

**SRI VENKATESWARA UNIVERSITY**  
**B.Sc. DEGREE COURSE IN CHEMISTRY**  
**SEMESTER SYSTEM WITH CBCS**

**SEMESTER V**

**W.E.F. 2022-2023**

Skill Enhancement Courses (SECs) for V Semester,  
from 2022-23 (Syllabus-Curriculum)

**Structure of SECs for Semester – V**

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

*(Syllabus with Learning*

*Outcomes, References, Co-curricular Activities & Model Q.P.  
Pattern)*

Univ. Code	Course NO. 6&7	Name of Course	Th.Hrs / Week	IE Mar-ks	EE Mar-ks	Credits	Prac. Hrs./ Wk	Mar-ks	Credits
	6B	Analytical Methods in Chemistry-1	3	25	75	3	3	50	2
	7B	Analytical Methods in Chemistry-1	3	25	75	3	3	50	2

O  
R

	6E	Analytical Methods in Chemistry	3	25	75	3	3	50	2
	7E	Cosmetics and Pharmaceutical Chemistry	3	25	75	3	3	50	2

**Note-1:** For Semester-V, for the domain subject Biochemistry, any one of the two pairs of SECs shall be chosen as courses 6 and 7, i.e., 6B, 7B & 6E, 7E. 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 field 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 field skills embedded in the syllabus citing related real field situations

**SRI VENKATESWARA UNIVERSITY**  
**B.Sc. DEGREE COURSE IN CHEMISTRY**  
**SEMESTER SYSTEM WITH CBCS**  
**SEMESTER V**

**W.E.F. 2022-2023**

**Skill Enhancement Courses (SECs) for V Semester**

**Max. Marks: 100**

**COURSE6-B: ANALYTICAL METHODS IN CHEMISTRY-1**

(Skill Enhancement Course (Elective), Credits: 04)

**I. Learning Outcomes:**

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

1. Identify the importance of solvent extraction and ion exchange method.
2. Acquire knowledge on the basic principles of volumetric analysis and gravimetric analysis.
3. Demonstrate the usage of common laboratory apparatus used in quantitative analysis.
4. Understand the theories of different types of titrations.
5. Gain knowledge on different types of errors and their minimization methods.

**II. Syllabus:**

*( Hours: Teaching: 50, Lab:30, Field Training: 05, Others incl. Unit tests: 05)*

*(Syllabi of theory and practical together shall be completed in 80 hours)*

**Unit-1: Quantitative analysis-1**

**8 hours**

1. A brief introduction to analytical methods in chemistry
2. Principles of volumetric analysis, concentration terms- Molarity, Molality, Normality, v/v, w/v, ppm and ppb, preparing solutions- Standard solution, primary standards and secondary standards.
2. Description and use of common laboratory apparatus- volumetric flask, burette, pipette, beakers, measuring cylinders.

**Unit-2: Quantitative analysis-2**

**12hours**

1. Principles of volumetric analysis: Theories of acid-base (including study of acid-base titration curves), redox, complexometric, iodometric and precipitation titrations - choice of indicators for these titrations.
2. Principles of gravimetric analysis: precipitation, coagulation, peptization, coprecipitation, post precipitation, digestion, filtration, and washing of precipitate, drying and ignition.

**Unit-3: Treatment of analytical data****8hours**

Types of errors- Relative and absolute, significant figures and its importance, accuracy - methods of expressing accuracy, errors- Determinate and indeterminate and minimization of errors, precision-methods of expressing precision, standard deviation and confidence interval.

**Unit-4: separation techniques****12 hours**

1. Solvent Extraction: Introduction, principle, techniques, factors affecting solvent extraction, Batch extraction, continuous extraction and counter current extraction. Synergism. Application-Determination of Iron (III).
2. Ion Exchange method: Introduction, action of ion exchange resins, applications.

**UNIT-5: Analysis of water****10hours**

Determination of dissolved solids, total hardness of water, turbidity, alkalinity, Dissolved oxygen, COD, determination of chloride using Mohr's method.

**III. References**

1. Fundamentals of Analytical Chemistry by F.James Holler, Stanley R Crouch, Donald M.Westand Douglas A.Skoog, Ninth edition, Cengage.
2. Analytical Chemistry by Gary D.Christian, Purnendu K.Dasgupta and KevinA.Schug,Seventh edition, Wiley.
3. Quantitative analysis by R.A.DayJr. And A.L.Underwood, Sixth edition, Pearson.
4. Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.
5. Text book of Environmental Chemistry and Pollution Control by S.S.Dara and D.D.Mishra, Revised edition, S Chand & CoLtd.

## **Course6-B: Analytical methods in chemistry-1-PRACTICALSYLLABUS**

### **IV. Learning Outcomes:**

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

1. Estimate Iron(II) using standard Potassium dichromate solution
2. Learn the procedure for the estimation of total hardness of water
3. Demonstrate the determination of chloride using Mohr's method
4. Acquire skills in the operation and calibration of pH meter
5. Perform the strong acid vs strong base titration using pH meter

### **V. Practical (Laboratory) Syllabus:(30hrs)**

(Max.50 Marks)

1. Estimation of Iron(II) using standard Potassium dichromate solution (using DPA indicator)
2. Estimation of total hardness of water using EDTA
3. Determination of chloride ion by Mohr's method
4. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
5. Preparation of buffer solutions of different pH (i) Sodium acetate-acetic acid, (ii) Ammonium chloride-ammonium hydroxide.
6. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.
7. Determination of dissociation constant of a weak acid.

### **VI. Lab References:**

1. Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.

### **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 calibration of pH meter, Strong acid vs strong base titration using pH meter, determination of chlorideion, estimation of water quality parameters and estimation of Iron(II).
- 2. For Student:** Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe various methods used for the analysis of water. Write their observations and submit a hand written 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).

**b) Suggested Co-Curricular Activities**

1. Training of students' by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics).
3. Visits to facilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

**SRI VENKATESWARA UNIVERSITY**  
**B.Sc. DEGREE COURSE IN CHEMISTRY**

**V SEMESTER - W.E.F. 2022-23**

**COURSE6-B: ANALYTICAL METHODS IN CHEMISTRY-1**

**MODEL QUESTION PAPER**

Time: 3 hours

Marks: 75 marks

**Note:** This question paper contains two parts A and B.

Part A is compulsory which carries 25 marks. Answer any five of the following questions in Part A.

Part B consists of 5 Units. Answer one full question (A or B) from each unit (i.e., Q.No 9 from Unit – I, Q.No 10 from Unit – II, Q.No 11 from Unit – III, Q.No 12 from Unit – IV, Q.No 13 from Unit – V). Each question carries 10 marks.

**PART – A**

Answer any *Five* of the following question.

**(5X5=25M)**

<b>1.</b>	
<b>2.</b>	
<b>3.</b>	
<b>4.</b>	
<b>5.</b>	
<b>6.</b>	
<b>7.</b>	
<b>8.</b>	

**(P.T.O)**

**PART - B**

**Answer All The Questions. Each question carries 10 marks (5X10= 50M)**

9.	(A)  OR  (B)
10.	(A)  OR  (B)
11.	(A)  OR  (B)
12.	(A)  OR  (B)
13.	(A)  OR  (B)

**SRI VENKATESWARA UNIVERSITY**  
**B.Sc. DEGREE COURSE IN CHEMISTRY**  
**SEMESTER SYSTEM WITH CBCS**

**SEMESTER V**

**W.E.F. 2022-2023**

**Skill Enhancement Courses (SECs) for V Semester**

**Max. Marks: 100**

**COURSE7-B: ANALYTICAL METHODS IN CHEMISTRY-2**

(Skill Enhancement Course (Elective), Credits: 04)

**I. Learning Outcomes:**

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

1. Identify the importance of chromatography in the separation and identification of compounds in a mixture
2. Acquire a critical knowledge on various chromatographic techniques.
3. Demonstrate skills related to analysis of water using different techniques.
4. Understand the principles of spectrochemistry in the determination of metal ions.
5. Comprehend the applications of atomic spectroscopy.

**II. Syllabus :** (Hours: Teaching 50, Lab:30, Field Training:05, Others incl. Unit tests:05)  
(Syllabi of theory and practical together shall be completed in 80 hours)

**Unit-1: Chromatography-Introduction and classification** **10 hours**

Principle, Classification of chromatographic methods, Nature of adsorbents, eluents,  $R_f$  values, factors affecting  $R_f$  values.

**UNIT-2: TLC and paper chromatography** **12 hours**

1. Thin layer chromatography: Principle, Experimental procedure, preparation of plates, adsorbents and solvents, development of chromatogram, detection of spots, applications and advantages.
2. Paper Chromatography: Principle, Experimental procedure, choice of paper and solvents, various modes of development- ascending, descending, radial and two dimensional, applications.

**UNIT-3: Column chromatography** **12 hours**

1. Column chromatography: Principle, classification, Experimental procedure, stationary and mobile phases, development of the Chromatogram, applications.
2. HPLC: Basic principles, instrumentation –block diagram and applications.

**UNIT-4: Spectrophotometry****8hours**

Principle, Instrumentation: Single beam and double beam spectrometer, Beer-Lambert's law- Derivation and deviations from Beer-Lambert's law, applications of Beer-Lambert's law-Quantitative determination of  $\text{Fe}^{+2}$ ,  $\text{Mn}^{+2}$  and  $\text{Pb}^{+2}$ .

**UNIT-5: Atomic spectroscopy****8hours**

Types, atomizer, atomic absorption and emission and applications.

**III. References**

1. Fundamental so Analytical Chemistry by F.James Holler, Stanley R Crouch, Donald M.Westand Douglas A.Skoog, Ninth edition, Cengage.
2. Analytical Chemistry by Gary D.Christian, Purnendu K.Dasgupta and Kevin A.Schug, Seventh edition, Wiley.
3. Quantitative analysis by R.A.Day Jr. and A.L.Underwood, Sixth edition, Pearson.
4. Text book of Vogel's Quantitative Chemical Analysis, Sixth edition/ Pearson.

## **COURSE 7-B: ANALYTICAL METHODS IN CHEMISTRY-2- PRACTICAL SYLLABUS**

### **V. Learning Outcomes:**

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

1. Perform the separation of a given dye mixture using TLC
2. Learn the preparation of TLC plates
3. Demonstrate the separation of mixture of amino acids using paper chromatography
4. Acquire skills in using column chromatography for the separation of dye mixture

### **VI. Practical (Laboratory) Syllabus: (30hrs)**

(Max.50Marks)

1. Separation of a given dye mixture (methyl orange and methylene blue) using TLC (using alumina as adsorbent).
2. Separation of mixture of methyl orange and methylene blue by column chromatography.
3. Separation of given mixture of amino acids (glycine and phenyl alanine) using ascending paper chromatography.
4. Separation of food dyes using Column Chromatography
5. Separation of triglycerides using TLC
6. Verification of Beer Lambert's law. (Using potassium permanganate solution) using colorimeter /spectrophotometer.

### **VII. Lab References:**

1. Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.
1. Vogel A. I. Practical Organic Chemistry, Longman Group Ltd.
2. Bansal R.K. Laboratory Manual of Organic Chemistry, Wiley- Eastern.
3. Ahluwalia V. K. and Aggarwal R. Comprehensive Practical Organic Chemistry, University press.
4. Mann F.Gand Saunders B.C, Practical Organic Chemistry, Pearson Education.

### **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 determination of hardness of water, using the calorimeter and or Spectrophotometer, preparation of TLC plate, identification of spots in TLC and Paper chromatographic techniques, loading of column, selection of solvent system, separation of amino acids and dyes mixture using chromatographic techniques.

2. **For Student:** Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe the chromatographic techniques used for the separation of compounds. 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.*
5. Unit tests (IE).

**b) Suggested Co-Curricular Activities**

1. Training of students by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics).
3. Visits to facilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

**SRI VENKATESWARA UNIVERSITY**  
**B.Sc. DEGREE COURSE IN CHEMISTRY**

**V SEMESTER - W.E.F. 2022-23**

**COURSE7-B: ANALYTICAL METHODS IN CHEMISTRY-2**

**MODEL QUESTION PAPER**

Time: 3 hours

Marks: 75 marks

**Note:** This question paper contains two parts A and B.

Part A is compulsory which carries 25 marks. Answer any five of the following questions in Part A.

Part B consists of 5 Units. Answer one full question (A or B) from each unit (i.e., Q.No 9 from Unit – I, Q.No 10 from Unit – II, Q.No 11 from Unit – III, Q.No 12 from Unit – IV, Q.No 13 from Unit – V). Each question carries 10 marks.

**PART – A**

Answer any Five of the following question.

**(5X5=25M)**

1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	

**(P.T.O)**

**PART – B**

**Answer All The Questions. Each question carries 10 marks (5X10= 50M)**

9.	(A)  OR  (B)
10.	(A)  OR  (B)
11.	(A)  OR  (B)
12.	(A)  OR  (B)
13.	(A)  OR  (B)

**SRI VENKATESWARA UNIVERSITY**  
**B.Sc. DEGREE COURSE IN CHEMISTRY**  
**SEMESTER SYSTEM WITH CBCS**

**SEMESTER V**

**W.E.F. 2022-2023**

**Skill Enhancement Courses (SECs) for V Semester**

**Max. Marks: 100+50**

**COURSE6-E: ANALYTICAL METHODS IN CHEMISTRY**

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

**I. Learning Outcomes:**

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

1. Understand the various methods involved in Quantitative analysis.
2. Acquire a critical knowledge on separation techniques.
3. Demonstrate skills related to Chromatographic techniques through hands on experience.
4. Able to engage in safe and accurate laboratory practices by handling laboratory glassware, Equipment and chemical reagents appropriately.
5. Comprehend the applications of Chromatographic techniques in different fields.

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

**Unit-1: Quantitative analysis**

(10hrs)

Importance in various fields of science, steps involved in chemical analysis. Principles of volumetric analysis: Theories of acid-base, redox, complex metric, iodometric and precipitation titrations Detection of end point in redox titration, choice of indicators for the saturations. Principles of gravimetric analysis: precipitation, coagulation, peptization, co-precipitation, post-precipitation, digestion, filtration and washing of precipitate, drying and ignition.

**Unit-2: Treatment of analytical data:**

(10hrs)

Types of errors, significant figures and its importance, accuracy-methods of expressing accuracy, absolute and relative errors, error analysis and minimization of errors.

Precision - methods of expressing precision, standard deviation and confidence limit. The correlation coefficient.

**Unit-3: Separation techniques in Chemical analysis:**

(10hrs)

Solvent Extraction: Introduction, principle, techniques, factors affecting solvent extraction, Batch extraction, continuous extraction and counter current extraction. Synergism. Application-Determination of Iron (III).

Ion Exchange: Introduction, action of ionex change resins, separation of inorganic mixtures, applications.

#### **Unit– 4: Chromatography: Part - I (10hrs)**

Classification of chromatography methods, principles of differential migration adsorption phenomenon, Nature of adsorbents, solvent systems,  $R_f$  values, factors effecting  $R_f$  values.

Paper Chromatography: Principles,  $R_f$  values, experimental procedures, choice of paper and solvent systems, developments of chromatogram-ascending, descending and radial. Two dimensional chromatography, applications.

#### **Unit– 5: Chromatography: Part - II (10hrs)**

Thin layer Chromatography (TLC): Advantages. Principles, factors effecting  $R_f$  values. Experimental procedures. Adsorbents and solvents. Preparation of plates. Development of the chromatogram. Detection of the spots. Applications.

Column Chromatography: Principles, experimental procedures, Stationary and mobile Phases, Separation techniques, Applications. HPLC: Basic principles and applications.

### **III. Lab work-Skills Outcomes:**

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

1. List out, identify and handle various equipment in Analytical Chemistry lab.
2. Learn the procedures of preparation of primary and secondary standard solutions.
3. Demonstrate skills in the preparation of Paper, Thin layer and column Chromatography.
4. Acquire skills in observing the Chromatogram.
5. Perform some separation techniques of Organic compounds.

#### IV. PRACTICAL (LABORATORY) SYLLABUS :( 30HRS) (MAX.50MARKS).

1. Identification and handling of various laboratory equipment.
2. Determination of Zn(II)/ Mg(II) using EDTA
3. Determination of Fe (II) present in an Iron tablet using  $\text{KMnO}_4$  .Redox titration.
4. Determination of Saponification value of oil and Iodine value of oil.
5. Paper chromatographic separation of  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$ , and  $\text{Cr}^{3+}$ .
6. Separation and identification of the monosaccharaides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the  $R_f$  values.
7. Chromatographic separation of the active ingredients of plants, flowers and juices by TLC.
8. Separation by Column Chromatography – Mixture of Ortho and Para Nitro anilines.

#### V. List of Reference Books

1. Analytical Chemistry by Skoog and Miller
2. A text book of qualitative in organic analysis by A.I.Vogel
3. Nano chemistry by Geoffrey Ozin and Andre Arsenault
4. Stereo chemistry by D.Nasipuri
5. Organic Chemistry by Clayden
6. Analytical Chemistry by Gary D. Christian, 6<sup>th</sup> edition
7. Chemistry experiments for instrumental methods, Donald T Sawyer William
8. Instrumental methods of analysis, Willard, Merit, Dean, 6<sup>th</sup> edition.
9. Web related references suggested by teacher.

#### VI. Co-Curricular Activities:

**a) Mandatory:** (training of students by teacher on field related skills: 15 hrs.)

**1. For Teacher:** Training of students by the teacher in laboratory and field for not less than 15 hours on field related Quantitative techniques like Separation techniques, preparation by Column, preparation of TLC and determination of the purity of the sample.

**2. For Student:** Individual visit to any one of the Field agency, research laboratories in universities/research organizations/private sector culminating writing and submission of a hand- written fieldwork/project work Report not exceeding 10 pages in the given format.

**3.** Max marks for Fieldwork/project work Report: 05.

**4.** Suggested Format for Fieldwork/project work: *Title page, student details, index page, details of places visited, observations, findings and acknowledgements.*

**5.** Unit tests (IE).

#### b) Suggested Co-Curricular Activities:

1. Training of students by related industrial experts.
2. Visitor research organizations and laboratories.
3. Invited lectures and presentations on related topics by field / industrial experts.
4. Assignments.
5. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
6. Preparation of videos on tools, techniques and applications of chromatography.

**SRI VENKATESWARA UNIVERSITY**  
**B.Sc. DEGREE COURSE IN CHEMISTRY**

**V SEMESTER - W.E.F. 2022-23**

**COURSE6-E: ANALYTICAL METHODS IN CHEMISTRY**

**MODEL QUESTION PAPER**

Time: 3 hours

Marks: 75 marks

**Note:** This question paper contains two parts A and B.

Part A is compulsory which carries 25 marks. Answer any five of the following questions in Part A.

Part B consists of 5 Units. Answer one full question (A or B) from each unit (i.e., Q.No 9 from Unit – I, Q.No 10 from Unit – II, Q.No 11 from Unit – III, Q.No 12 from Unit – IV, Q.No 13 from Unit – V). Each question carries 10 marks.

**PART – A**

Answer any ***Five*** of the following question.

**(5X5=25M)**

1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	

**(P.T.O)**

**PART – B**

**Answer All The Questions. Each question carries 10 marks (5X10= 50M)**

9.	(A)  OR  (B)
10.	(A)  OR  (B)
11.	(A)  OR  (B)
12.	(A)  OR  (B)
13.	(A)  OR  (B)

**SRI VENKATESWARA UNIVERSITY**  
**B.Sc. DEGREE COURSE IN CHEMISTRY**  
**SEMESTER SYSTEM WITH CBCS**  
**SEMESTER V**

**W.E.F. 2022-2023**

**Skill Enhancement Courses (SECs) for V Semester**

**Max. Marks: 100**

**COURSE7- E: COSMETICS AND PHARMACEUTICAL CHEMISTRY**

(Skill Enhancement Course (Elective), Credits- 04)

**I. Learning Outcomes:**

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

1. Explain the principles of formulation and application of Cosmetics & perfumes.
2. Acquire a critical knowledge on synthetic techniques of drugs.
3. Demonstrate the skills in various aspects of the fermentation technology and apply for production.
4. Comprehend the applications of fermentation.

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

**Unit- I Chemistry of Cosmetics** (8hrs)

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours.

**Unit- II Chemistry of Perfumes** (8hrs)

Essential oils and their importance in cosmetic industries with reference to Eugenol, Geranial, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmine, Civet one, Mascon.

**Unit-III Drugs & Pharmaceuticals – I** (10hrs)

Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, ibuprofen)

**Unit-IV Drugs & Pharmaceuticals - II** (12hrs)

Synthesis of the representative drugs of the following classes: Antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glycerol triturate), antilaprosy (Daps one), HIV-AIDS related drugs (AZT-Zidovudine).

## **Unit – V Fermentation (12hrs)**

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B<sub>2</sub>, Vitamin B<sub>12</sub> and Vitamin C.

### **III. Lab work-Skills Outcomes:**

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

1. The ability to develop comprehensive product development programs to meet new product criteria and timing.
2. Acquire skills in the preparation of Cosmeceuticals.
3. Demonstrate proficiency in the experimental techniques for fermentation and microbial production of enzymes.
4. Carry out perfume testing with the knowledge of perfumes.
5. Learn the procedure of synthesis of drugs.
6. Critically develop, apply, report, interpret and reflect on strategies for collecting data in the lab and field.

#### **IV. PRACTICAL (LABORATORY) SYLLABUS :( 30HRS) (MAX.50MARKS)**

1. Identification of various equipment in the laboratory
2. Preparation of talcum powder.
3. Preparation of shampoo.
4. Preparation of hair remover.
5. Preparation of face cream.
6. Preparation of nail polish and nail polish remover.
7. Preparation of Aspirin and it's analysis.
8. Preparation of Magnesium bisilicate (Antacid).
9. Fermentation process.

#### **V. Reference Books:**

1. A handbook of Industrial Organic Chemistry by Samuel P Sadtler, JB Lippincott company.
2. Handbook Industrial Chemistry by Mohammad Farhat Ali Khan, First edition
3. Related online methods available.
4. Industrial Chemistry, E. Stocchi: Vol -I, Ellis Horwood Ltd. UK.
5. Engineering Chemistry P.C. Jain, M. Jain:,Dhanpat Rai & Sons, Delhi.
6. Industrial Chemistry, Sharma, B.K. & Gaur, , Goel Publishing House, Meerut(1996)
7. Introduction to Medicinal Chemistry, G.L. Patrick: Oxford University Press, UK.
8. Medicinal and Pharmaceutical Chemistry, Hakishan, V.K. Kapoor:, Vallabh Prakashan, Pitampura, New Delhi.
9. Principles of Medicinal Chemistry, William O. Foye, Thomas L., Lemke, David A. William: B.I. Waverly Pvt. Ltd. New Delhi.
10. Industrial Microbiology, 3rd Edition, JR Casida L.E. (2015New Age International (P) Limited Publishers, New Delhi, India.
11. Industrial Microbiology: An Introduction. 1st Edition, Waites M.J., Morgan N.L., Rockey J.S. and Higton G. (2001) Blackwell Science, London, UK.
12. Microbiology. 5th Edition, Pelczar M.J., Chan E.C.S. and Krieg N.R. (2003) Tata McGraw-Hill Publishing Company Limited, New Delhi.

#### **VI. Co-Curricular Activities:**

**a) Mandatory :( Training of students by teacher on field related skills: 15hrs)**

**1. For Teacher:** Training of students by the teacher in laboratory and field for not less than 15 hours on field skills/techniques like purification of the crude, Separation techniques, synthesis of simple drugs etc.

**2. For Student:** Individual visit to any one of the related local agencies, cosmetic industry, pharmaceutical laboratories in universities / research organizations / private sector culminating writing and submission of a hand-written fieldwork/project work Report not exceeding 10 pages in the given format.

**3. Max marks for Fieldwork/project work Report: 05.**

**4. Suggested Format for Fieldwork/project work: Title page, student details, index page, details of places visited, observations, findings and acknowledgements.**

**5. Unit tests (IE).**

## **b) Suggested Co-Curricular Activities**

1. Training of students by related industrial experts.
2. Assignments(including technical assignments like identifying tools in plant biotechnology and their handling, operational techniques with safety and security, IPR)
3. Seminars, Group discussions, Quiz, Debates etc. (on related topics).
4. Preparation of videos on tools and techniques in plant biotechnology.
5. Collection of material/figures/photos related to products of plant tissue culture, writing and organizing them in a systematic way in a file.
6. Visits to plant tissue culture/biotechnology facilities, firms, research organizations etc.
7. Invited lectures and presentations on related topics by field/industrial experts.

