



## MAHARSHI DAYANAND SARASWATI UNIVERSITY

AJMER

### NOTICE

Copies of the "Syllabus and Courses of Study" prescribed for the Faculties of Arts, Fine Arts, Social Science, Science, Commerce, Law, Education, Management Studies etc. Commencing from July, Can be obtained from our authorised Agent.

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## 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 Examination**

(w.e.f. 2015-16)

**M.Sc. Semester III & IV Examination**

(w.e.f. 2016-17)

संस्करण  
2015

मूल्य : 10/-



महर्षि दयानन्द सरस्वती विश्वविद्यालय, अजमेर

## 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।

## M.D.S.U. Syllabus / M.Sc. Applied Chemistry / 3

### M.Sc. APPLIED CHEMISTRY (2015-17)

#### SEMESTER-I(2015-16)

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 (2015-17)

#### SEMESTER-II(2015-16)

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 (2015-17)

#### SEMESTER-III(2016-17)

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

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##### M.Sc. APPLIED CHEMISTRY (2015-17)

##### SEMESTER-IV (2016-17)

Max. Marks: 50

<u>SEMESTER-IV (2016-17)</u>				<u>No. of Univ. Int.</u>			
<u>S. No.</u>	<u>Course Code</u>	<u>Titles of the Course</u>	<u>credits</u> <u>L-T-P</u>	<u>exam</u>	<u>exam</u>	<u>Int.</u>	<u>Total</u>
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
<b>TOTAL</b>			<b>36</b>	<b>30</b>	<b>260</b>	<b>40</b>	<b>300</b>

##### 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	Total Marks
and Course Nomenclature	

#### M.D.S.U. Syllabus / M.Sc. Applied Chemistry / 5

##### 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
<b>Total= 300</b>		

##### 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
<b>Total= 300</b>		

##### 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
<b>Total= 300</b>		

##### 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
<b>Total= 300</b>		
<b>Grand Total = 1200</b>		



**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 <sup>nd</sup> Class
$6 < CGPA < 7$	1 <sup>st</sup> Class
$CGPA > 7$	Distinction

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

Equivalent Percentage =  $CGPA * 10$

Cumulative Grade Point Average (CGPA) is computed as  
 $CGPA = \Sigma(\text{Credit} * \text{Grade Points}) / \text{Total semesters credits}$ .

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

**M.SC. APPLIED CHEMISTRY SEMESTER I EXAMINATION**  
**MIAC01-CC-01 GENERAL 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 batteries 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 of light solar batteries.

Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion monitoring and prevention methods.

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

**Unit-II****Crystal defects and Non-Stoichiometry**

Perfect and imperfect crystals, intrinsic and extrinsic defects – point defects, line and plane defects, vacancies- Schottky defects and Frenkel defects. 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, factors affecting the stabilities of transition states, intermediates and products.

**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 (Pergamon 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, 1<sup>st</sup> 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, ISDN 978-81-89866-54-9/2009, TBA (B.H. Khawas)
2. A Laboratory Manual of Metals and Alloys Vol-II ISDN 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 Test 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, 5<sup>th</sup> 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, A<sub>2</sub>B<sub>2</sub> etc.) spin decoupling, basic ideas about instrument, Applications of NMR, <sup>13</sup>CNMR- 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 (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

##### Raman Spectroscopy

Classical and quantum theories of Raman 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, Presentation of 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.
3. 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 when present together
- 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<sub>f</sub> values :

- Cadmium (II) and Zinc (II) ions
- Zinc (II) and Magnesium (II) ions
- Nickel (II), Cobalt (II) and Zinc (II) ions
- Manganese (II), Cobalt (II) and Zinc (II) ions.
- Silver (I), Lead (II) and Mercury (II) ions

- Arsenic (III), Antimony (III) and Antimony (II) ions
  - Lithium (I), Sodium (I) and Potassium (I) 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 a mixture of sudan red and sudan yellow by adsorption on silica gel
- (III) To separate a mixture of methylene blue and fluorescein (sodium salt) on an alumina column
- (IV) To separate a mixture of o- and p- nitroanilines on an alumina column
- (V) To study the separation of organic acids by one dimensional paper chromatography
- (VI) To separate a mixture of amino acids by Thin Layer Chromatography
- (VII) To separate a mixture of monosaccharides by Thin Layer Chromatography
- (VIII) To separate a mixture of dyes by thin layer chromatography
- (IX) To separate a mixture of components e.g. o- and p- nitro anilines by TLC technique
- (X) To determine by Column or TLC Technique whether the following inks consist of single or multiple mixtures of dyes.
- (XI) To separate components of chlorophyll by ascending paper 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: Six 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
<b>Grand Total</b>	<b>100</b>

**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, phosphorus (Total, inorganic, organic), carbohydrate (Total, dissolved, particulate) and different forms of nitrogen, DO, BOD, COD, free  $\text{CO}_2$ , 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 - 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  $\text{CO}$ ,  $\text{SO}_2$ ,  $\text{NO}_x$ , HC as gaseous pollutants,

suspended particulate matter aerosols, photochemical air pollution. Source 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, Sushl 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: PragatiPrakashan, Meerut.
12. Water Pollution : V.P. Kudesia & R. Kudesia: PragatiPrakashan Meerut.
13. Industrial Pollution : V.P. Kudesia: PragatiPrakashan 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, AmirthaAnand, R. WidfredSugumar
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, PragatiPrakashan, 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. Operating systems with DOS as an example. Introduction to UNIX and WINDOWS, MS Office, Data Processing, principles of programming. Algorithms and flow-charts.

**Introduction to Networking**

- a) Introduction – Server, client and parts, server and network operating system, 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, web page and website, scientific websites, Web resources – search engines, message boards, web page creation concept – planning navigation.

**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, IF .....Else statement, GO TO statement, Decision Making and Looping, WHILE statement, DO statement and FOR statement, Jumps In loop.

**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. Linear simultaneous equations to solve secular equations within the Huckel theory Elementary structural features such as bond lengths.

**Books Suggested:**

1. Computer and their application to Chemistry : R Kumari : Springer 2008
2. Computer for Chemists, Pundir & Bansal, Pragati Prakashan
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 (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**

**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. Description of the procedure for an X-ray structure analysis, absolute configuration of molecules, 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 solids and liquids, magnetic scattering,

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 and condensed systems, chemical and surface applications.

##### Books Suggested:

1. Basic of X-Ray Diffraction and its application. ISBN 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. Chakarbarty, 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, doping 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 3<sup>rd</sup>Edn 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 Ttsui, John Wiley N.Y. 1980
12. Introduction to the Principles of Homogenous Catalysis, J.M.

## 20 / M.D.S.U. Syllabus / M.Sc. Applied Chemistry

Thomas &amp; 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
- xviii. Iron by Colorimetry
- xix. Determine the available chlorine content of bleaching powder extract supplied with the solution of thiosulphate against standard dichromate solution.
- xx. Discuss the physical and chemical characteristic of water you have examined and comment on the suitability of water for drinking industrial purpose.
- xxi. 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
<b>Grand Total</b>	<b>100</b>

**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, Craig's technique & its application.

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 Letter 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****Titrimetric, Gravimetric and Thermal Methods of Analysis**

General principles of Volumetric analysis, concentration systems, acid-base, complexometric, precipitation, oxidation-reduction titration, theories, its applications, theory & application of gravimetric analysis. Process & treatment of precipitation, Co-precipitation and ageing, Organic precipitation. Theory, instrumentation & application of thermo- gravimetric & differential thermal Analysis. Thermal methods in quantitative analysis.

**Unit-****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. Diek 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. Himalaya Pub. House
7. Analytical Chemistry, 6<sup>th</sup> 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 (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****Food Analysis**

Moisture, ash, crude protein, fat, crude fibre, carbohydrates, calcium, potassium, sodium and phosphate. Food adulteration-common adulterants in food, contamination of food stuffs. 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:** Characteristic & classification of fossil fuels-solid, liquid and gas. Ultimate and proximate analysis of coal, grading of coal. Liquid fuels-flash point, fire point, cetane number, octane number and carbon residue. Gaseous fuels-producer gas and water gas, calorific value and its determination.

**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.

(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.

(C) **Testing of dyes** – Testing of fastness properties, effect of light, washing agents and rubbing on dye shades.

**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 Quantitative Chemical Analysis: J. Mendham et al: 6<sup>th</sup> edn 2008
4. A Handbook of Chemical Analysis, 2005 Pooja Bhagwan
5. Applied Chemistry, A.K. Bagavathi Sundry, MJP Publishers
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)

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

**M3AC15-CP-03 PRACTICAL****Duration: 6 hours****Maximum Marks :100****Practicals****A. Fuel Analysis (Minimum Three)**

- The proximate analysis of given sample of coke and wood charcoal.
- The ultimate analysis of given sample of soft coke.
- Determine the swelling index of coal.
- Determine Phosphorus present in coal.
- 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
- 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)**

- Determine Acid Value of lubricating oil.
- Determine Saponification Value of a lubricating oil
- Determine Iodine Value of lubricating oil.
- Determine Aniline Point of lubricating oil.
- Determine Cloud- Point and Pour-Point of lubricating oil.
- Determine Flash Point of lubricating oil.
- Determine Fire Point of lubricating oil
- Determine Rancidity of oil sample.

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

- Preparation of Aspirin.
- Preparation of Paracetamol
- Preparation of Salol
- Preparation of Sulphanilic acid

**Books Suggested:**

- Advanced Practical Chemistry, Jagdamba Singh, PragatiPrakashan
- 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**

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

**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 1<sup>st</sup> Edn. 2005
2. Principles of Polymerization, George Odian. Illrdedn, John Wiley & Sons.
3. Principles of Polymer Chemistry, A. Rawe 1995
4. Principles of Polymer Systems, Ferdinand Rodriguez IVthedn, Taylor & Francis
5. Experiment in Polymer Science, D G Hundiware, 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, ISDN 978-81-90746-23-6/ 2009. S.M. Ashraf, Sharif Ahmad, UfanaRauaz
9. A Handbood of Polymer Chemistry, 2005, Dinesh Sharma
10. Text Book of Polymer Science, Fred W. Billmeyer Jr
11. Principles of Polymer Chemistry, A Ravve
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-nitrite, 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. NitroxideMediated 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

- Principles of Polymer Chemistry by P. J. Flory
- Principles of Polymerization, G. Odian, Wiley- Inter Science
- Condensation polymers by interfacial and solution methods, Paul W. Morgan Inter Science Publishers
- Organic Polymer Chemistry, K J Saunders, Chapman and Hall, London
- High performance polymers, their origin and development by Seymour. R. B and Kirshenbaums, G.S. Elsevier.
- 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 (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****Glass Industry:**

Introduction, classification of glass, basic raw materials of glass, manufacturing processes including chemical reactions, some special glasses: optical glass, coloured glass, fibre glass, laminate glass, safety glass, photosensitive glass, photo chromatic glass, lead glass, borosilicate glass and glass wool.

**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.

**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 & amphotytic 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:**

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

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

- 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. (8<sup>th</sup> Edn) 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 Amsterdam

Analytical methods for textile laboratory III<sup>rd</sup> edn. 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-23 PHARMACEUTICAL 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****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, fluconazole, econazole, griseofulvin, chloroquin and primaquin.

**Antibiotics**

Cell wall biosynthesis, inhibitors,  $\beta$ -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 and Febiger Philadelphia
3. The Organic Chemistry of drugs synthesis, D Ledwith and L N Mitscher, John Wiley & Sons N.Y.
4. Medicinal Chemistry, A.K. Arora, Wiley Eastern Ltd N.Y.
5. A Text book of Synthetic Drugs, O D Tyagi M Yadav, Anmol Publications
6. An Introduction to drug design, S N Pandeya, J R Demmock, New age International Publishers
7. Biopharmaceutics & Pharmacokinetics, D M Brahanabankar, Sunil B Jaiswal
8. Introduction to Pharmaceutical II, A K Gupta S S Bajaj, CBS Publishers and Distributors
9. Computer for Chemists, Pundir, Pragati Prakashan
10. Computer and their application to Chemistry, Ramesh Kumar, Narosa Publishing House

**M4AC18-ET-23B PHARMACEUTICAL 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**

- a) **Local Anaesthetic:** Classification, Structure activity relationship of Local Anaesthetics, Mechanism & Theories of local anaesthetics,

Synthesis, MOA, Uses and Adverse effects of Benzocaine, Procaine, Lignocaine, Dibucaine, Doperidon.

- b) **General Anaesthetics:** Definition, classification, theories of General anaesthetics, Synthesis, Uses, Adverse effects of Cyclopropane, Halothane, Nitrous oxide, Chloroform, Thiopental sodium, Tribromoethanol.

**Unit-II**

- a) **Antimetabolites:** Synthesis, Uses and Side Effects of Sulfanilamide, Sulfapyridine, sulfadiazine, SAR of Sulphanilamide.
- b) **Antineoplastic Agents:** Introduction to tumor & Cancer, Causes of Cancer, Treatment of Cancer, Chemotherapy of Cancer, Classification of Antineoplastic Agents, Role of Alkylating Agents, Synthesis, Uses, Properties & Side Effect of Mustard Drugs, Mechlorethamine, Cyclophosphamide, Melphalan, Uracil.

**Unit-III**

- a) Definition and Types of Toxicology, Basic Principles of Toxicology, Carcinogenicity, Mutagenicity, Teratogenicity, Acute, Sub-acute and Chronic Toxicity, Pre-Clinical Evaluation of Drugs.
- b) Drugs of Abuse, Classification of Drugs of Abuse, Drug Addiction, Definition of Tolerance and Dependence. Physical Dependence, Psychological Dependence, Mechanism of Tolerance and Dependence.
- c) Types of Poisoning, Causes of Poisoning General Treatment and Management of Poisoning.

**Books Suggested:**

1. Burger's Medical Chemistry, M.E. Wolff, John Wiley sons N.Y.
2. Principles of Medicinal Chemistry, W.O. Foye and Febiger Philadelphia
3. The Organic Chemistry of drugs synthesis, D Ledwith and L N Mitscher, John Wiley & Sons N.Y.
4. Medicinal Chemistry, A.K. Arora, Wiley Eastern Ltd N.Y.
5. A Text book of Synthetic Drugs, O D Tyagi, M Yadav, Anmol Publications
6. An Introduction to drug design, S N Pandeya, J R Demmock, New Age International Publishers
7. Biopharmaceutics & Pharmacokinetics, D M Brahanabankar, Sunil B Jaiswal
8. Introduction to Pharmaceutical II, A K Gupta S S 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 (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****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 liquors. Physical I& Chemical test of pulp and paper. Natural and Synthetic fibers & textile fiber. Manufacture of viscous rayon fiber, cellulose acetate fiber, acrylic fiber.

**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 Celotex, 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 lacouers, 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, Alkylation of paraffin-acid, Catalytic refining, solvent refining.

General characteristics of petroleum hydrocarbons viz. Alkanes, Alkenes,

Alicyclics, Aromatics. Preparations of gaseous hydrocarbons, separation of liquid hydrocarbons.

**Books Suggested:**

1. Principles of Industrial Chemistry, Chrlies A Clansmen III, Mattsen J Wiley Inter Science
2. A text book of Chemical Technology Voll, S.D. Shukla and G.N. Pandey
3. Wellman's encyclopedia of Industrial Chemistry, Arpe et at, Editorial Advisory Board
4. Pulp and Paper Chemistry & Chemical Technology – Vol. I,II,III by Jones P Carey

**M4AC19-ET-24B MATERIAL CHARACTERISATION****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****Importance of Quality control and Characterization of molecular weight:**

Importance of specification & standards in quality control of polymers, Preparation of polymer test specimens and conditioning, determination of molecular weight by Gel Permeation Chromatography. Ebulliometry, Cryoscopy.

**Unit-II-A****Material Characterization test:**

Introduction, Melting point, Softening point, Thermal conductivity, Shrinkage, Melt Flow Index test, Particle size, Density, and bulk factor, Water and Moisture absorption.

**Unit-II-B****Chemical and Weathering properties:**

Immersion test, Stain resistance test, Solvent stress cracking resistance test, Environmental stress cracking resistance test, Accelerated weathering test, Outdoor weathering of polymers.

**Unit-III****Mechanical, Electrical and Flammability test:**

Introduction, Hardness, Tensile strength, Compression strength, Flexural

strength, Impact strength, Dielectric strength, Dielectric constant, Insulation resistance and arc resistance, Ignition properties, Oxygen Index test and smoke generation tests.

**Books Suggested:**

1. Handbook of plastics test method, R.P. Brown, Longman Scientific and Technical.
2. Handbook of plastics testing technology, Vishu Shah, John Wiley & Sons, New York.
3. ASTM, BIS, ISO standards.
4. Instrumental methods of Analysis, Will and Merritt, CBS Publisher, New Delhi.
5. Principles of Instrumental Analysis, Douglas A. Skoog, F. James Holler and Timothy A. Nieman, Harcourt Brace College Publishing, Philadelphia.
6. Encyclopedia of Polymer Science and Engineering, Wiley Inter Science, New York.

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

1. Loss on ignition
2. Silica
3.  $\text{Fe}_2\text{O}_3$
4. Combined  $\text{Fe}_2\text{O}_3$  and  $\text{Al}_2\text{O}_3$
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.
6. Determine Molecular Weight of a polymer.
7. Determine Isocyanate Content of Resin/Plastic Material.
8. Determine Epoxy Equivalent and Epoxy Value of Resins/Plastic Material.
7. Determine Capacity of Cation exchange resin.

8. Determine Capacity of an Anion exchange resin.
9. 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.
10. 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 or Bulk or Solution Polymerisation.
7. Prepare Polysulphide Rubber
8. Prepare Polyester Resin by Melt Condensation or Solution Condensation Method
9. Prepare Epoxy Resin.

**Books Suggested:**

1. Experiments in Polymer Science, D.G. Hundiware, V.D. Athawale, New Age International Publishers
2. Advanced Practical Chemistry, Jagdamba Sing, PragatiPraksahan
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
<b>Grand Total</b>	<b>100</b>



**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	$75 < m < 85$	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 <sup>nd</sup> Class
$6 < CGPA < 7$	1 <sup>st</sup> Class
$CGPA < 7$	Distinction

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

Equivalent Percentage =  $CGPA * 10$

Cumulative Grade Point Average (CGPA) is computed as

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

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