ANDHRA UNIVERSITY

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All Official letters, packages etc, should be addressed to the Registrar by designation and not by name

LI(2)/B.Sc. Analytical Chemistry/2020-21

Visakhapatnam,
Dated. 18-01-2023

PROCEEDINGS OF THE VICE-CHANCELLOR

Sub : Approval of B.Sc. Analytical Chemisty Syllabi, Course Structure & Model Question Papers Under Skill Enhancement Course, semester-V - Orders- Issued.

Read : Implementation of B.Sc. Analytical Chemisty Syllabi, Course Structure & Model Question Papers under Skill Enhancement Courses (SECs) of semester-V, with effect from the academic year 2020-2021 received from the Academic Officer, Academic Cell APSCHE, Govt. of A.P, Guntur.

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ORDER:

Having considered the letter read above, the Hon'ble Vice Chancellor is pleased to order that the Implementation of B.Sc. Analytical Chemisty Syllabi, Course Structure & Model Question Papers under Skill Enhancement Courses (SECs) of semester-V, introduced by APSCHE, Govt. of A.P with effect from the academic year 2020-2021 admitted batch be approved.

It is further ordered to place above matter before the ensuing meeting of the Academic Senate for ratification.

(BY ORDER)

(K.UMA MAHESWARI)
DEPUTY REGISTRAR (ACADEMIC)

Copies to

1. The Principal's of affiliated colleges B.Sc. Analytical Chemistrty U.G program.
2. The Dean of Academic Affairs, A.U. VSP.
3. The Dean UG Examinations, A.U. VSP
4. The Controller of Examinations, A.U. VSP.
5. The Supdt. S.I & E.III,E.IV Sections, A.U. VSP.
6. The Director, Computer Centre, A.U., VSP.

ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

REVISED UG SYLLABUS UNDER CBCS
(Implemented from Academic Year, 2020-21)
PROGRAMME: FOUR YEAR B.Sc. (Hons)
Domain Subject: **ANALYTICAL CHEMISTRY**

Skill Enhancement Courses (SECs) for Semester V, from 2022-23 (Syllabus with Learning Outcomes, References, Co-curricular Activities & Model Q.P. Pattern)

Structure of SECs for Semester–V

(To choose One pair from the Three alternate pairs of SECs)

Univ. Code	Course NO. 6&7	Name of Course	Th. Hrs. / Week	IE Marks	EE Marks	Credits	Prac. Hrs./ Wk.	Marks	Credits
	6A	Instrumental Methods of Analysis	3	25	75	3	3	50	2
	7A	Electroanalytical Techniques	3	25	75	3	3	50	2
		OR							
	6B	Analytical techniques	3	25	75	3	3	50	2
	7B	Sampling methods and Data analysis	3	25	75	3	3	50	2
		OR							
	6C	Separation methods, Corrosion, Laboratory safety and Quality control	3	25	75	3	3	50	2
	7C	Applied Analysis	3	25	75	3	3	50	2

Note-1: *For Semester–V, for the domain subject Analytical Chemistry, any one of the three pairs of SECs shall be chosen as courses 6 and 7, i.e., 6A&7A or 6B&7B or 6C&7C. The pair shall not be broken (ABC allotment is random, not on any priority basis).*

Note-2: *One of the main objectives of Skill Enhancement Courses (SEC) is to inculcate skills related to the domain subject in students. The syllabus of SEC will be partially skill oriented. Hence, teachers shall also impart practical training to students on the skills embedded in syllabus citing related real field situations.*

A.P. State Council of Higher Education

Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc (Hons)

Domain Subject: **ANALYTICAL CHEMISTRY**

IV Year B.Sc (Hons)- Semester-V

Max. Marks: 100+50

***Course 6-A*: Instrumental methods of analysis**

(Skill Enhancement Course (Elective), Credits: 05)

I. Learning Outcomes:

Students after successful completion of the course will be able to:

1. Demonstrate the knowledge on different spectroscopic techniques
2. Acquire knowledge on basic concepts in ESR spectroscopy
3. Understand the importance of spectroscopy in the qualitative and quantitative determination of metals
4. Comprehend the applications of AAS and AES

II. Syllabus :*(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)*

Unit-1: UV – Visible Spectroscopy **12 hours**

1. Electronic spectra of diatomic molecules. The Born - Oppenheimer approximation. Vibrational coarse structure - The Franck-Condon principle.
2. Beer – Lambert's law and its limitations
3. Single beam and double beam UV – Visible Spectrophotometers: Block diagram
4. Applications of UV-Visible Spectroscopy: Quantitative determinations of metal ions-Mn (II) and Fe (II)

Unit-2: NMR spectroscopy **12 hours**

1. FT NMR- Theory, Instrumentation and advantages
2. Homo nuclear and heteronuclear coupling, Spin decoupling, Nuclear Overhauser Effect (NOE)
3. Chemical shift reagents

Unit-3: ESR spectroscopy **12 hours**

1. Basic principle, theory and Instrumentation
2. Comparison between ESR and NMR
3. 'g' factor and hyperfine coupling constant (a)
4. Application in the detection of Organic radicals- Methyl, Ethyl, Benzene radical anion.

Unit-4: Atomic Emission Spectroscopy (Flame Photometry) — 12 hours

1. Introduction and Principles of Flame Emission Spectroscopy
2. Instrumentation-Block diagram
3. Applications of Flame Emission Spectroscopy: Determination of Alkali & Alkaline earth metals in natural water
4. Spectrofluorimetry: Principle, Instrumentation and Applications

Unit-5: Atomic Absorption Spectroscopy (AAS) — 12 hours

1. Introduction and Principles of Atomic Absorption Spectroscopy
2. Instrumentation-Block diagram
3. Radiation sources (Line sources), Hollow cathode lamps, Deuterium Discharge lamps
4. Applications of Atomic Absorption Spectroscopy: Determination of calcium and Magnesium in water

5. References

1. Instrumental Methods of Analysis by H. H. Willard, L. L. Merritt and J. A. Dean.
2. Quantitative chemical analysis by Vogel's; 6th & 7th Editions
3. Fundamentals of Analytical Chemistry by Skoog and West
4. Principles of Instrumental Analysis by Skoog, Holler and Crouch
5. Handbook of analytical Instruments by RS Khandpur
6. Instrumentation methods of Chemical Analysis by G.R. Chatwal
7. C.N. Banwell: Fundamentals of Molecular Spectroscopy.
8. Quantitative Chemical Analysis by Daniel C. Harris
9. Analytical Chemistry by Gary D, Christian
10. Quantitative analysis by R.A. Day Jr and A.L. Underwood

Course6-A: Instrumental Methods of Analysis: PRACTICAL SYLLABUS

6. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. Perform the quantitative determination of various ions by using instrumentation methods
2. Learn the procedure for the calibration of standards and determination of concentration of unknown using standard addition method
3. Acquire skills to carry out the conductometric and potentiometric titrations

IV. Practical (Laboratory) Syllabus :(30hrs) — **(Max.50 Marks)**

1. Colorimetry/Spectrophotometry:
    a. Verification of Beer-Lambert Law:
        - Calibration of standards and plotting of graph
        - Determination of unknown sample
    b. Method of Standard addition
        - Calibration of standards and plotting of graph
        - Determination of Concentration of unknown sample by standard addition
2. Conductometry:
    - Conductometric titrations:
        i. Titration of weak acid vs strong base
        ii. Titration of mixture of acids vs strong base
3. Potentiometry/ pH metry:
    i. Determination of p^{Ka} of an acid.
    ii. Determination of zinc with ferrocyanide.
    iii. Determination of ferrous ion with dichromate.

VI. References

1. Quantitative chemical analysis by Vogel's; 6th & 7th Editions
2. Practical Physical chemistry by B. Viswanathan and P.S.Raghvan
3. Practical Chemistry by O.P.Pandey, D.N. Bajpai and S.Giri
4. Experimental Physical chemistry by V D Athwale and P. Mathur

VII. Co-Curricular Activities

a) Mandatory: *(Lab/field training of students by teacher: (lab: 10+field:05)*:

1. **For Teacher**: Training of students by the teacher in laboratory and field for not less than 15 hours on the field techniques/skills of quantitative determination of various ions by using different Spectroscopic techniques
2. **For Students**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the instrumental techniques for quantitative determination of various ions. Write their observations and submit a hand written fieldwork/project work report not exceeding 10 pages in the given format to the teacher.
3. Max marks for Fieldwork/project work Report: 05.
4. Suggested Format for Fieldwork/project work: *Title page, student details, Index page, details of place visited, observations, findings, and acknowledgements.*

4. Unit tests (IE).

b) Suggested Co-Curricular Activities

1. Assignments, Seminars and Quiz (on related topics), collection of relevant videos and

material.

2. Visits of facilities, laboratories, firms, research organizations etc.
3. Invited lectures and presentations on related topics by field/industrial experts.

VII. Suggested Question Paper Pattern:

Time: 3 hrs.

Max. Marks: 75

SECTION – A (Total: 10 Marks)

Very Short Answer Questions (10Marks:5x2)

SECTION - B (Total: 5x5=25 Marks)

(Answer any Five Questions. Each answer carries 5 marks

(At least 1 question should be given from each Unit)

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SECTION - C (Total: 4x10 =40 Marks)

(Answer any Four questions. Each answer carries 10 marks

(At least 1 question should be given from each Unit)

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MODEL PAPER

MAX.MARKS 75 TIME:3 HRS

SECTION-A

ANSWER ANY FIVE QUESTIONS **5 X 2 = 10M**

1. Write the limitations of Beer-Lambert law?
2. State Frank Condon principle?
3. What is spin decoupling?
4. What are lanthanide shift reagents?
5. What is "g" factor?
6. Define Kramer's degeneracy?
7. Write Block diagram of Flame Emission Spectroscopy
8. Write the application of Spectro fluorometry?
9. Write about Hollow cathode lamps
10. Write Block diagram of Atomic Absorption Spectroscopy?

SECTION-B

ANSWER ANY FIVE QUESTIONS **5 X 5 = 25 M**

11. State and explain Beer -Lamberts Law?
12. Write briefly about Born - Oppenheimer approximation?
13. Explain about Nuclear Overhauser Effect (NOE)
14. Explain the basic principle of ESR spectroscopy?
15. Write about Principles of Flame Emission Spectroscopy?
16. Explain the determination of Magnesium in water by using Atomic Absorption Spectroscopy?
17. Write the Comparisons between ESR and NMR.
18. Explain about Deuterium Discharge lamps.

SECTION-C

ANSWER ANY FOUR QUESTIONS **4 X 10 = 40M**

19. How do you determine Mn(II) and Fe(II) quantitatively by using UV - Visible Spectroscopy?
20. Explain the theory & Instrumentation FT NMR?
21. Explain the application of ESR spectroscopy in the detection of Organic radicals- Methyl, Benzene radical anion?
22. Explain the Application of Flame Emission Spectroscopy in the determination of Alkali metals in natural water?
23. Explain the basic principles and Instrumentation of Atomic absorption spectroscopy.
24. Explain the Principle and Instrumentation of Spectro fluorometry?

A.P. State Council of Higher Education

Semester-wise Revised Syllabus under CBCS, 2020-21

Course Code:

Four-year B.Sc (Hons)

Domain Subject: **ANALYTICAL CHEMISTRY**

IV Year B.Sc (Hons)- Semester-V

Max. Marks: 100+50

***Course 7-A*: Electroanalytical Techniques**

(Skill Enhancement Course (Elective), Credits: 05)

I. Learning Outcomes:

Students after successful completion of the course will be able to:

1. Acquire basic knowledge about Electroanalytical techniques
2. Demonstrate the importance of different electroanalytical techniques
3. Understand the importance of Electroanalytical techniques in chemical analysis
4. Acquire skills to handle various Electroanalytical instruments

II. Syllabus :(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Unit-1: An Introduction to Electro analytical Chemistry **12 hours**

1. Electrochemical Cells
2. Potentials in Electroanalytical Cells
3. Electrode Potentials
4. Calculation of Cell Potentials from Electrode Potentials
5. Currents in Electrochemical Cells
6. Types of Electroanalytical Methods

Unit- 2: Electrodes in electroanalytical methods **12 hours**

1. Ion selective electrodes: Introduction and their importance in chemical analysis
2. Reference electrodes – Hydrogen electrode, Calomel electrode, silver chloride electrode.
3. Indicator electrodes –Hydrogen and glass electrodes, Metal –metal ion electrode, inert electrode
4. Applications of ion selective electrodes: Qualitative and Quantitative determinations

Unit-3: Potentiometry **12 hours**

1. General Principles
2. Ion-Selective Field-Effect Transistors
3. Molecular-Selective Electrode Systems
4. Instruments for Measuring Cell Potentials

5. Potentiometric Titrations

12 hours

Unit-4: Polarography

1. Introduction and Basic Principles of Polarography
2. Residual current, migration current, diffusion current, half wave potential, Ilkovic equation.
3. Instrumentation and techniques of Polarographic technique.
4. Dropping mercury electrode (DME), advantages and disadvantages of DME
5. Qualitative and quantitative analysis of inorganic ions by Polarographic technique

12 hours

Unit-5: Amperometric Titration Methods

1. Amperometric titration – definition
2. Methodology: current-voltage curves of lead sulphate
3. Current-voltage curves of dichromate and lead ions
4. Titrations to Zero Current
5. Comparison with Other Titration Methods
6. Amperometric Titration of Lead with Dichromate

III: References

1. Quantitative chemical analysis by Vogel's; 6th & 7th Editions
2. Fundamentals of Analytical Chemistry by Skoog and West
3. Principles of Instrumental Analysis by Skoog, Holler and Crouch
4. Handbook of analytical Instruments by RS Khandpur
5. Instrumentation methods of Chemical Analysis by G.R. Chatwal
6. Quantitative Chemical Analysis by Daniel C. Harris
7. Analytical Chemistry by Gary D, Christian
8. Quantitative analysis by R.A. Day Jr and A.L. Underwood

***Course7-A*: Electroanalytical Methods - PRACTICAL SYLLABUS**

IV. Learning Outcomes:

1. Perform the determination of sodium carbonate in washing soda and carbonate and hydroxide in commercial caustic soda
2. Prepare the TLC plates and determine the R_f values of organic compounds
3. Acquire skills to pack the column and use the column chromatography in the separation of mixture of organic compounds

3. Thin Layer Chromatography:

   a. Preparation of TLC Plates
   b. Selection of solvent ratios for polar and non-polar organic compounds
   c. Determination of R_f values of different organic compounds

4. Column Chromatography:
   a. Packing of a synthetic column
   b. Separation of mixture of organic compounds by column chromatography

References

1. Quantitative chemical analysis by Vogel's; 6th & 7th Editions
2. Practical Organic chemistry by FG Mann and BC saunders
3. Laboratory manual of Organic Chemistry by Raj K Bansal
4. Comprehensive Practical Organic Chemistry by VK Ahluwalia and R. Agarwal

. Co-Curricular Activities:

Mandatory:*(Lab/field training of students by teacher:(lab:10+field:05):*

1. **For Teacher**: Training of students by teacher in laboratory and field for not less than15 hours on the field techniques/skills of electroanalytical techniques, related analytical methods and their applications for quantitative determination of various components.
2. **For Student**: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe the related electroanalytical techniques used for quantitative chemical analysis. Write their observations and submit a handwritten fieldwork/project work report not exceeding10 pages in the given format to the teacher.
3. Max marks for Fieldwork/project work Report: 05.
4. Suggested Format for Fieldwork/project work: *Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.*
5. Unit tests (IE).

Suggested Co-Curricular Activities

1. Assignments, Seminars and Quiz (on related topics), collection of videos and other material.
1. Visits of facilities, laboratories, firms, research organizations etc.
2. Invited lectures and presentations on related topics by field/industrial experts.

VII. Suggested Question Paper Pattern:

Max. Marks: 75 Time: 3 hrs.

SECTION - A (Total: 10 Marks)

Very Short Answer Questions (10Marks:5x2)

SECTION - B (Total: 5x5=25Marks)

(Answer any Five questions. Each answer carries 5 marks

(At least 1 question should be given from each Unit)

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SECTION - C (Total: 4x10 =40 Marks)

(Answer any Four questions. Each answer carries 10 marks (At least 1 question should be given from each Unit)

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