

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS)**

**LATUR - 413512**

**DEPARTMENT OF ANALYTICAL CHEMISTRY**



**Syllabus**

**B.Sc. (Third Year) Analytical Chemistry**

**(V Semester)**

**With Effect From 2017-2018**

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**Rajarshi Shahu Mahavidyalaya, Latur**  
**Faculty of Science**  
**B.Sc. III (Third) Year**  
**Analytical Chemistry**  
**Course Structure, Semester-V (w.e.f.2017-18)**

Paper	Course Code	COURSE	Periods/ Week	Total periods	Marks	Credits
IX	U-ANC-561	Modern Techniques Of Chemical Analysis-IX	03	45	50	02
X	U-ANC-562	Environmental & Food Analysis-X	03	45	50	02
VII	U-ANC-563	Analytical Chemistry Laboratory Course – VII	03	45	50	02
VIII	U-ANC-564	Analytical Chemistry Laboratory Course – VIII	03	45	50	02
			Total		200	08

**B.Sc. III (Third) Year**  
**Analytical Chemistry**  
**Course Structure, Semester-VI (w.e.f.2017-18)**

Paper	Course Code	COURSE	Periods/ Week	Total periods	Marks	Credits
XI	U-ANC-661	Electroanalytical Techniques & Chromatography-XI	03	45	50	02
XII	U-ANC-662	Applied Analytical Chemistry-XII	03	45	50	02
IX	U-ANC-663	Analytical Chemistry Laboratory Course – IX	03	45	50	02
X	U-ANC-664	Analytical Chemistry Laboratory Course – X	03	45	50	02
			<b>Total</b>		<b>200</b>	<b>08</b>

**Rajarshi Shahu Mahavidyalaya, Latur**  
**Faculty of Science**  
**B.Sc. III ( Third ) Year ;Semester -V (w.e.f.2017-18)**  
**Analytical Chemistry**  
**Paper – IX**  
**Modern Techniques of Chemical Analysis**  
**Paper Code: U-ANC-561**

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**Periods : 45 Per Semester**

**3 Period/week**

**Marks : 50**

**Credits : 02**

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**Learning Objective:**

- 1.To understand the Modern Techniques of chemical analysis.
2. Prepare the students for interpretation of spectral data for research.

**Course Outcome:**

With the knowledge of spectroscopic techniques students can explain principles and mechanisms involved and interpreted spectral data.

**Unit – I Infrared Spectroscopy :**

**12 Periods**

Range of IR-radiation, Theory- Requirements for I R radiation absorption, Different normal modes of vibrations of atoms in polyatomic molecules, Instrumentation and Experimental Technique. Applications of IR spectroscopy.

**Unit – II <sup>1</sup>H NMR Spectroscopy :**

**13 Periods**

Theory of <sup>1</sup>H NMR Spectroscopy, Instrumentation, Experimental technique, NMR spectra, Number of signals- equivalent and nonequivalent protons, Chemical Shift, Measurement of Chemical Shift, Factors affecting chemical shift, Spin-spin coupling, Interpretation of <sup>1</sup>H NMR spectra in structure determination and identification.

**Unit – III Mass Spectrometry :**

**12 Periods**

Theory, Instrumentation, components of mass spectrometer, Recording of mass spectrum, Resolution of mass spectrometer, Types of ions produced in a mass spectrometer, Applications of mass spectrometry.

**Unit – IV Fluorescence Spectroscopy :**

**08 Periods**

Theory, Relation between fluorescence intensity and concentration, Single and Double beam filter fluorometers, Applications.

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**B.Sc. III ( Third ) Year ;Semester-V (w.e.f.2017-18)**  
**Analytical Chemistry**  
**Paper - X**  
**Environmental and Food Analysis**  
**Paper Code- U-ANC-562**

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**Periods : 45/Semester**

**Marks : 50**

**3 Period/week**

**Credits : 02**

**Learning Objective:**

1. Make the students aware of environmental pollution & study the level of pollutants
2. Learn the analysis of food.

**Course Outcome:**

Student get acquainted with issues regarding the environmental pollution and procedures for analysis of pollutants and food samples.

**Unit - I Environmental Analysis-I ( Air and water ) :**

**12 Periods**

**Analysis of Air :** Composition of natural atmospheric air, pollution, pollutants in air, causes of pollution, sampling of air, Determination of i ) particulate matter suspended and settled ii ) Sulphur dioxide iii) Nitrogen dioxide iv) Carbon mono and dioxide as pollutants.

**Analysis of Water :** Introduction to potable water quality standards, objectives of water analysis. Methods of measurement of water quality parameters: Physical parameters - pH, conductivity, total dissolved solids. Determination of chemical parameters - Temporary and Permanent Hardness, Dissolved oxygen, Chemical Oxygen Demand and Bio chemical Oxygen Demand.

**Unit - II Environmental Analysis-II ( Industrial Effluent)**

**Analysis of Industrial Effluent :**

**5 Periods**

Definition of industrial effluent, Estimation of toxic metals like Hg & Zn in industrial effluent.

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**Unit – III Environmental Analysis-III (Analysis of Soil) :**

**12 Periods**

Methods of soil sampling, Determination of : i) Bulk density (ii) specific gravity (iii) water holding capacity (iv) moisture content (v) Loss on ignition (vi) soil pH. Chemical Analysis of Soil : Determination of i) Total nitrogen, (ii) Nitrate Nitrogen (iii) organic matter. Determination of potassium and sodium.

**Unit – IV Analysis of Food and Food Products:**

**16 Periods**

**Composition and Analysis of following :**

i) Milk : Determination of specific gravity , Total solids, Fat, Protein, Lactose and Acidity .

Wheat flour : Determination of moisture, ash, fat, protein, fiber, acidity, pH & starch.

ii) Fish : Assessment of raw fish for its spoilage, Chemical methods for assessment of spoilage.

Determination of moisture, total fat, ash, chloride, Nitrogen and total phosphorus.

iii) Honey : Determination of total solids, moisture , ash , free acid pH and glucose.

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**Rajarshi Shahu Mahavidyalaya, Latur**  
**Faculty of Science**  
**B.Sc. III ( Third ) Year ;Semester -V (w.e.f.2017-18)**  
**Analytical Chemistry Laboratory Course - VII**  
**Paper Code-U-ANC-563**

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**Total Period: 45**

**3 Period/week**

**Marks : 50**

**Credits : 2**

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**Learning Objective:**

Develop experimental skills for the environmental & food analysis.

**Course Outcome:**

Student can analyse environmental and food samples practically.

**Note :** Out of 21 experiments, at least 08 experiments should be completed.

**A. Environmental Analysis :**

1. Colorimetric estimation of traces of nitrogen in the sample of water using Nessler's reagent.
2. Determination of dissolved oxygen in water by Winkler's method.
3. Determination of nitrate nitrogen/ nitrite nitrogen/ phosphate in a sample of water by colorimetry.
4. Determination of total hardness, calcium hardness and magnesium hardness of a water sample.
5. Determination of chemical oxygen demand (COD) of a waste water sample.
6. Estimation of carbon/ organic matter in a soil sample by chromic acid digestion.
7. Determination of Silica in soil.
8. Determination of magnesium in soil.
9. Determination of soil pH.
10. Estimation of micro nutrients Zinc/Copper/ Maganese in a soil sample

**B. Food & Food product analysis :**

11. Determination of nitrogen in wheat flour.
  12. Estimation of lipids in egg yolk.
  13. Estimation of protein in milk by formal titration/ casein nitrogen.
  14. Analysis of milk for its lactose/ total solid.
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15. Determination of ascorbic acid in fruit juices/ citrus fruits.
16. Determination of total acidity, fixed acidity and volatile acidity in pickles / titratable acidity in fruits/ fruits juices.
17. Determination of sodium bicarbonate in carbonated drinks/ soda water/ soft drinks and determination of caffeine in cola drinks/ carbonated beverages.
18. Determination of iron content in foods by spectrophotometry
19. Isolation of piperine from black pepper and its determination as crude piperine.
20. Determination of Carbon dioxide in carbonated beverages.
21. Determination of glucose in honey by Winstatter's method.

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**B.Sc. III ( Third ) Year ;Semester-V (w.e.f.2017-18)**  
**Analytical Chemistry Laboratory Course – VIII**  
**Paper Code-U-ANC-564**

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**Total Period: 45**

**3 Period/week**

**Marks : 50**

**Credits : 2**

**Learning Objective:**

Acquire practical knowledge of chromatographic separation, analysis of water & metals.

**Course Course:**

Students can handle chromatographic techniques and analyse water and metal samples.

**Note :** Out of 13 experiments, at least 08 experiments should be completed.

**1. Chromatographic Techniques :**

1. Paper/Thin layer chromatography separation of metals/ amino acids / Sugars from a mixture.
2. Chromatographic separation of plant leaf pigments.
3. Separation of inorganic ions by TLC.

**2. Analysis of water:**

4. Potentiometric determination of fluoride in drinking water/ river water using Fluoride- ion selective electrode.
5. Determination of available chlorine in bleaching powder volumetrically using an external Indicator.
6. Microscale quantitative Analysis of Hard water samples using an indirect potassium permanganate Redox titration.

**3. Elemental Analysis:**

7. Determination of concentration of ferrous ion by potentiometric titration.
8. Determination of antimony by titration with iodine.
9. Iodometric determination of copper.
10. Estimation of ferrous and ferric iron in a mixture.
11. Determination of copper and nickel in a mixture.

**4. Spectroscopic Analysis:**

12. Determination of functional groups of given compounds by IR spectrophotometry.
  13. Study of complexes by IR spectrophotometry.
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**Rajarshi Shahu Mahavidyalaya, Latur**  
**Faculty of Science**  
**B.Sc. III (Third ) Year; Semester -VI (w.e.f.2017-18)**  
**Analytical Chemistry**  
**Paper - XI**  
**Electroanalytical Techniques and Chromatography**  
**Paper Code-U-ANC-661**

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**Periods : 45 Per Semester ,**

**3 Period/week**

**Marks : 50**

**Credits : 02**

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**Learning Objective:**

1. Introduce the students to electroanalytical techniques.
2. Understand new chromatographic techniques in analysis

**Course Outcome:**

Thorough knowledge regarding electroanalytical techniques and chromatographic techniques are incorporated in students

**Unit - I Electroanalytical Techniques-1 :**

**12 Periods**

**1.1 Conductometry:** Conductance, specific conductance, Equivalent conductance, molecular conductance, Effect of dilution, measurement of conductance- conductivity cell, wheat stone bridge apparatus. Conductometric Titrations, apparatus for conductometric titrations, Types of conductometric titrations -Acid base, Precipitation and Redox titrations.

**1.2 Potentiometry :** Electrode Potential, Standard electrode potential, Nernst equation, EMF of an electrolytic cell, reference, indicator and ion selective electrodes. Theory of potentiometric titrations, Types of potentiometric titrations- Acid base, Redox and precipitation titrations.

**1.3 Karl Fischer method.**

**Unit - II Electro analytical Techniques-2 :**

**13 Periods**

**2.1 Polarography :**

Principle of DC polarography, polarogram, Limiting current, Residual current, Migration current, Diffusion Current, Ilkovic equation, Kinetic Current, Decomposition potential, Half wave potential, Oxygen wave and its removal, Current maxima. Instrumentation, Dropping mercury electrode,

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Dissolved oxygen electrode. Analytical applications.

**2.2 Amperometry:** Theory of amperometric titrations, Typical titration curves, Apparatus with rotating Platinum microelectrode and applications.

**Unit - III Chromatographic Techniques -2 :**

**05 Periods**

**Ion Exchange Chromatography:** Principle, ion exchange resins & their types- cation exchange resins, anion exchange resins, ion exchange reactions, ion exchange equilibria, properties of ion exchange resins, ion exchange capacity, Techniques- Batch & Column method and applications.

**Unit - IV Chromatographic Techniques-3 & Hyphanated Techniques :**

**a) Size Exclusion chromatography :** Principle, Gel-materials, Technique, instrumentation and applications.

**05 Periods**

**b) Super Critical Fluid Chromatography:** Principle, instrumentation and applications

**05 Periods**

**c) Hyphanated Techniques:** GC-MS, LC-MS

**05 Periods**

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**B.Sc. III ( Third ) Year ;Semester -VI**  
**Analytical Chemistry (w.e.f.2017-18)**  
**Paper - XII**  
**Applied Analytical Chemistry**  
**Paper Code-U-ANC-662**

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**Periods : 45 Per Semester ,**  
**Marks : 50**

**3 Period/week**  
**Credits : 02**

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**Learning Objective:**

1. Understand pharmaceutical, Clinical & cosmetic Analysis.
2. Learn separation by solvent extraction & fuel analysis techniques.

**Course Outcome:**

Students became familiar with pharmaceutical, clinical, cosmetic and fuel analysis as well as with solvent extraction techniques.

**Unit - I Pharmaceutical Analysis :**

**11 Periods**

Definition, classification of drugs on the basis of their therapeutic action and structure. Definition and analysis of followings classes of drugs with one specific example of each : (i) Antiseptics and Disinfectants (ii) Analgesics (iii)Antipyretics (iv )Antibiotics

**Unit - II Clinical & Cosmetic Analysis :**

**12 Periods**

**2.1 Clinical Analysis:** Composition of Blood, Non cellular/ plasma and cellular components, Normal range of concentration of important constituents, collection and preservation of blood for plasma, serum, glucose and CO<sub>2</sub> analysis. Estimation of sodium, potassium, calcium, bicarbonate, blood glucose, and blood urea.

**2.2 Analysis of Cosmetics:** Introduction to cosmetics , definition, General characteristics, composition and analysis in outline of the following (i) Face Powders (ii) Hair dyes

**Unit - III Separation by Solvent Extraction :**

**10 Periods**

**Theoretical Principles** – Nernst distribution law, Distribution constant, Distribution ratio, Efficiency of extraction, Percentage extraction, Amount of solute extracted and left unextracted,

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Sequence of extraction process, Extraction equilibria, Factors favouring extraction, Techniques of extraction, Analytical applications.

**Unit - IV Analysis of Fuels :**

**12 Periods**

Definition and classification of fuels, solid fuels, liquid fuels and gaseous fuels. Calorific value of fuels, Gross and Net calorific value, Determination of calorific value by Bomb Calorimeter, Proximate analysis of coal- moisture, volatile matter, Ash, fixed carbon & their significance. Flash, fire and aniline points of liquid fuels, their determination and significance.

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**Rajarshi Shahu Mahavidyalaya, Latur**  
**Faculty of Science**  
**B.Sc. III ( Third ) Year**  
**Semester -VI (w.e.f.2017-18)**  
**Analytical Chemistry Laboratory Course – IX**  
**Paper Code-U-ANC-663**

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**Total Period : 45**

**3 Period/week**

**Marks : 50**

**Credits : 02**

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**Learning Objective:**

Develop instrumental skills and Chromatographic techniques handling skill

**Course Outcome:**

Students acquired skill of handling instruments and chromatographic techniques

**Note :** Out of 13 experiments, at least 08 experiments should be completed.

**A. Conductometry:**

1. Assay of aspirin by conductometry.
2. Determination of velocity constant of hydrolysis of ethyl acetate by base (NaOH) conductometrically.
3. Determination of strength of acetic acid in commercial sample of vinegar by conductometry.

**B. Potentiometry:**

4. Determination of iron in pharmaceutical preparation by potentiometry.
5. Determination of percentage purity of commercial washing soda by potentiometry.
6. Determination of pH of Hair shampoos.

**C. Autotitration:**

7. Determination of moisture content in the sample by Karl-Fischer method.

**D. Chromatography:**

8. Determination of Capacity of cation exchange resin.
  9. Determination of Capacity of anion exchange resin.
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10. Determination of magnesium and Zinc in a mixture/ Zinc in pharmaceutical preparations by ion exchange separation and complexometric titration.

11. Separation of cadmium and zinc on an anion exchanger and their subsequent determination by EDTA titration.

12. Separation of cobalt and nickel on an anion exchange resin and their subsequent determination by direct back EDTA titration.

13. Estimation of sodium by ion exchange method

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**Faculty of Science**  
**B.Sc. III ( Third ) Year; Semester -VI (w.e.f.2017-18)**  
**Analytical Chemistry Laboratory Course – X**  
**Paper Code U-ANC-664**

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**Total Period : 45**

**3 Period/week**

**Marks : 50**

**Credits : 02**

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**Learning Objective:**

Develop experimental skills in pharmaceutical clinical, cosmetic & fuel analysis.

**Course Outcome:**

Student acquired experimental skill for pharmaceutical, clinical, cosmetic and fuel analysis.

**Note :** Out of 14 experiments, at least 08 experiments should be completed.

**A. Pharmaceutical Analysis:**

1. Determination of milk of magnesia in given antacid sample.
2. Assay of aspirin (acetyl salicylic acid).
3. Assay of Isoniazide
4. Analysis of Sulpha drugs i.e. Sulphadiazine, Sulphadimethoxine, Sulphathiazole/ Sulphaxole, Sulphaacetamide sodium.

**B. Clinical analysis & Cosmetic Analysis:**

5. Estimation of blood glucose.
6. Estimation of serum bicarbonate.
7. Estimation of blood urea.
8. Determination of zinc in talcum powder sample.
9. Determination of magnesium in talcum powder sample.

**C. Solvent Extraction**

10. Ultraviolet spectrophotometric determination of Asprin, Phenacetin, and caffeine in APC tablets using solvent extraction.
  11. Determination of ether extractives and caffeine in tea/coffee samples.
  12. Spectrophotometric estimation of lead on leaves using solvent extraction.
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#### **D. Fuel Analysis:**

13. Determination of moisture in coal

14. Determination of Ash in coal.

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#### **Recommended Books for Theory Papers IX, X, XI & XII and Laboratory Courses – VII, VIII, IX & X (w.e.f.2017-18):**

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1. Fundamentals of Analytical Chemistry : 7<sup>th</sup> Edition – Douglas A Skoog, Donald M West and Holler, Harcourt College Pub
  2. Principles of instrumental analysis : D.A Skoog and D. M. West saunder's college publishers.
  3. Standard methods of chemical analysis : Part A & B – Editor : Welcher, Van Nostrand reinhold Co.
  4. Text Book of Microbiology : Freeman Burrows, WB saunders.
  5. Text Book of Biochemistry : West and Tood/ Lehninger.
  6. Practical physiological chemistry : Hawn, Oser and summerson, Tata- Mograw Hill book Co
  7. A Text book of quantitative Inorganic Analysis : A. I Vogel
  8. Quantitative Analysis : Cumming and Key
  9. Quantitative Chemical Analysis : Kolthoff, sandell and others 4<sup>th</sup> Edition
  10. Analytical chemistry : Gary D. Christain, 4<sup>th</sup> Edition, John Wiley and Sons, New York .
  11. Environmental analysis : G. R. Chatawal, MC Mehra, M. satake and others – Amol Publications, New Delhi
  12. Analytical Agricultural Chemistry : SL Chopra and J. S. Kanwar Kalyani Publishers, Ludhiana
  13. Chemistry of the Soil : Edited by Firman E. Bear 2nd Edition, Americal chem.. Soc. Monograph Series Oxford & IBH Publishers.
  14. A text Book of Experiments & Calculations in Engineering Chemistry S. S. Dara S. Chand and Co.
  15. Elements of Environmental Chemistry : H . V. Jadhav , Himalaya Publishing House, New Delhi.
  16. Methodology for water Analysis : IAAB Editional Board M. S. Kodarkar, AD Diwan and others, IAAB Publication, V.V. College, Hyderabad .
  17. Experiments in general Chemistry : C. N. R. Rao and U. C. Agrawala, 4<sup>th</sup> Edition Affiliated East – West Press
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18. Chemistry of air and air pollution : S.A. Iqubal and Y. Mido, Discovery Publishing house, New Delhi .
  19. A Text Book of Environmental Chemistry and Pollution Control : S. S. Dara
  20. Environmental Chemistry : A.K. De, Wiley Estern Pub.
  21. Pearsons Chemical Analysis of Foods : Harold Egan, Ronald S. Kirk and Ronald Sawyer, 8<sup>th</sup> Edition, Churchill Livingstone.
  22. Hand Book of Analysis & Quality Control for fruit and vegetable products : S. Ranganna, Tata Mc Graw Hill Pub. Co.
  23. Chemical analysis of food and food products : M.B. Jacob
  24. Food analysis – Lab Experiments : Melon and Pomerazu
  25. Introduction to Chromatography : V. K. Srivastava and K Krishna, S. Chand and Co.
  26. Polarographic methods in Analytical Chemistry : M.G. Arora, Anmol Publications, New Delhi
  27. Quantitative Pharmaceutical Chemistry : Jenkins and others
  28. Bentley and Drivers T. B. of Pharmaceutical Chemistry : Revised By L. M. Atherden, 8<sup>th</sup> Edition Oxford University Press, New Delhi
  29. Air Pollution : Henry C. Perkins
  30. Chemnical Analysis of Water : Dickinson
  31. Applied Inorganic Analysis : Hoffmann, Lundell & others.
  32. Commercial Method of Analysis : Foster D Snell and Frank M. Biffen
  33. Quantitative Analysis : Day & Underwood
  34. Instrumental methods Chemical analysis : Willard, Dean and Merit
  35. Instrumental methods of Analysis : Chatwal and Anand
  36. Spectrometric Identification of Organic Compounds : Silverstein, Bessler and others
  37. Spectroscopic Methods in Organic Chemistry : D. H. Williams and Ian Flaming
  38. Spectroscopy : William Kemp
  39. Biochemical Laboratory Technique : Chey kin
  40. ISI Standard methods of Water and Air analysis : Blackie , USA
  41. Experimens in modern Analytical Chemistry : D.Kealey, Chapman & Hall.
  42. Analytical Chemistry - H, Kaur, Pragati Prakashan, Meerut ( for Fuel & Soil Analysis )
  43. Analytical Chemistry - Dr. Alka K. Gupta , Pragati Prakashan, Meerut ( for Fuel & Soil Analysis )
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44. Analytical Chemistry - Gary D. Christian Wiley students Old & 6 th edition ( for automation )
45. Principles and practice of Analytical Chemistry – F. W. Fi Field & D. Kealey ( for automation)
46. Chromotography – D. R. Brown, Ivy publishers, New Delhi .
47. Chemical Analysis, 2<sup>nd</sup> Edition, 2007 Franc's Rouessac & Annick Rouessac John Wiley & Sons.  
( for chromatography )

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**Prepared By Chairman BoS in Analytical Chemistry (UG) :**

**Dr. S.D. Salunke**

Vice Principal and

Associate Professor in Analytical Chemistry

Rajarshi Shahu Mahavidyalaya, Latur.

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**From:**

**Dr. S.D. Salunke,**

**Associate Professor** in Analytical Chemistry and

Principal,

Rajarshi Shahu Mahavidyalaya ,Latur

e-mail : [salunke\\_shridhar@yahoo.co.in](mailto:salunke_shridhar@yahoo.co.in)

Date: 13.05.2017

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To,  
**The Principal,**  
Rajarshi Shahu Mahavidyalaya,  
**LATUR - 413 512**

**Sub :-** New syllabus of B.Sc III, Analytical chemistry (Semester V & VI ) to be implemented From the academic Year 2017-18 under autonomous status.

Dear Sir,

As per your requirement, I am submitting herewith the new syllabi of B.Sc. III Analytical Chemistry, two theory papers each of semester V & VI ( P - IX,X, XI & XII ) and four practical papers ( Laboratory Course - VII, VIII, IX & X) under autonomous status as an attachment to this e-mail.

Accept the same for implementation from the academic year 2017-18.

Thanking you.

Yours faithfully,

**(Dr. S. D. Salunke)**

**Note :- Total Papers = 1 + 16 = 17**

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