduction to Molecular Spectroscopy, G.M. Barrow, Mc Craw Hill Company N.Y. 1972
8. Spectroscopy Vol I & II, S.Walker& H. Stane, Chapman & Hall 1962
9. Principles of Magnetic Resonance, C.P. Shichter, Springer Verlag 1981
10. Molecular Spectroscopy, J.D. Graybeal, McGraw Hill 1988
11. Fundamental of Molecular Spectroscopy, Colin N Banwell and Elaine, M Mccasn
12. Instrumental Methods of Chemical Analysis by Willard, East West Press Pvt. Ltd.
13. Instrumental Methods of Chemical Analysis by Chatwal & Anand, Himalaya Pub.
14. Instrumental Methods of Chemical Analysis by B.K. Sharma, Goel Pub. House Meerut.
15. Spectroscopy of Organic Compounds by P.S. Kalsi New Age International Publisher.

MIAC04-CC-04 : SPECTROSCOPY-II

Duration: 3 hours

Maximum Marks: 40

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8 marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions, at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I**Raman Spectroscopy**

Classical and quantum theories effect, Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion Principle. Resonance Raman spectroscopy, Coherent Anti Stokes Raman Spectroscopy (CARS).

Elementary idea of principle and applications of Mossbauer Spectroscopy.

Unit-II**Mass Spectrometry**

Theory, Instrumental Set-up and its mode of operation, mass spectrometers, Process of ionization separation and detection of ions. Mass spectrum and its interpretation, determination of molecular formula, weight and structure, Fragmentation, Recognition of molecular ion. General appearance of the mass spectra, Meta stable ion, Mass spectra of classes of organic compound, Application of mass spectrometry.

Unit-III**Nuclear Quadrupole Resonance Spectroscopy**

Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant, splitting. Applications.

Electron Spin Resonance Spectroscopy

Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, applications.

Books Suggested:

1. Introduction to Mass Spectrometry- J. Robog, John Wiley Inter. Pub.
2. Instrumental Methods of Chemical Analysis by Willard, East West Press Pvt. Ltd

- Instrumental Methods of Chemical Analysis by Chatwal & Anand, Himalaya Pub.
- Instrumental Methods of Chemical Analysis by B.K. Sharma, Goel Pub. House Meerut.
- Spectroscopy of Organic Compounds by P.S. Kalsi New Age International Publisher.
- Organic Chemistry by T.M. Graham Solomons & Craig B. Fryhle, John Wiley & Sons, New York
- Electron Spectroscopy, 2002 (Rajbir Singh)
- Spectroscopy. H. Kaur, PragatiPrakashan

MIAC05-CP-01 : PRACTICAL

Duration: 6 hours

Maximum Marks: 100

A. Quantitative analysis of Ore and Alloys (Minimum three)

- To estimate Ferrous, Ferric individually or both Ferrous and Ferric Iron in the given sample.
- To determine copper and nickel in the given sample by Iodometry
- To determine chromium in chromite ore.
- To estimate calcium in limestone or dolomite.
- To estimate Manganese Dioxide in pyrolusite
- To determine percentage of copper in brass.
- To determine percentage of iron in plain carbon steel.
- To determine percentage of silver in the given sample.

B. Flame Photometric Determinations (Minimum Three)

- Sodium in Water or Soil sample.
- Potassium in Water or Soil sample.
- Calcium in Water or Soil sample.
- Sodium and potassium together in Water or Soil sample.
- Lithium in Water sample.
- Barium/strontium in Water sample.
- Sulphate in Water sample.
- Phosphate in Water sample.
- Silver in Water sample.

C. Chromatographic Separations (Minimum Five)(I) Perform Thin Layer Chromatographic Separation of the following and determine R_f values:

- Nickel (II) and Zinc (II) ions
- Zinc (II) and Cobalt (II) ions

- Nickel (II), Cobalt (II) and Zinc (II) ions
- Lead (II) and Copper (II) ions
- Arsenic (III), Antimony (II) and Antimony (III) ions
- Barium (II), Strontium (II) and Calcium (II) ions
- Nickel (II), Cobalt (II), Copper (II) and Zinc (II) ions
- Mercury (II), Copper (II), Lead (II), Bismuth (II) and Cadmium (II) ions
- Fluoride, Chloride, Bromide and Iodide Ions
- (II) To separate the components from a mixture of sudan red and sudan yellow by TLC
- (III) To separate the components from a mixture of methylene blue and fluorescein (sodium salt) by TLC
- (IV) To separate the components from a mixture of o- and p- nitroanilines by TLC
- (V) To study the separation of organic acids by one dimensional paper chromatography
- (VI) To separate the components from a mixture of amino acids by TLC
- (VII) To separate the components from a mixture of monosaccharides by TLC
- (VIII) To separate the components from a mixture of dyes by TLC
- (IX) To determine by Column or TLC Technique whether the given inks consist of single or multiple mixtures of dyes.
- (X) To separate components of chlorophyll by ascending paper chromatography.
- (XI) To separate the components from a mixture of dyes by column chromatography

D. Spectroscopy.

Identification of organic compounds by the analysis of their spectral data (UV, IR, PMR, MASS)

Books Suggested:

- A textbook of Quantitative Analysis, A.I. Vogel
- A textbook of Qualitative Analysis, A.I. Vogel
- Water Analysis. Trivedi and Goel
- Experiments and Calculations in Engineering Chemistry, S.S. Dara

INSTRUCTIONS FOR PRACTICALS

Duration: 6 hours

Maximum Marks: 100

The Board of Examiners will constitute of one External Examiner and one Internal Examiner

Marking Scheme

Exercise	Marks
A. Quantitative analysis	30
B. Flame Photometric Determinations	20
C. Chromatographic Separations	15
D. Spectroscopy	15
E. Record	10
F. Viva	10
Grand Total	100

M.SC. APPLIED CHEMISTRY SEMESTER II EXAMINATION**M2AC06-CC-05 ENVIRONMENTAL CHEMISTRY**

Duration: 3 hours

Maximum Marks : 40

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions, at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I**Water and Water Pollution**

Objectives of analysis, parameter for analysis-colour, temperature, transparency, turbidity, total solids, conductivity, acidity, alkalinity, hardness, chloride, sulphate, fluoride, silica, hydrogen sulphide. Fe, Na, K, P (Total, inorganic, organic), carbohydrate (Total, dissolved, particulate) and different forms of nitrogen, DO, BOD, COD, free CO₂, Purification and Waste Treatment (Primary, Secondary and Tertiary Treatment Processes)

Sources of water pollution- solid waste, industrial, agriculture, oil, radioactive waste, pesticides, thermal pollution, classification of water pollutants and their effects, sampling of water pollutants. Heavy metal pollution in water by cadmium, chromium, copper, lead, zinc, manganese, mercury and arsenic pollution and their analysis.

Unit-II**Air and Air Pollution**

Important Chemical and photochemical reactions in atmosphere. Greenhouse effect, acid rain, ozone hole phenomenon, thermal inversion. Air quality standards, sampling of air pollutants- gaseous and particulate, analysis of air pollutants, stack monitoring. Sources- stationary and transportation sources of air pollution, classification of air pollutants- sources, effects and control of CO, SO₂, NO_x, hydrocarbons as gaseous pollutants,

suspended particulate matter aerosols, photochemical air pollution. Sources and toxic effects of Pb, Cd, Hg, As, Cr, Ni and Mn.

Unit-III**Soil and Soil Pollution**

Definition, components of soil, fertility management of soils, soil sediment analysis-physical and chemical parameters.

Soil pollution – sources, detrimental effects and control.

Analysis of soil: moisture, pH, total nitrogen, phosphorus, silica, lime, magnesia, manganese, sulphur and alkali salts.

Book Suggested:

1. A Laboratory Manual for – Environmental Chemistry, ISDN 978-81-907462-5-0/2009, R. Gopalan, AmirthaAnand, R. WidfredSugumar
2. Standard Method of Chemical Analysis Vol I & II, Hulcher
3. Environmental analysis & instrumentation, RajvidyaMarkomdey
4. Experiments in Environmental Chemistry, Satya Prakash Mohan, Sushu Chauhan
5. Environmental Chemistry by A.K. De Willey Eastern ltd.
6. Environmental Chemistry by S.E. Manahan, Willgrd Grant Press.
7. Environmental Chemistry by B.K. Sharma & Miss H. Kaur
8. Chemistry and Biological Method for water Pollution studies by Goel & Trivedi Env. Pub.
9. Environmental Chemistry (Lewis Publishers), ScMannahan
10. Environmental Chemistry (Wiley Eastern), A.K. Dey
11. Air Pollution : V.P. Kudesia: Pragati Prakashan, Meerut.
12. Water Pollution : V.P. Kudesia & R. Kudesia: Pragati Prakashan Meerut.
13. Industrial Pollution : V.P. Kudesia: Pragati Prakashan Meerut.
14. Soil Testing and Analysis: Plant, Water and Pesticide Residues Pantram, 2007, ISDN 8189422707
15. A Laboratory Manual for – Environmental Chemistry, ISDN 978-81-907462-5-0/2009. R. Gopalan, Amirtha Anand, R. Widfred Sugumar
16. Principles and Practices of Air Pollution and Control, ISDN 978-93-80026-38-1/2009. TBA (J.R. MudaKavi)
17. The Chemistry of our environment, R.A. Horse, Wiley Inter Science 1978
18. Environmental Chemistry of soils, Murray BMC, Oxford University Press 1994
19. Environmental Chemistry. H Kaur, Pragati Prakashan, Meerut
20. Environmental Chemistry. M.S. Sethi, Shri Sai Printographers

21. Soil Chemical Analysis, M.L. Jackson
22. Soil Chemical Analysis, Piper, Elsevier's Publication

M2AC07-CC-06 COMPUTER PROGRAMMING FOR CHEMISTS

Duration: 3 hours

Maximum Marks : 40

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions, at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I.

Introduction to Computers and Computing

Basic structure and functioning of computers with a PC as an illustrative example. Memory, I/O devices. Secondary storage. Computer language. Number System binary, octal, hexadecimal and their interconversions, memory management. Binary Arithmetic operations (addition, subtractions, multiplication, division). Operating systems with DOS as an example. Introduction to UNIX and WINDOWS, MS Office, MS Word → Creating and saving documents, Orientation, Margin, formatting, paragraphs, find & replace, spell checks, thesaurus, printing Basics. MS Excel → Creating and saving documents, printing Basics, formulas, pivot table, principles of programming, Algorithm and flow charts.

Introduction to Networking

- a) Introduction – Server, client and parts, network cards, cabling and hubs, maintenance and connecting to internet.
- b) Features and concepts of e-mail technology – Message headers, Address book, Attachment, Filtering and forwarding mails.
- c) Web Technology – languages and protocols, scientific websites, Web resources – search engines, message boards.

Unit-II

Computer Programming in C

Overview of C, Constants, Variables, and Data Types. Operators and Expression, Managing Input and Output Operators, Decision Making and Branching, Single and two dimensional arrays, structure, IF statement, IFElse statement, GO TO statement, Decision Making and Looping, WHILE statement, DO statement and FOR statement, Jumps in loop, string pointer, union.

Unit-III

Programming in Chemistry

Development of small computer codes involving simple formulae in chemistry, such as Vander Waals equation, titration, kinetics, radioactive

decay. Evaluation of lattice energy and ionic radii from experimental data.

Books Suggested :

1. Computer and their application to Chemistry : R Kumari : Springer 2008.
2. Computer for Chemists, Pundir & Bansal, PregatiPrakashan.
3. Computer and Common Sense, R. Hunt and J. Shelley, Prentice Hall
4. Computational Chemistry, A.C. Norris.
5. Microcomputer Quantum Mechanics, J.P. Killingbeck, Adam Hilger.
6. An Introduction to Digital Design, V. Rajaraman and T. Radhakrishnan, Prentice Hall

M2AC08-CC-07 DIFFRACTION METHODS & SPECTROSCOPY

Duration: 3 hours

Maximum Marks: 40

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8 marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions, at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I

Diffraction Methods

X-ray Diffraction

Bragg condition, Miller indices, Laue methods, Bragg method, Debye-Scherrer method of X-ray structural analysis of crystal, index reflections, identification of unit cells from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, Structure factor and its relation to intensity and electron density, phase problem, Ramchandran diagram.

Electron Diffraction

Scattering intensity v/s scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules, Low energy electron diffraction and structure of surfaces.

Neutron diffraction

Scattering of neutrons by solid-state materials

measurement techniques. Elucidation of structure of magnetically ordered unit cell.

Unit-II**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.

Atomic Absorption Spectroscopy :

Principles, Instrumentation set-up and analytical procedure of absorption spectroscopy. Precision and accuracy of atomic absorption spectroscopy. Relation between atomic absorption and flame emission spectroscopy. Applications: Qualitative, Quantitative and Analytical.

Unit-III**Photoelectron Spectroscopy**

Basic principles, photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules, Electron Spectroscopy for Chemical Analysis (ESCA), chemical information from ESCA. Basic Idea of Auger Electron Spectroscopy.

Photo acoustic Spectroscopy

Basic principles of photo acoustic spectroscopy (PAS), PAS- gases are condensed systems, chemical and surface applications.

Books Suggested:

1. Basic of X-Ray*Diffraction and its application. ISDN 978-81-89866-07-5/2007 (K. RamakanthHebbar)
2. Solid State Chemistry 2009, Kumar. J. Rajputana Book House, Ajmer
3. Solid State Chemistry, D.K. Chakarbarti, New age International Publishers

M2AC09-CC-08 CATALYSTS AND ENZYMES

Duration: 3 hours

Maximum Marks : 40

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions, at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I

Catalysts- Introduction, classification, types, actions, catalytic action of

enzymes, industrial catalysis. Metal ion catalysis, Spectral and Magnetic properties of transition and inner transition elements, industrial importance of their compounds as catalysts, catalysts for refining and petrochemical industries.

Unit-II**Enzymes and their Biotechnical Applications**

Properties of enzymes like catalytic power, specificity and regulation. Uses of Metalloenzymes (Carbonicanhydrase. Carboxypeptidase)

Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes and their applications, use of enzymes in food industry, brewing and cheese making, high fructose corn syrup, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA technology.

Unit-III**Electronic Properties and Band Theory**

Electronic structure of solids-band theory, band structure of metals, insulators and semiconductors. Intrinsic and extrinsic semiconductors, p-n junctions, superconductors.

Optical properties – Optical reflectance, photoconduction.

Magnetic Properties- Classification of material, quantum theory of paramagnetic cooperative phenomena-magnetic domains, hysteresis.

Books Suggested:

1. Bioorganic Chemistry: A Chemical Approach to Enzyme Action (SpringerVerlag): HeermanDugas and C Penny
2. Understanding Enzymes (Prentice Hall), Trevor Palmer
3. Biochemistry: The Chemical Reactions of living cells (Academic Press), De Metzler
4. Catalysis, concept and green applications : Gadi Rothenberg : Cambridge University Press
5. Understanding Enzyme : Trevor Palmer: Prentice Hall
6. Enzyme Chemistry : Impact & Applications : Ed. Collin J Suckling. Chapman and Hall.
7. Fundamental of Enzymology : N.C. Price and I.Stevens : Oxford University Press 3rdEdn 2006
8. Immobilized Enzymes : An introduction and Application in Biotechnology : Michael D. Trevan. John Wiley.
9. Enzyme Structure and Mechanism : A Fersht, W.H. Freeman.
10. Homogeneous Catalysis, G.W. Persons, John Wiley N.Y. 1990
11. Principles & Application of Homogeneous Catalysis. A. Kira Nakamura Minoru Tstui, John Wiley N.Y. 1980
12. Introduction to the Principles of Homogenous Catalysis. J.M.

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Thomas & W.J. Thomas, Academic Press London 1967

13. Biology of Chemists, Dr P K Agarwal, PragatiPrakashan

14. Biochemistry, John K Joseph

15. Enzymes, S. K. Singh

M2AC10-CP-02 PRACTICAL**Duration: 6 hours Maximum Marks :100****A. Analysis of water (Minimum ten)**

Examine the physical characteristics of the sample of water supplied and determine the following characteristics.

- i. Alkalinity to Phenolphthalein and methyl orange.
- ii. Total Hardness
- iii. Calcium Hardness
- iv. Chloride
- v. Dissolved Oxygen
- vi. Sulphate
- vii. Resident Chlorine.
- viii. Total dissolved solids
- ix. Conductivity
- x. Biological Oxygen Demand
- xi. Chemical Oxygen Demand
- xii. Acidity or pH
- xiii. Ammonia Nitrogen
- xiv. Nitrite Nitrogen
- xv. Nitrate Nitrogen
- xvi. Silicon
- xvii. Phosphorus
- xviii. Fluoride
- xix. Iron by Colorimetry
- xx. Determine the available chlorine content of bleaching powder extract supplied with the solution of thiosulphate against standard dichromate solution.
- xxi. Discuss the physical and chemical characteristic of water you have examined and comment on the suitability of water for drinking industrial purpose.
- xxii. Determine the physico-chemical parameters of soil.

B. Preparations and Isolations (Minimum five)

1. Preparation of Indigo
2. Preparation of Methyl Orange
3. Isolation of Caffeine from tea leaves

4. Isolation of Casein from milk
5. Isolation of Mucic Acid from milk
6. Isolation of Nicotine from tobacco
7. Isolation of piperine from black pepper.
8. Isolation of carotene from Carrot
9. Isolation of lactose from milk
10. Isolation of eugenol from cloves
11. Isolation of (+) limonene from citrus rind
12. Isolation of Cystine from human hair
13. Isolation of D (+) Glucose from cane-sugar
14. Isolation of Hippuric Acid from Urine.

Books Suggested:

1. Advanced Practical Chemistry, Jagdamba Singh, PragatiPrakashan
2. Experiments and Calculations in Engineering Chemistry, S.S. Dara

INSTRUCTIONS FOR PRACTICALS**Duration: Six hours****Maximum Marks: 100**

The Board of Examiners will constitute of one External Examiner and one Internal Examiner

Marking Scheme

Exercise	Marks
A. Water analysis (Two Exercise)	40 (20 each)
B. Preparation and Isolation (Two exercise)	40 (20 each)
C. Record	10
D. Viva	10
Grand Total	100

M.Sc. APPLIED CHEMISTRY SEMESTER III**EXAMINATION****M3AC11-CC-09 SEPARATION TECHNIQUES****Duration: 3 hours****Maximum Marks : 40****Unit-I****Solvent Extraction and Ion Exchange:-**

Basic principle of solvent extraction (Distribution law), Factor affecting extraction, Techniques of extraction, Quantitative treatment of solvent extraction equilibria, classification & types of solvent extraction system, mechanism of extraction, advantages & application in analytical chemistry Introduction of counter current extraction.

Ion Exchange – Definition, types of ion exchangers, preparation, action and applications of ion exchangers.

Unit-II**Chromatography-I**

An introduction to chromatographic methods, paper, thin layer and column chromatography, theory of chromatography, classification of chromatographic techniques, retention time, relationship between retention time and partition coefficient, the rate of solute migration, band broadening & column efficiency, applications of chromatography in qualitative and quantitative analysis.

Unit-III**Chromatography-II**

Instrumentation and applications of Gas Chromatography (GC) and High Pressure Liquid Chromatography or High Performance Liquid Chromatography (HPLC), comparison of GC and HPLC, Ion chromatography, size exclusion chromatography, super critical fluid chromatography, affinity chromatography and its specialized analytical applications.

Books Suggested:

1. Instrumental Methods of Chemical Analysis – Will and Letten Edu. Pub Ltd, New York
2. Instrumental Methods of Chemical Analysis – Chatwal Anand, Himalaya Pub.
3. Spectroscopy of Org. Compounds – P.S. Kalsi, New Age Inter. Pub.
4. Instrumental Methods of Chemical Analysis – B.K. Sharma, Goel Pub. Meerut
5. Instrumental Methods of Chemical Analysis – H. Kaur, Pragati Pub.
6. Instrumental Methods of Chemical Analysis by Golen W. Ewing. McGraw Hill

M3AC12-CC-10 ANALYTICAL METHODS**Duration: 3 hours****Maximum Marks : 40**

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions, at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I**General Analytical Chemistry:-**

Importance; applications & scope of analytical chemistry, classification of

analytical methods - (classical and instrumental), selecting analysis method. Sampling, Definition and purpose of sampling. Sampling of gases. Ambient & Stack sampling, sampling of solids & liquids, techniques of weighing, possible errors, calibration of glassware, sample preparation - dissolution and decompositions.

Unit-II**Thermal & Optical methods of Analysis**

- (a) Thermal Methods - Principle, Instrumentation and application of thermogravimetry (TGA), differential thermal Analysis (DTA) and differential scanning calorimetry (DSC)
- (b) Optical methods - Principle, Instrumentation and applications of refractometry, polarimetry, nephelometry and turbidimetry calorimetry.

Unit-III**Conductometry and Conductometric titrations:-**

General principle of conductometry, instrumentation, electrolytic conductance and electrolytic concentration relationship, conductometric titrations including neutralization, precipitation, oxidation-reduction, complexation and high frequency titrations; other applications of analytical importance.

Books Suggested:

1. Analytical Chemistry by J.G. Dick Pub. International Students Edition.
2. Instrumental Methods of Chemical Analysis by H.H. Willard & I.I. Merrit. Pub. Affiliated East West press
3. Analytical Chemistry by R.M. Verma Pub. CBS Pub. & Distributors Delhi
4. Instrumental Methods of Chemical Analysis by Golen W. Ewing Pub. International Student Edn.
5. Vogels Text book of Quantitative Chemical Analysis by G.H. Geffery, J Bassett. Pub. Longman Scientific Tech. John Wiley New York
6. Instrumental Methods of Chemical Analysis by Gurdeep Chatwal, Sham Anand Pub. Hinalaya Pub. House
7. Analytical Chemistry, 6th edn D. Christian wile

M3AC13-CC-11 CHEMICAL ANALYSIS**Duration: 3 hours****Maximum Marks: 40**

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8 marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions, at least

one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24, marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I

Food Analysis

Moisture, ash, crude protein, fat, crude fibre, carbohydrates, calcium, potassium, sodium and Phosphorous. Food adulteration-common adulterants in food, Tests for detection of adulterants in food stuffs, Pesticide analysis in food products- Extraction and purification of sample, Gas chromatography for organophosphates. Thin-layer chromatography for identification of chlorinated pesticides in food products.

Unit-II

FUEL ANALYSIS

Characteristics and classification of fossil fuels - Solid, liquid and gas. Ultimate and proximate analysis of coal, grading of coal, metallurgical coke, carbonization process - Beelive coke oven & Otto Hoffmann Oven (By product Oven), Knocking, Octane number, Anti Knocking agent, Cetane number, Reforming, Cracking. Gaseous fuels - producer gas & water gas. Calorific Value & its determination, Flue gas analysis.

Unit- III

- (a) **Industrial water treatment** :- Water as engineering material Treatment of water for steam generation, (boiler feed water) boiler problem, remedies and its numerical problems. Determination of hardness of water EDTA method, soap titration method, break point, chlorination method.
- (B) **Lubricants** -Properties, classification, Physico- chemical analysis and testing of lubricants - viscosity and viscosity index, flash point, fire point, aniline point, iodine value, saponification value, acid value. Uses of lubricants, cloud and pour point, carbon residue.

Books suggested:

1. Standard Methods of Chemical Analysis, Vol. III (Van Nostrand Reinhold Co.) F.J. Welcher
2. Instrumental Methods of Chemical Analysis: Chatwal & Anand: Himalaya Publishing House, New Delhi
3. Vogel's Text Book of Quantity Chemical Analysis: J. Mendham et al: 6th edn 2008
4. A Handbook of Chemical Analysis, 2005 Poojabhagwan
5. Applied Chemistry, A.K. Bagavathi Sundry, MJP Publihers
6. Instrumental methods of Chemical Analysis H. Kaur

PragatiPrakashan.

M3AC14-CC-12 PRINCIPLES OF CHEMICAL ENGINEERING

Duration: 3 hours

Maximum Marks : 40

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I

Basic Concept of Unit Operations and Unit Process. Unit Processes and unit operations with equipments, characteristics of unit processes, process instrumentation. Good laboratory Processes, Safety hazards in chemical laboratory.

Mass transfer: Different modes of mass transfer, concentration, various velocities and fluxes, Ficks law of diffusion.

Unit-II

Definition of Thermodynamic Laws and application of thermodynamics in unit process, combustion reaction, Theoretical Air, Excess air, Air Fuel Ratio, analysis of products of combustion. Internal energy and enthalpy of reaction, heating value of fuels, enthalpy of formation, adiabatic flame temperature, entropy changes for reactive mixtures.

Unit-III

Chemical Process Kinetics: Types of chemical reactions, catalytic rate equations. Adsorption-equations, factors affecting a chemical process. Reactor shape and effect of back mixing on products distribution. Selection and sizing of Homogeneous and catalytic reactor.

Books Suggested:

1. Process Heat Transfer: S.K. Das: Springer 2008
2. Comprehensive Engineering Chemistry, ISDN 98-81-89866-55-6/2007. (Devender Singh, BalrajDeshwal, Satish Kumar Vats)
3. Modeling and Analysis of Chemical Engineering Processes, ISDN 978-81-89866-31-0/2007, (K. Balu, K. Padmanabhan)
4. Problems on Material and Energy Balance Calculation, ISDN 978-93-80026-04-06/2009 (K. Balu, N. Satyamurthi, S. Ramalingam, B. Deepika)
5. Process Central Instrumentation, ISDN 978-93-80026-39-8/2009. TBA (P. Sai Krishna)
6. Fundamentals of Fluid Mechanics, ISDN 978-81-89866-67-9/2008,

(G.S. Sawhney)

7. Material Sciences for Engineers, ISDN TBA/2009, TBA (Kishore T. Kashyap)
8. Principles of industrial Chemistry, Chries A Clansmen III, Mattsen J Wiley Inter Science
9. A text book of Chemical Technology Voll, S.D. Shukla and G.N. Pandey
10. Wellman's encyclopedia of Industrial Chemistry, Arpe et al, Editioal Advisory Board
11. Industrial Organic Chemistry, K. Weissermel/H J arpe
12. Engineering Chemistry, Jain & Jain, Dhanpatrai and Sons
13. Engineering Chemistry, S P Bakshi, CBS Publishers and Distributors
14. Unit Processes in organic synthesis, P H Goriging, Tata McGraw Hill Publishing Company Ltd
15. Concepts of Chemical Engineering, SS. Dara

M3AC15-CP-03 PRACTICAL

Duration: 6 hours

Maximum Marks :100

Practicals**A. Fuel Analysis (Minimum Three)**

1. The proximate analysis of given sample of coke and wood charcoal.
2. The ultimate analysis of given sample of soft coke.
3. Determine the swelling index in coal.
4. Determine Phosphorus present in coal.
5. Determine the viscosity in centistokes of a given sample of oil at temperature 37.8°C, 50°C, 70°C and 99°C using Redwood Viscometer and calculate the viscosity index of the oil sample. Data or Theta – 40 to 85 Sec, A=0.0026, B=1.90 For Theta =82 to 2000 Sec. A=0.0026, B=0.65
6. Determine the viscosity of a given sample of Oil in centistokes at room temperature and at 40°, 60°, 65°, 70°C by Redwood Viscometer. Plot a graph between kinematic viscosity and temperature in degree centigrade.

B. Lubricant Analysis (Minimum Five)

1. Determine Acid Value of lubricating oil.
2. Determine Saponification Value of a lubricating oil
3. Determine Iodine Value of lubricating oil.
4. Determine Aniline Point of lubricating oil.
5. Determine Cloud- Point and Pour-Point of lubricating oil.
6. Determine Flash Point of lubricating oil.
7. Determine Fire Point of lubricating oil
8. Determine Rancidity of oil sample.

C. Preparation of Drugs and Drug intermediates (Minimum Two)

1. Preparation of Aspirin.
2. Preparation of Paracetamol
3. Preparation of Salol
4. Preparation of Sulphanilic acid

Books Suggested:

1. Advanced Practical Chemistry, Jagdamba Singh, PragatiPrakashan
2. Experiments and Calculations in Engineering Chemistry, S.S. Dara

INSTRUCTIONS FOR PRACTICALS

Duration: Six hours

Maximum Marks: 100

The Board of Examiners will constitute of one External Examiner and one Internal Examiner

Marking Scheme

Exercise	Marks
A. Fuel Analysis	35
B. Lubricant analysis	25
C. Preparation of Drugs and Drug intermediates	20
D. Record	10
E. Viva	10
Grand Total	100

M.Sc. APPLIED CHEMISTRY SEMESTER IV EXAMINATION**M4AC16-ET-21A POLYMER CHEMISTRY-I**

Duration: 3 hours

Maximum Marks : 40

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I**Polymer Processing**

Plastics, elastomers and fibres. Compounding, Processing techniques: calendaring, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning.

Structure and Properties of polymer

Order in crystalline polymers- configurations of polymer chains. Crystal

structure of polymers, crystallization and melting. Polymer structure and physical properties- crystalline melting point- melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, Relationship between T_m and T_g effects on molecular weight.

Unit-II**Analysis of Polymers**

Polydispersion-average molecular weight concept. Number, weight and viscosity, average molecular weights, Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights. End-group, viscosity, light scattering, osmotic and ultracentrifugation methods.

Analysis and testing of polymers-chemical analysis of polymers, spectroscopic methods, X-ray diffraction study, Microscopy. Thermal analysis and physical testing- tensile strength. Fatigue impact. Tear resistance. Hardness and abrasion resistance.

Unit-III**Commercial Polymers**

Preparation, properties and uses of Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. New polymers- Fire retarding polymers, liquid crystal polymers and electrically conducting polymers. Biomedical polymers.

Books Suggested:

1. Liquid Crystals and Polymers: G.D. Arora: Sarup & Sons, New Delhi 1stEdn. 2005
2. Principles of Polymerization, George Odian. 3rdEdn, John Wiley & Sons.
3. Principles of Polymer Chemistry, A. Rawe 1995
4. Principles of Polymer Systems, Ferdinand Rodriguez 4thEdn, Taylor & Francis
5. Experiment in Polymer Science, D G Hundiwale, New age international Publishers
6. Advance and Polymer Science, J.P. Kennedy, S Nagg, D Hunkeler
7. Advance Polymer Chemistry, Dr V K Selvaraj
8. Laboratory Manual of Polymers Vol-I, ISBN 978-81-90746-23-6/ 2009. S.M. Ashraf, Sharif Ahmad, UfanaRauaz
9. A Handbook of Polymer Chemistry, 2005, Dinesh Sharma
10. Text Book of Polymer Science, Fred W. Billmeyer Jr
11. Principles of Polymer Chemistry, A Rawve
12. Polymer Chemistry, V. Gwarikar

M4AC16-ET-21B POLYMER CHEMISTRY-II

Duration: 3 hours

Maximum Marks : 40

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I**Basic Concept in Polymer Science**

Different ways in classification of polymers- depending on the origin, structure, formation, Homopolymers, copolymers, on the basis of molecular forces (Plastics, fibre, elastomers), the behaviour on application of heat and pressure (thermoplastic and thermosetting) chemical bonding in polymers – ionic, covalent, coordinate, metallic, hydrogen bonding. Stereochemistry of polymers, Introduction to two types of polymerisation reactions viz. condensation and addition polymerisation.

Unit-II**Monomer structure and polymerizability**

Concept of functionality. Writing the structure of the polymer formed for a given monomer and its classification. Raw materials for monomers with specific example viz. acrylo-nitrile, vinyl chloride, methyl methacrylate, isobutylene, isoprene, styrene, hexamethylene diamine and adipic acid, Caprolactum, ethylene glycol and terephthalic acid and their polymerisation reactions.

Methods of Polymerisation

Bulk polymerisation, solution polymerisation, Emulsion polymerisation, suspension polymerisation, Interfacial polymerisation, melt polycondensation, Solution polycondensation.

Unit-III

Controlled polymerisation methods, viz. Nitroxide Mediated Polymerisation (NMD), Atom Transfer Radical Polymerisation (ATRP), Group Transfer Polymerisation (GTP), Reversible Addition Fragmentation Termination (RAFT)

Books Recommended

1. F.W. Billmeyer, Textbook of polymer science, Wiley-Inter Science.
2. Physical Chemistry of Macromolecules by D.D. Deshpande Vishal Publication.
3. Introduction to Polymer Chemistry, R. Seymour, Wiley Inter Science.
4. Polymer Science V R Gwarikar

5. Principles of Polymer Chemistry by P. J. Flory
6. Principles of Polymerization. G. Odian, Wiley- Inter Science
7. Condensation polymers by interfacial and solution methods, Paul W. Morgan Inter Science Publishers
8. Organic Polymer Chemistry, K J Saunders, Chapman and Hall, London Seymour, R. B and Kirshenauns, G.S. Elsevier.
9. High performance polymers, their origin and development by Seymour. R. B and Kirshienbauns, G. S. Elsevier.
10. Organic Chemistry of Synthetic high polymers, Robert W. Lenz Inter Science Publisher.

M4AC17-ET-22A INDUSTRIAL CHEMISTRY-I

Duration: 3 hours

Maximum Marks: 40

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8 marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions, at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I

Glass Industry

Introduction, Basic raw material of glass, manufacturing process including chemical reaction, types and properties of glass, annealing of glass .

Ceramics (Clay and clay products):-

Formation, classification, composition and plasticity of clay and clay products, Efflorescence on bricks. Terracotta ware. Pottery porcelain, other clay products, sanitary wares, porcelain insulators their chemistry and compositions. Refractories-Definition, properties and classification, silica and fire clay refractories.

Unit-II

Cement Industry: Types of cement, manufacture of Portland cement, composition, setting and hardening of cement, Mortars and concrete, gypsum, plaster of Paris, estimation of silica, alumina, calcium oxide and sulphates in Portland cement.

Oil, Fats, Soaps:-

Introduction of oils, fats and soaps, Chemistry of extraction, refining and bleaching of oil. Manufacture of soyabean and cotton seed oils. Extraction of essential oils. Physical & chemical properties and tests of oils, fats and

soaps, Manufacture of anionic, cationic, nonionic & ampholytic surfactants, production of different types of soap.

Unit-III

Synthetic dyes and Nitrogen, Phosphorus, Potassium (NPK) fertilizers:-

Unit process for manufacture of dyestuff-intermediates, General classification of synthetic dyes. Brief ideas of preparation, properties and uses of the nitro, nitroso, azo, triphenylmethane, xanthene and Phthalocyanin dyes.

Classification and role of fertilizers, Manufacture and uses of Urea, Ammonium Sulphate, Ammonium Nitrate, Single Super Phosphate, Triple Super Phosphate, Potassium Chloride and Potassium Sulphate fertilizers, Biofertilizers.

Books Suggested:

1. Thermal Engineering Data Handbook, ISDN 978-81-89866-32-7/2007, B. Sreenivasa Reddy, K Hemachandra Reddy
2. Industrial Hygiene and Chemical Safety, ISDN 978-81-888237-92-0, (M.H. Fulekar)
3. Industrial Chemistry, J S Jangwal & A S Mathuria
4. Industrial Chemistry, B K Sharma, Goel Publishing House Meerut
5. Industrial Chemistry, Reegel, Reinhold Publishing Co.

M4AC17-ET-22B TEXTILE CHEMISTRY

Duration: 3 hours

Maximum Marks : 40

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions, at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I

Chemistry of Fibre:

Chemical structure of Natural fibres like cotton and wool, Man made fibres like Polyester and Nylon.

Action of different chemicals and reagents on these fibres, Effect of acid, alkali, oxidising agent, reducing agent, solvent, heat and light on various types of fibres

Physical Testing of textiles:

- a) Fibers: Shape, staple length, denier tensile strength elongation moisture regain
- b) Yarns: count evenness turns per inch tensile strength elongation.

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- c) Fabric: ends, picks, weight of warp and weft identification of stiffness, Crease recovery, wrinkle test.
Chemical Testing: Determination of ash content, % Shrinkage, Colour fastness of dyed, printed textile. Analysis of blend composition. Cotton/Polyester, Cotton/Viscose, Viscose/Nylon.

Unit-II**Technology of Bleaching and Finishing Technology**

Determination of hardness of water, treatment of water to make it suitable for textile industry, Analysis of desizing, scouring, bleaching agents, dyes and printing gums.

Singeing, desizing, scouring and bleaching methods of Cotton and Polyester. General introduction and application of temporary & permanent finishes, starches, gums and softness, Finishing machines, Calendaring machines, mercerisation of cotton.

Unit-III**Technology of Dyeing and Printing:**

Classification of dyes, General idea about chemistry of dyes, Dyeing of Cotton and Polyester, Dyeing of their blends.

Various methods of Printing, Block Printing, Screen Printing, roller and rotary printing.

Printing of Cotton with direct style, Printing of synthetic fibres, Discharge and resist style of Printing on Cotton and Polyester. Dyeing of Wool and Silk.

Practicals

1. Testing and complete analysis of chemicals involved in wet processes.
2. Identification of fibres.
3. Identification of dyes.
4. Determination of hardness of water.
5. Dyeing of fabric with different dyes.
6. Printing of fabric with different dyes.

Books Suggested:

1. Hall A.J. (8thEdn) the standard Hand Book of Textiles Butter Worth, London
2. Clark, W An Introduction to Textile [rom tomg.- A practical for use in laboratories college and school Arts Manual Butterworth, London.
3. Shenai. V.A.: Technology of Textile Processing Vol I, to IX, Sevok Publication Mumbai.
4. Chakravarty , R. R. Glimpses of Textile Technology, Caxton Press, Delhi
5. Hall, A.J.: Textile finishing, Elsevier.
6. Peters. R.H.: Textile chemistry. Vol. I and Vol. II, Elsevier Amsterda

Analytical methods for textile laboratory IIIrdedn. Williams Univ. of Deleware, U.S.A.

7. R.S. Prayag Technology, Textile Printing
8. R.S. Prayag Bleaching Mercerising and Dyeing of cotton material.

M4AC18-ET-23APHARMACEUTICAL CHEMISTRY-I**Duration: 3 hours****Maximum Marks : 40**

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions, at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I**Drug Design-I**

Development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrug and soft drugs, structure- activity relationship (SAR), factors affecting bioactivity. Theories of drug activity: occupancy theory, rate theory, induced fit theory.

Drug Design-II

Quantitative structure activity relationship (QSAR, History and development of QSAR. Concept of drug receptors. Elementary treatment of drug receptor interactions. Physico-chemical parameters: lipophilicity, partition coefficient, electronic ionization constants, steric, Free-Wilson analysis, relationships between Free-Wilson and Hansch analysis. LD-50 ED-50 (Mathematical derivations of equations excluded.)

Unit-II**Pharmacokinetics**

Introduction to drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetic parameters in defining drug disposition and in therapeutics, uses of pharmacokinetics in drug development process.

Pharmacodynamics

Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, membrane active drugs, drug metabolism, biotransformation, significance of drug metabolism in medicinal chemistry.

Unit-III**Drugs against infection**

Introduction and general mode of action.

Synthesis of sulphonamides furazolidone, nalidixic acid, ciprofloxacin, norfloxacin, dapson, amino salicylic acid, isoniazid ethionamide, ethambutol, flucanazole, econazole, griseofulvin, chloroquin and primaquine.

Antibiotics

Cell wall biosynthesis, inhibitors, α -lactum rings, antibiotics inhibiting protein synthesis. Synthesis of penicillin G., cephalosporin, Streptomycin, ampicillin, amoxicillin tetracycline.

Books Suggested

1. Burger's Medical Chemistry, M.E. Wolff John Wiley Sons N.Y.
2. Principles of Medicinal Chemistry, W.O. Foye Lea and Febiger Philadelphia
3. The Organic Chemistry of drugs synthesis, D Ledwith and L N Mitscher, John Wiley & Sons. N.Y.
4. Medicinal Chemistry, Akar, Wiley Eastern Ltd. N.U.
5. A Text Book of synthetic Drugs, O.D. Tyagi M. Yadav, Anmol Publication
6. An Introduction to drug design, S N Pandeya, JR Demmock, New age International Publishers.
7. Biopharmaceuticals & Pharmacokinetics, D.M. Brahanabankar, Sunil B Jaiswal
8. Introduction of Pharmaceutical II, AK Gupta SS Bajaj, CBS Publishers and Distributors.
9. Computer for Chemists, Pundir, Pragati Prakashan

10. Computer and their application to Chemistry, Ramesh Kumar Narosa Publishing House.

M4AC19-ET-24A INDUSTRIAL CHEMISTRY -II

Duration: 3 hours

Maximum Marks: 40

Note:- The paper is divided into three independent units. The question paper is divided into three Parts- Part A, Part B and Part C. Part A (8 marks) is compulsory and contains 8 questions (20 words each). Each question is of one mark. Part B (8 marks) is compulsory, contains four questions, at least one question from each unit. Candidate is required to attempt all four questions. Each question is of two marks (50 words each). Part C (24 marks) contains six questions, two from each unit. Candidate is required to attempt three questions, one from each unit. Each question is of 8 marks (400 words).

Unit-I

Pulp, Paper and Textile Technology

Introduction. Raw material, wood chemistry, Chemistry of Pulping & bleaching. Manufacture of rayon and paper pulp. Production of Kraft, writing & printing paper (Paper making). Recovery of chemical from spent liquor. Physical I & Chemical test of pulp and paper. Natural and Synthetic fibres & textile fibre. Manufacture of viscous rayon fibre, cellulose acetate fibre, acrylic fibre. Testing of dyes- Testing of fastness properties, effect of light, washing & rubbing on dye shades.

Unit-II**Fermentation and Sugar Technology**

Introduction. Fermentation. Equipment. Media preparation. Growth Phase & Enzyme. Functions, Account of Some Fermentation processes. Manufacture of Alcoholic beverages, Manufacture of Vinegar, Lactic Acid, Citric Acid. Introduction of sugar technology. Manufacture of Cane Sugar, recovery of sucrose from molasses preparation of Celotes, Physico Chemical properties and testing of Sugar and its intermediate. Sugar industry in India.

Enamels:-

Definition, types of enamels and description of enamels, Manufacturing processes of lacquers, paint enamels, pyroxylin, vitreous enamels.

Unit-III**Petroleum and its products:-**

Composition of petroleum, natural gas, petroleum distillation, methods of separation of products, Crystallization, Super fractionation. Azeotropic and extractive distillation study of cooling tower, cracking processes, lubrication oil refining hydrogen processing of petroleum petro-chemical industry, Catalytic refining, solvent refining.

General characteristics of petroleum hydrocarbons viz. Alkanes, Alkenes, Alicyclics, Aromatics. Preparations of gaseous hydrocarbons.

Books Suggested :-

1. Principles of Industrial Chemistry, Chries A Clansmen III, mattsen J Wiley Inter Science.
2. A text book of Chemical Technology Voll, S.D. Shukla and G.N. Panday

3. Wellman's encyclopedia of Industrial Chemistry. Arpe et al. Editorial Advisory Board.
4. Pulp and Paper Chemistry & Chemical Technology - Vol. I,II,III, by James P Carey

M4AC20-EP-01PRACTICAL**Duration: 6 hours****Maximum Marks: 100****A. Analysis of Cement (Minimum three):**

1. Loss on ignition
2. Silica
3. Fe_2O_3
4. Combined Fe_2O_3 and Al_2O_3
5. Calcium
6. Magnesium
7. Sodium
8. Potassium

B. Analysis of Polymers (Minimum three):

1. Determine Acid Number of Resin/Plastic material.
2. Determine Saponification value of Plastic material.
3. Determine Iodine value of Resin/Plastic material.
4. Determine Hydroxyl Value of Plastic material.
5. Determine Carbonyl Value of Resin/Plastic Material.

6. Determine Amine Value of Resin/Plastic Material.
7. Determine Molecular weight of a polymer.
8. Determine Isoyanate Content of Resin/Plastic Material
9. Determine Epoxy Equivalent and Epoxy Value of Resins/Plastic Material.
10. Determine Capacity of Cation exchange resin.
11. Determine Capacity of an Anion exchange resin.
12. Separate Zn and Mg in the given unknown solution by anion Exchange Resin (Amberlite IRA-400) column followed by their estimation with N/100 EDTA and Eriochrome Black-T as indicator.
13. Separate Ni and Co in the given sample solution by Anion Exchange column followed by their estimation by back titration using EDTA and xylenol orange as indicator.

C. Preparation of Polymers (Minimum three)

1. Prepare Urea Formaldehyde resin.
2. Prepare Phenol Formaldehyde resin.
3. Prepare Nylon-6,6 Poly (HexamethyleneAdipamide)
4. Prepare Nylon -6,6 or Nylon -6,10 by interfacial Polymerization
5. Prepare Polyurethane Prepolymer
6. Prepare Polystyrene by Suspension or Emulsion of Bulk or Solution Polymerisation.
7. Prepare Polysulphide rubber

8. Prepare Polyester Resin by Melt Condensation or Solution Condensation Method
9. Prepare Epoxy Resin.

Book Suggested :-

1. Experiments in Polymer Science, D.G. Hundiwale, V.D. Athawale. New Age international Publishers
2. Advanced Practical Chemistry Jagdamba Sing, Pragati Parkashan
3. Experiments and Calculations in Engineering Chemistry, S.S. Dara

INSTRUCTION FOR PRACTICALS

Maximum Marks: 100

Duration: Six Hours

The Board of Examiners will constitute of one External Examiner and one Internal Examiner

Marking Scheme

	Exercise	Marks
A.	Analysis of Cement	30
B.	Analysis of Polymers	30
C.	Preparation of Polymers	20
D.	Record	10
E.	Viva	10
Grand Total		100

GRADE POINTS

Grade	Mark m out of 100	Grade Points	Grade	Mark m out of 100	Grade Points
O	$m \geq 95$	10	E	$35 \leq m < 45$	4
O	$85 \leq m < 95$	9	F	$25 \leq m < 35$	3
A	$75 \leq m < 85$	8	F	$15 \leq m < 25$	2
B	$65 \leq m < 75$	7	F	$05 \leq m < 15$	1
C	$55 \leq m < 65$	6	F	$m < 05$	0
D	$45 \leq m < 55$	5			

AWARD OF CLASS

CGPA	Class
$CGPA < 4$	Fail
$4 < CGPA < 5$	Pass Class
$5 < CGPA < 6$	2 nd Class
$6 < CGPA < 7$	1 st Class
$CGPA > 7$	Distinction

Grade Point Average = $\Sigma(\text{credit} \times \text{Grade Points}) / \text{Total credits}$.

Equivalent Percentage = $CGPA \times 10$

Cumulative Grade Point Average (CGPA) is computed as

$CGPA = \Sigma(\text{Credit} \times \text{Grade Points}) / \text{Total semesters credits}$.