

North Maharashtra University, Jalgaon.

S. Y. B. Sc. Syllabus
(Semester III and IV, 60+40 Pattern)



Subject -Chemistry

From June 2016

North Maharashtra University, Jalgaon.

Class- S. Y. B. Sc. (Semester Pattern) (With effect from June 2016)

The nomenclature accepted is as follows. CH-YSC [Y for year, S for semester and C for course number]. The course structure and title of the courses for S. Y. B. Sc. (Chemistry) are as given below

Course Title	Semester	Lectures	Marks	
			Ext.	Int.
CH 231: Physical and Inorganic Chemistry	III	60	60	40
CH-232:-Organic and Analytical Chemistry	III	60	60	40
CH-233:-Chemistry Practical's	III	60	60	40
CH-241:-Physical and Inorganic Chemistry	IV	60	60	40
CH-242:-Organic and Analytical Chemistry	IV	60	60	40
CH-243:-Chemistry Practical's	IV	60	60	40

Note

1. Each course is having weight-age four lectures per week.
2. Each practical course is having weight age four lectures per week.
3. Examination of practical course shall be held at the end of the each semester.

IMPORTANT NOTE

***In volumetric analysis, volume of pipette solution should be 10 ml instead of 25 ml. Similarly preparation of 100 ml solution by using 100 ml volumetric flask instead of 250 ml. (To avoid wastage of chemicals)**

*** External Examination Pattern. Chemistry Practical CH-233**

**Marks 60
Time 3 hrs**

Instructions

1. Duration of examination 3hrs (Batch-I-10.00 am to 1.00 pm. and Batch-II 2 to 5pm)
2. All the students in a batch should be divided in three equal groups, which have been provided with Physical OR Analytical OR Volumetric OR Chromatography and Organic/ Inorganic preparation
3. Students should have complete Certified Journal at the time of practical examination.

1. Physical OR Volumetric OR Chromatography and Organic/ Inorganic preparation
50 Marks
 2. Oral
10 Marks
- Total 60 Marks

Internal Examination Pattern. Chemistry Practical CH-233

1. Physical OR Volumetric OR Chromatography and Organic/ Inorganic preparation
30 Marks
 2. Journal (Complete and Certified)
10 Marks
- Total 40 Marks

**External Examination Pattern.
Chemistry Practical CH-243**

**Marks 60
Time 3 hrs**

Instructions

1. Duration of examination 3 hrs (Batch-I-10.00 am to 1.00 pm. and Batch-II 2 to 5 pm)
2. All the students in a batch should be divided in three equal groups, which have been provided with Physical OR Organic qualitative OR Gravimetric analysis experiment.
3. Students should bring complete certified journal at the time of practical examination.

1. Physical OR Organic qualitative OR Gravimetric analysis	50 Marks
2. Oral	10 Marks
Total	60 Marks

**Internal Examination Pattern.
Chemistry Practical CH-243**

1. Physical OR Organic qualitative OR Gravimetric analysis	30 Marks
2. Journal (Complete and Certified)	10 Marks
Total	40 Marks

S. Y. B. Sc. New Syllabus 2016-17

The Course Structure and title of the courses for S. Y. B. Sc. (Chemistry) are as given below:

Course	Title	Semester	Periods	Marks	
				External	Internal
CH-231	Physical and Inorganic Chemistry	III	60	60	40
CH-232	Organic and Analytical Chemistry	III	60	60	40
CH-233	Chemistry Practical	III	60	60	40
CH-241	Physical and Inorganic Chemistry	IV	60	60	40
CH-242	Organic and Analytical Chemistry	IV	60	60	40
CH-243	Chemistry Practical	IV	60	60	40

Note:-

1. Each period is of 50 minutes duration.
2. Each course is having weightage four periods per week.
3. Each practical course is having weightage four periods per week per batch.
3. Each Practical batch should be consist of maximum of 12 students
4. Examination of practical course shall be held at the end of the each semester.

Subject Title: Physical and Inorganic Chemistry

S.Y.B. Sc.

CH-231

Semester-III

Part I - Physical Chemistry

1.Chemical Thermodynamics:

(M- 17/25, P-16)

Introduction, The Helmholtz free energy, ΔA for reactions, Gibb's free energy and, ΔG for reactions, Properties and significance of Gibb's free energy changes, Calculation of free energy changes, Fugacity and activity concepts, The reaction isotherm, Standard free energy change of formation, Criteria of equilibrium .

Physical equilibria involving pure substances, Clapeyron equation and its use, Vapour pressure of liquid and variation of vapour pressure with temperature, Clausius-Clapeyron equation, Different form of Clausius Clapeyron equation and its applications, Related numerical.

Ref.-1:- Pages 189-203, 206-213, 215-218

Ref.-2:- Relevant Pages.

Ref.-3:- Relevant Pages.

Ref.-4:- Relevant Pages.

2.Solutions:

(M-13/20, P-14)

Introduction, **Solubility**, Factors affecting solubility, , Types of solutions, Different way of expressing the concentration of solution , Ideal and non-ideal solutions, Raoult's law and its limitation, The vapour pressure of actual liquid pairs the vapour pressure of ideal solution. Classification of binary solution of completely miscible liquids (Type-I, Type-II and Type-III) on the basis of Raoult's law), Boiling point diagrams of miscible binary mixtures, Distillation of binary miscible solutions, Azeotropes, the fractionating column, Solubility of partially miscible liquid pairs, Phase diagram Phenol-water system, Tri ethyl amine-water and Nicotine-water system

Ref.-1:- Pages 261-264,270-286,288-291

Ref.-2:- Relevant Pages.

Ref.-3:- Relevant Pages.

Ref.-4:- Relevant Pages.

S.Y.B. Sc.

CH-241

Semester-IV

Part I - Physical Chemistry

1.Colligative Properties:

(M- 17/25, P-16)

Introduction, Lowering of vapor pressure of solvent, Calculation of molecular weight of solute from Lowering of vapor pressure of solvent. Boiling point elevation of solution, Calculation of molecular weight of solute from boiling point elevation of solution, Freezing point depression of solution, Calculation of molecular weight of solute from depression in Freezing point, Osmosis and osmotic pressure, Relation of osmotic pressure to vapour pressure, Van't -Hoff equation for osmotic pressure, Landberger's method for the determination of elevation of boiling point, Beckman's method for determination of depression in freezing point ,Berkley and Hearty's method, Solution of electrolyte, Colligative properties of electrolyte (Qualitative concept only), related numerical.

Ref.-1:- Pages 312-324, 325-330

Ref.-2:- Relevant Pages.

Ref.-3:- Relevant Pages.

Ref.-4:- Relevant Pages.

2.Electrochemistry

(M- 13/20, P-14)

Introduction, Electromotive force and its measurements , Standard cell ,Cell reaction and EMF, convention regarding sign of EMF, Single electrode potential, Standard hydrogen and calomel reference electrodes, Calculation of single electrode potential, Calculation of cell EMF from single electrode potential, Thermodynamics and EMF, ΔG , ΔH , ΔS from EMF data, Thermodynamics of electrode potential (Nernst equation), Standard potential and equilibrium constant, Classification of electrodes, Related numericals.

Ref.-1:- Pages 481-497

Ref.-2:- Relevant Pages.

Ref.-3:- Relevant Pages.

Reference books :-

1. Principles of Physical Chemistry

S. H. Maron and C. F. Prutton (4th edition)

2. Essentials of Physical Chemistry

B. S. Bahl, G. D. Tuli, Arun Bahl (S. Chand and Co Ltd.) (25th edition)

3. Elements of Physical Chemistry

S. Glasstone and D. Lewis (The Macmillan Press Ltd.) (2nd edition)

4. Physical Chemistry

Robert A. Alberty (John Willey and Sons) (7th edition)

Part-II Inorganic Chemistry**1. Chemistry of Transition Elements.****(M-16, P-16)**

(A) Elements of first, second & third transition series.

(B) General characteristics of d-block elements.

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|---------------------------------|--------------------------------|
| a. Metallic character. | b. Molar volume & densities. |
| c. Atomic radii | d. Ionic Radii |
| e. Melting & boiling points | f. Ionization Energies |
| g. Reactivity | h. Oxidation states |
| i. Standard electrode potential | j. Reducing properties |
| k. Color | l. Magnetic properties |
| m. Catalytic Properties | n. Tendency to form complexes. |

Ref. 1-653-671**Ref. 4 -615 -624****Ref. 5-1128-1143****2. The Metallic Bond****(M-06, P-6)**

a. General Properties of Metals.

b. Conductivity, Luster, Malleability & cohesive force.

c. Conductors, Insulators & Semiconductors, Intrinsic & Extrinsic semiconductors.

Ref. 1 -121 - 144**Ref. 2-220-231****Ref. 4-175-179****Ref.5-259-264****3. The Metallurgy of Aluminium (Electrometallurgy)****(M-08, P- 8)**

Occurance, Indian resources, Physicochemical principles, Extraction of Aluminium, Purification of Bauxite, Serpeck's Process, Bayer process, Electrolysis & Alumina, Refining of Aluminium, Hoop's process, Properties & uses of Aluminium, Aluminium Industry in India.

Ref. 6 relevant pages**Ref. 7 relevant pages**

Part-II Inorganic Chemistry**1) Chemistry of Lanthanoids Elements.****(M 12, P-11)**

- a. Electronic Structure.
- b. Oxidation States .
- c. Extraction from monazite sand with flow sheet .
- d. Uses .
- e. Lanthanoid contraction – Definition, Causes, effects of lanthanoid contraction on chemistry of lanthanoids & post lanthanoid elements.
- f. Separation of lanthanoids from one another by solvent extraction & ion exchange chromatography.

2) Chemistry of Actinoids Elements.**(M 6, P-6)**

- a. Electronic structure
- b. Position in periodic table
- c. Oxidation states
- d. Occurrence of actinoids
- e. Preparation of actinoids using
 - i) Neutron bombardment
 - ii) Accelerated projectile bombardment
 - iii) Heavy ion bombardment.

Ref. 1 - pages 859-885**Ref. 4 - 704 - 717****3) Molecular Orbital Theory (MOT)****(M 12, P-13)**

- a. Molecular orbital method.
- b. LCAO method.
- c. s-s, s-p, p-p, p-d & d-d combination of orbitals.
- d. Non Bonding combination of orbitals.
- e. Rules for linear combination of orbitals.
- f. Molecular orbital treatment for Homo nuclear Diatomic species- $H_2, He_2, He_2^+, Li_2, Be_2, B_2, N_2$ & F_2
- g. Molecular orbital treatment for Hetero nuclear diatomic molecules $CO, NO,$ & HCl .

Reference Books :

1. Concise Inorganic Chemistry by J.D.Lee.5th Edition.
2. Theoretical Principles of Inorganic chemistry by G.S.Manku Tata McGraw Hill edition.
3. Advanced Inorganic Chemistry Volume-I by Satya Prakash, G.D. Tuli S.K. Basu. R. D. Madan S. Chand & Company Ltd.(2004)
4. Principles of Inorganic Chemistry By Sharma, Puri Kalia 30th edition Milestone Delhi.
5. Advanced Inorganic Chemistry Volume - I , by Gurdeep Raj 23rd edition , Goel Publishing House, Meerut.
6. A Textbook of Inorganic Chemistry by P.L.Soni (20th edition) (S. Chand & Sons , new Delhi.)
7. Advanced Inorganic Chemistry by Tuli, Basu, Madan & Satya Prakash -16 Revised Edition 1992 New Delhi.

Semester III**Subject Code CH-232****Subject Title: Organic and Analytical Chemistry**

Semester III**Subject Code CH-232****Part-I Organic Chemistry****Chapter 1: Stereoisomerism****(M-12/18, P-12)**

- a) **Types of stereoisomerism.**
- b) **Projection formulas** – Fischer projection formula, Newman projection formula, Saw horse formula.
- c) **Optical isomerism** – optical activity, enantiomerism, chiral centre and chirality, Elements of symmetry, dextrorotatory, laevorotatory, Configuration - R and S nomenclature system.
- d) **Geometrical isomerism**- Geometrical isomers, condition for geometrical isomerism, nomenclature system - Cis and Trans, E and Z, Syn and Anti (for oximes)
- e) **Conformational isomerism**- conformational isomers, conformational isomerism in ethane and n- butane with energy profile diagrams.

Ref 3, 4, 8 (Relevant pages)**Chapter 2: Amines****(M-10/15, P-10)**

- a) **Aliphatic Amines** - Introduction , Classification, preparation of amines from alkyl halides by reduction of nitroalkanes and cyanides, Gabriel- Phtalamide synthesis, by alkylation of primary and secondary amines, reduction of isocyanides.Physical properties of amines, basicity of amines, **Reactions** –formation of salts, Reaction with HNO₂, acylation, carbylamines reaction, reaction with aldehydes and ketones.

b) Aromatic amines-Preparation of aniline-from chlorobenzene and nitrobenzene. Basicity of Aromatic amines.

Reactions-Benzoylation, N-Alkylation, Preparation of Benzene Diazonium chloride, Reactions of Benzene Diazonium chloride- Formation of Iodobenzene, Sandmaeyer reaction, Azo coupling reaction (formation of methyl orange).

Ref. 1 (Pages 908-942)

Ref. 6 (Pages 548-560, 730-739)

Chapter 3: Organometallic compounds

(M-08/12, P-08)

a) Nomenclature, carbon-metal bond in organometallic compounds.

b) Preparation of organolithium compounds, Preparation of alcohols from organolithium compounds,

c) Preparation of organocopper compounds (Lithium dialkyl cuprate) and synthesis of alkanes, Reformatsky reaction.

d) Preparation of organozinc compounds, Synthesis of Cyclopropanes using $RZnX$ (The Simmons-Smith reaction)

Ref. 1 (Pages 578-595)

Semester IV

Subject Code CH-242

Part-I Organic Chemistry

Chapter 1: Chemistry of Heterocyclic Compounds.

(M-10/15, P-10)

Definition , Classification of heterocyclic compounds, Nomenclature and aromatic character,

a) Five membered rings with one hetero atom:

Furan, pyrrole and thiophene- Synthesis and Reactions - Nitration, Sulphonation, F C Acylation, Reimer Tiemann reaction, Catalytic hydrogenation.

b) Six membered ring with one hetero atom:

Pyridine- Synthesis- from Acrolein, from Acetylene.

Reactions- Nitration, Sulphonation, Bromination, Catalytic hydrogenation.

c) Condensed heterocycles-

Quinoline- Properties, Skraup's Synthesis.

Isoquinoline - Properties, Bischler-Bapieralski Synthesis.

Ref. 2 (Pages 1093-1104)

Ref. 6 (Pages 849-871)

Chapter 2: Synthetic Reagents

(M-08/12, P-08)

- a) **Acetoacetic ester**-Preparation of acetoacetic ester
Synthesis of alkyl acetic acid, dialkyl acetic acid, succinic acid, adipic acid, α - β unsaturated acid, methyl ketone (butanone) from Acetoacetic ester.
- b) **Malonic ester** - Preparation of malonic ester
Synthesis of alkyl acetic acid, dialkyl acetic acid, succinic acid, glutaric acid, β keto acid (acetoacetic acid), α - β unsaturated acid from Malonic ester.

Ref. 1,2 (Relevant pages)

Chapter 3 : Elimination reactions

(M-12/18, P-12)

Types of Elimination

- a) 1,2-(β)-Elimination, Mechanism of 1,2-(β)-Elimination,
b) E1 and E2 mechanism, Features of E1 and E2 mechanism,
c) Stereochemistry of E2 reactions (Newman Projection formula is expected)
d) Orientation in E2, Saytzev and Hofmann Orientation.
e) Elimination in cyclic system, Bredt's Rule.

Ref.2- (Pages 326-343).

Ref.7 – (Pages 240-255).

Ref. 5,8 (Relevant pages)

Reference Books:

- 1) Organic chemistry - Francis A Carey (3rd Edition)
- 2) Organic chemistry - Morrison and Boyd (6th Edition)
- 3) Stereochemistry of organic compounds- E L Eliel
- 4) Stereochemistry of organic compounds- P S Kalsi
- 5) Organic chemistry - Stanley H pine (5th Edition)
- 6) A Text book of Organic chemistry- Arun Bahl and B S Bahl, S Chand publication.
- 7) A guide book to reaction mechanism in organic chemistry by Peter Sykes.5th Ed.
- 8) Organic reaction mechanism by P. N. Mukherjee, Domanant Publishers and Distributors, New Delhi

Part-II Analytical Chemistry

Chapter 1: Introduction to Analytical Chemistry

(M-08/12, P-08)

- a) Analytical Chemistry, importance of Analytical Chemistry, types of analysis- qualitative and quantitative analysis.
- b) Sampling – Definition, procedure of sampling, types of sampling.
- c) Accuracy, precision, significant figures, significance of zero, rounding off.
- d) Errors – Definition, types of errors, minimisation of errors.

Ref.1- 1,2,4,14,15,16,20,21,22

Ref.2,3,4,5 Relevant pages

Chapter 2 : Volumetric (Titrimetric) Analysis

(M-22/33, P-22)

a) Classification of volumetric methods of analysis

b) Acid base titrations

Principle, Acid–base indicators, Henderson-Hasselbalch equation, transition range of indicators. study of acid base titrations with respect to- neutralisation curve, selection of indicators and calculations of pH

i) Strong acid versus strong base

ii) Weak acid versus strong base

Applications of acid base titrations (in short)

c) Precipitation titrations

Principle, detection of end point in precipitation titrations, preparation of AgNO_3 solution, standardisation of AgNO_3 solution- by Mohr's method, Estimation of halides- by Fajan's method, precipitation titration curve.

Applications of precipitation titrations (in short).

d) Redox titrations

Oxidation, reduction, redox reaction, oxidising agents, reducing agents, redox titrations, titration of Ce (IV) and Fe (II) - nature of titration curve, calculation of emf, detection of end point- redox indicators, self indicator and starch indicator, iodimetry and Iodometry.

Applications of redox titrations (in short)

e) Complexometric titrations

Complexes, ligands, types of ligands, chelates, chelating agents, formation of complex, formation constant, chelation effect, chelating agent EDTA, EDTA equilibria, EDTA titration curve, detection of end point- indicators, principle involved in colour change of indicator

Applications of complexometric reactions and titrations (in short)

Ref.1- 83, 220-225, 227-230, 690-696, 277-281, 702-704, 284-287, 354-365, 708-718, 250-263, 696-701

Ref.2, 3, 4, 5 Relevant pages

Semester IV

Subject Code CH-242

Part-II Analytical Chemistry

Chapter 1: Gravimetric analysis

(M-15/22, P-15)

Introduction, advantages of gravimetric analysis, solubility product (with problems), conditions for precipitations, steps of gravimetric analysis: preparation of solution, precipitation, digestion. Impurities in the precipitate- a) co-precipitation b) post precipitation. filtration, washing, drying or ignition, weighing, precipitation from homogeneous solution

Applications- estimation of Ba as BaSO₄, Ni as Ni-DMG, Pb as PbCrO₄.

Ref.1- 145-153, 161-165

Ref.2,3,4,5 Relevent pages

Chapter 2: Chromatography

(M-15/23, P-15)

- Introduction, advantages and disadvantages of chromatography.
- Principle of chromatography, classification of chromatographic methods- partition, adsorption ion exchange chromatography and size exclusion chromatography.
- Paper chromatography- principle, technique, R_f value, ascending and descending techniques, applications.
- Thin layer chromatography- principle, technique and applications.
- Column chromatography- principle, technique and applications.

Ref.1- 505-510, 550-554

Ref.2,3,4,5,6 Relevent pages

Reference Books

- Analytical chemistry – G D Christian (5th Edition).
- Quantitative chemical analysis- J Mendham, R C Denny, Barnes, Thomas
- Analytical chemistry- D A Skoog, D M West, F J Holler
- Vogel's text book of quantitative chemical analysis- Bassett, Denney, Jeffreys
- Quantitative analytical chemistry- James S Fritz, George H Schenk- fifth
- Chemical Analysis by A.K. Shrivastava, P.C. Jain, S. Chand and company.

NORTH MAHARASHTRA UNIVERSITY, JALGAON

SYLLABUS FOR S. Y. B. Sc. Subject Title: Chemistry Practical (CH-233) Sem -III

A) PHYSICAL CHEMISTRY EXPERIMENTS (any 2)

1. Determination of critical solution temperature of phenol-water system.
2. Determination of normality and strength of HCl titrating with standard NaOH potentiometrically.
3. Construct Daniel cell and determine thermodynamic parameters ΔG , ΔH , ΔS of the cell
4. Determine molecular weight of liquid by steam distillation technique

B) VOLUMETRIC ANALYSIS (any 4)

1. Estimation of acetic acid in commercial vinegar using NaOH.
2. Estimation of aspirin in drug sample.
3. Estimation of chloride by Mohr's method.
4. Estimation of Fe(II) by redox titration with KMnO_4 .
5. Estimation of copper iodometrically.
6. Estimation of Mg^{+2} by complexometric titration with EDTA.

C) CHROMATOGRAPHY (any 1)

1. Separation of mixture of o-nitroaniline and p-nitroaniline by Thin Layer Chromatography and to determine their R_f values.
2. Separation of mixture of any two amino acids by paper chromatography.

D) ORGANIC PREPARATIONS: (any 2)

1. Acetanilide to P-bromoacetanilide using Ceric Ammonium Nitrate.
2. Benzaldehyde to dibenzalpropanone using NaOH.
3. Semicarbazone derivative of Aldehyde / Ketones.
4. Benzoyl derivative of $-\text{OH}$ / $-\text{NH}_2$.

E) INORGANIC PREPARATIONS (any 1)

1. Tetramine Cu (II) sulphate.
2. Hexamine Ni (II) chloride.
3. Ferrous ammonium sulphate (Mohr's salt).

NORTH MAHARASHTRA UNIVERSITY, JALGAON

SYLLABUS FOR S. Y. B. Sc.

Subject Title: Chemistry Practical (CH-243) Sem- IV

A) PHYSICAL CHEMISTRY EXPERIMENTS (any 2)

1. Determination of molecular weight of solute (acetanilide/ m -dinitrobenzene /sulphur) by depression of freezing point method.
2. Determination of molecular weight of non-volatile solute (KCl/ BaCl₂/ Urea) by using Landsbergers apparatus.
3. Determination of standard electrode potential of Cu/Cu⁺² or Ag/Ag⁺, Zn/Zn⁺² electrodes potentiometrically.

B) ORGANIC QUALITATIVE ANALYSIS (any 6 compounds)

Determination of

1. Type
2. Preliminary tests
3. Physical constant (melting/ boiling point)
4. Elements (Sodium fusion test)
5. Functional groups
6. Structure

C) GRAVIMETRIC ANALYSIS (any 2)

1. Estimation of Ni as Ni-DMG (by Counterpoise method)
2. Estimation of Ba as BaSO₄ (by Ignition using filter paper)
3. Estimation of Pb as PbCrO₄ (by Gooch crucible or by counterpoise method)

Suggested books for Chemistry Syllabus :

1. Principles of Physical Chemistry, Fourth edition, P.W.Marron and C.F. Prutton
2. Essentials of Physical Chemistry, Colour edition, B.S.Bahl, Arun Bahl and G.D.Tuli, S.Chand & Company (Reprint 2008)
3. Physical Chemistry, R.A.Alberty, Wiley Estern Ltd.
4. Elements of Physical Chemistry, P.W.Atkins, Oxford
5. Physical Chemistry, Ira N. Levin, McGraw Hill, Inc.
6. Physical Chemistry , W. J. Moore
7. Chemical Kinetics , K. J. Laidler, McGraw Hill
8. Concise Inorganic Chemistry by J.D.Lee ,5th Edition
9. Principles of Inorganic Chemistry by B.R.Puri,L.R.Sharma,Vishal Publication Jallandher,Delhi.
10. Text book of Inorganic Chemistry by P.L.Soni.
11. Principles of Inorganic Chemistry,B.R.Puri,L.M.Sharma & K.C.Kalia-Vallabh Prakashan ,DEIHIJ]
12. Basic Inorganic Chemistry, F.A.Cotton, G.Willkinson and P.L.Gaus, Wiley.
13. Advanced Inorganic Chemistry Satya Prakash, Tuli, Basu.
14. Concepts of Models of Inorganic Chemistry, B.Douglus, D.Mcdaniel and J.Alexander, John Wiley.
15. A Text Book of Organic Chemistry, Arun Bahl and B.S.Bahl, S.Chand & Company (7th Edition)
16. Reaction mechanism, Peter Sykes, Orient Longman.
17. Organic Chemistry, S.H. Pine
18. Industrial Chemistry , Shreve.
19. Organic Chemistry, Vol. I & II, Finar ELBS
20. Stereochemistry of Carbon compounds, Eliel McGraw Hill
21. Organic Chemistry, Francis A.Carey, Tata McGraw Hills
22. College Organic Chemistry, 15th Edition Rao & Others, Himalaya Pub. House, MUMBAI.
23. Organic Chemistry, Morrison and Boyd, Pearson Education (6th Edn.)

24. Outline of Biochemistry, E.E.Conn and P.K.Stumpf, John Wiley
25. Green Chemistry – Theory and Practice, D.T. Anastas, J. C. Warner Oxford.
26. An Introduction to Green Chemistry, V.K.Ahluwalia , Vishal Publishing Company, Jalhandhar.
27. An Introduction to Green Chemistry, V. Kumar, Vishal Publishing Company, Jalhandhar.
28. Green Chemistry – Environment, Friendly Alternatives, Rashmi Sanghi and M.M. Shrivastav , Narosa Publishing House, Mumbai .
29. Analytical Chemistry by G.D.Christain(5th Edition)
30. Fundamentals of Analytical Chemistry, 6th Edn D.A.Skoog and D.M. West.
31. Instrumental methods of chemical analysis by Chatwal and Anand (5th edition)

S Y B Sc CHEMISTRY EQUIVALANCE

Syllabus to be Implemented from 2016-2017

Name of Subject (old)	Subject Code OLD[80:20]	Name of Equivalent Subject (New)	Subject Code NEW [60:40]
Semester III			
Physical and Inorganic Chemistry	CH 231	Physical and Inorganic Chemistry	CH 231
Organic and Analytical Chemistry	CH-232	Organic and Analytical Chemistry	CH-232
Semester IV			
Physical and Inorganic Chemistry	CH-241	Physical and Inorganic Chemistry	CH-241
Organic and Analytical Chemistry	CH-242	Organic and Analytical Chemistry	CH-242
Chemistry Practical (Annual)	CH-203	Chemistry Practical	CH-233* OR CH-243**

* If Practical Examination held in October Equivalent subject is CH-233

** If Practical Examination held in March Equivalent subject is CH-243