



**Karmaveer Bhaurao Patil University, Satara**

**Syllabus for**

**Advance Diploma I**

**Synthesis and Processing of Dye**

**Under**

**Faculty of Science and Technology**

**With effect from Academic Year 2024-2025**

**Department of Chemistry**  
**Revised Syllabus of Advanced Diploma Programme(PG)**  
**Synthesis and Processing of Dye**

**Preamble:**

This course will provide knowledge to dye chemistry. Emphasis will be given on the most important natural as well as synthetic dye, chemical constitution of dyes and unit process and dye intermediates. Chemical synthesis, properties and characteristics dyes will be discussed in details. This course vividly elaborates its nature and promises the outcomes that are to be accomplished by studying the course.

**Programme Objectives:**

1. To provide students with broad theoretical and applied background in dye Chemistry with emphasis on qualitative and quantitative technique.
2. To provide broad common frame work of syllabus to expose young graduates to the recent and applied knowledge of interdisciplinary branches of chemistry.
3. To encourage students to participate in various academic activities like midterm tests, online tests, open book tests, tutorial, surprise test, oral, seminar and assignments.
4. To educate and prepare post graduate students from rural and urban area for getting employment in academic institutes, R&D and Quality control laboratories of Indian chemical/pharmaceutical industries as well as multinational and forensic Laboratories.

**Program Outcomes:**

1. A graduate with a Master's degree in Chemistry has in-depth and detailed functional knowledge of the fundamental, theoretical concepts and is skilled in experimental methods of chemistry.
2. The knowledge in dye chemistry will enhance the merit of students in employment in dye, paint and pigments industry as well as pharmaceutical industry.

**I Year Advanced Diploma Programme**

1. Title: **Synthesis and Processing of Dye**
2. Year of Implementation: 2024-25
3. Duration: Two Years
4. Pattern: Semester
5. Medium of Instruction: English
6. Contact hours: 7 hours/week
7. Structure of Course:

## Syllabus Structure

Year	Semester	Course No.	Course Code	Contact Hours	Credits(1 Credit=15H)	Total Marks	
1	I	CTI	ADCST101	30	2	75	
		CLI	ADCSL101	60	2	150	
	II	CTII	ADCST202	30	2	75	
		CL II	ADCSL202	60	2	150	
	Annual	CPI	ADCSP101	60	2	150	
	<b>Total</b>				<b>240</b>	<b>10</b>	<b>600</b>
2	III	CTIII	ADCST303	30	2	75	
		CLIII	ADCDL303	60	2	150	
	IV	CTIV	ADCST404	30	2	75	
		CLIV	ADCDL404	60	2	150	
	Annual	CPII	ADCSP202	60	2	150	
	Industrial and or Incubation and or Research and or Field Training				60	2	-
	<b>Total</b>				<b>270</b>	<b>12</b>	<b>600</b>
	<b>Total</b>				<b>510</b>	<b>22</b>	<b>1200</b>

AD:Advanced Diploma,\*: Departmental Code

C:Course,T:Theory,L:Lab(Practical),P:Project

Total No. of Papers: 10(Theory: 04,Practical: 04,Project: 02) Theory and Practical: Semester, Project:Annual

### Semester I

#### ADCST101: Introduction to Dye Chemistry (Contact Hrs:30 Credits:2)

#### Course Objectives:

To introduce students to,

- The fundamentals of dye.
- Learn different dyeing methods.

#### Unit I: (A) Introduction to the Dye Industry

[15]

- 1.1 Dyes, Definition of dyes, requirements of a good dye i.e. Colour, Chromophore and Auxochrome
- 1.2 Solubility, Linearity, Coplanarity, Fastness, Substantivity, Economic viability.
- 1.3 Definition of fastness and its properties and Mordants with examples.
- 1.4 Explanation of nomenclature or abbreviations of commercial dyes with at least one example suffixes – G, O, R, B, K, L, C, S H, 6B, GK, 6GK.
- 1.5 Naming of dyes by colour index (two examples) used in dye industries.
- 1.6 Natural and Synthetic Dyes.

Natural Dyes: Definition and limitations of natural dyes.

Examples and uses of natural dyes w.r.t Heena, Turmeric, Saffron, Indigo, Madder.

Chlorophyll –

Names of the chief dyeing material/s in each natural dye.

Synthetic dyes: Definition of synthetic dyes, primaries and intermediates. Important milestones in the development of synthetic dyes.

-Emphasis on Name of the Scientist, dyes and the year of the discovery is required.

**(B) Substrates for Dyes: Types of Fibres**

- 1.1 Natural: cellulosic and proteinaceous fibres, examples – wool, silk and cotton structures and names of dyes applied on each of them.
- 1.2 Semi – synthetic: definition and examples.
- 1.3 Synthetic: Nylon, Polyesters and Polyamides structures and names of dyes applied on each of them.
- 1.4 Blended fabrics: definition and examples.
- 1.5 Binding forces of dyes on substrate: ionic forces, covalent linkages.
- 1.6 Hydrogen bonding, vander-walls forces.

**Unit II: Classification of dyes based on applications and dyeing methods.**

[15]

2.1 Dyeing Methods-Basic Operations involved in dyeing process:

- a. Preparation of fibers.
- b. Preparation of dye bath.
- c. Application of dyes.
- d. Finishing.

2.2 Dyeing Method of Cotton Fibres:

- a. Direct dyeing.
- b. Vat dyeing.
- c. Mordant dyeing.
- d. Disperse dyeing.

2.3 Classification of dyes based on applicability on substrates (examples with structures):

- a. Acid Dyes- Orange II.
- b. Basic Dyes-methyl violet.
- c. Direct cotton Dyes- Benzofast Yellow 5GL.
- d. Azoic Dyes – Diazo components; fast yellow G, Fast orange R. Coupling components. Naphthol AS, Naphthol ASG.
- e. Mordant Dyes-Eriochrome Black A, Alizar.
- f. Vat Dyes- Indanthrene brown RRD.
- g. Sulphur Dyes- Sulphur Black T (no structure).
- h. Disperse Dyes-Celliton Fast brown 3R.

**Course Outcomes:**

At the end of course, student will,

- Understand different dyes, their chemical structure.
- Explain different dyeing methods

**References:**

**Chemistry of Synthetic Dyes, Vol II– IV, Venkatraman K., Academic Press 1972.**

1. Lubs, H.A. *The Chemistry of Synthetic Dyes and Pigments*. Robert E. Krieger Publishing Company, New York, 1995.
2. Shenai, V.A. *Chemistry of Dyes and Principles of Dyeing*. Sevak Publications, 1973.
3. Benny, Joseph. *Environmental Studies*. Tata McGraw Hill Education, 2005.
4. Sodhi, G. S. *Fundamental Concepts of Environmental Chemistry*. Alpha Science International, 2009. Accessed via Planning Commission, Niti Aayog, FSSAI, and FDA websites.

5. Sharma, S.K., ed. *Green Chemistry for Dyes Removal from Waste Water: Research Trends and Applications*. Wiley, 2015.
6. Khopkar, S.M. *Environmental Pollution: Monitoring and Control*. New Age International (P) Ltd, New Delhi, 1982.

**ADCDL101: (Practical):**  
**(Contact Hrs: 60 Credits: 02)**

**Course Objectives:**

To make students familiar with,

- Synthesis methods of dyes
- Analysis of dyes

**List of Practical's**

1. Thin layer chromatography (TLC) of a mixture of dyes (3)
2. Dyeing of wool silk with commonly used dye classes such as Acid, Metal complex, and Basic dyes etc. including chrome dyes of wool.
3. Dyeing of cotton with acid
4. Dyeing of cotton with metal complex
5. Dyeing of cotton with reactive dyes (Any 2)
6. Dyeing of acrylic and Art Silk (viscoserayon).
7. Extraction of natural dyes from natural resource (any 3 e.g. *Haldi*)
8. Extraction of natural dyes from natural resource (any 3 e.g. *Toor dal*)

**Course Outcomes:**

After completion of the practical, student will develop

1. The synthetic skill in dye chemistry.
2. Analytical identification skill in dye chemistry.

**References:**

1. Fierz-David, Hans Eduard, and Louis Blangey. *Fundamental Processes of Dye Chemistry*.
2. Buxbaum, G., and G. Pfaff, eds. *Industrial Inorganic Pigments*. Wiley VCH.
3. Venkataraman, K. *Chemistry of Synthetic Dyes – Vol II*. New York: Academic Press, 1952.
4. Zollinger, H. *Color Chemistry – Synthesis, Properties and Applications of Dyes and Pigments*. 2nd ed. Weinheim: VCH, 1991.

**Semester II**  
**ADCST202: Chemical Constitution of Dyes**  
**(Contact Hrs: 30 Credits: 2)**

**Course Objectives:**

To introduce students with,

1. Composition of dyes and dye intermediates.
2. Different unit processes for preparation of dyes.

**Unit I (A) Colour and Chemical Constitution of Dyes** **[15]**

- 1.1 Absorption of visible light, Colour of wavelength absorbed, Complementary colour.
- 1.2 Relation between colour and chemical constitution.
  - a. Armstrong theory (quinonoid theory) and its limitations.
  - b. Witt's Theory: Chromophore, Auxochrome, Bathochromic & Hypsochromic Shift, Hypochromic & Hyperchromic effect.
  - c. Valence Bond theory, comparative study and relation of colour in the following classes of compounds/dyes: Benzene, Nitrobenzene, Nitroanilines, Nitrophenols, Benzoquinones, Azo, Triphenyl methane, Anthraquinones.
  - d. Molecular Orbital Theory.

**(B) Unit process and Dye Intermediates**

- 1.1 A brief idea of Unit Processes
- 1.2 Absorption of visible light, Colour of wavelength absorbed, Complementary colour.
- 1.3 Relation between colour and chemical constitution.
  - a. Armstrong theory (quinonoid theory) and its limitations.
  - b. Witt's Theory: Chromophore, Auxochrome, Bathochromic & Hypsochromic Shift, Hypochromic & Hyperchromic effect.
  - c. Valence Bond theory, comparative study and relation of colour in the following classes of compounds/dyes: Benzene, Nitrobenzene, Nitroanilines, Nitrophenols, Benzoquinones, Azo, Triphenyl methane, Anthraquinones.
  - d. Molecular Orbital Theory.

**(C) Unit process and Dye Intermediates**

- 1.1 A brief idea of Unit Processes
- 1.2 Introduction to primaries and intermediates
- 1.3 Unit processes: definition and brief ideas of below unit processes:
  - a. Nitration
  - b. Sulphonation
  - c. Halogenation
  - d. Diazotization: (3 different methods & its importance)
  - e. Ammonolysis
  - f. Oxidation

NB: Definition, Reagents, Examples of each unit processes mentioned above with reaction conditions (mechanism is not expected)

**Unit II: Preparation of the Following Intermediates** **[15]**

- 2.1 Benzene derivatives: Benzenesulphonic acid; 1,3-Benzenedisulphonic acid; sulphanilic acid; o-, m-, p-chloronitrobenzenes; o-, m-, p-nitroanilines; o-, m-, p-phenylene diamines; Naphthol ASG

2.2 Naphthalene Derivative: Schaeffer acid; Tobias acid; Naphthionic acid; N.W. acid; cleve-6-acid; H-acid; Naphthol AS

2.3 Anthracene Derivative:

### Course Outcomes:

At the end of the course, student will be able to,

- Understand chemical composition of dyes.
- Describe different unit processes used for dye making

### References:

1. Venkataraman, K. *Chemistry of Synthetic Dyes, Vol I – VIII*. Academic Press, 1972.
2. Lubs, H.A. *The Chemistry of Synthetic Dyes and Pigments*. Robert E. Krieger Publishing Company, New York, 1995.
3. Shenai, V.A. *Chemistry of Dyes and Principles of Dyeing*. Sevak Publications, 1973.
4. LUBS. *Chemistry of synthetic dyes and pigments*. R.E. Krieger Publishing Company. *Chemistry of dyes and intermediates*, Cain, Thorpe, and Linstend. 1969.
5. Trotman, E.R. *Dyeing and Chemical Technology of Textile Fibres*.
6. Driffths, J. *Development in the Chemistry and Technology of Organic Dyes*. Society of Chemicals Industry, Blackwell Scientific Publications.
7. Venkataraman, K. *The Chemistry of Synthetic Dyes*. Academic Press, Vol. I-III.
8. Venkateraman, K. *The Analytical Chemistry of Synthetic Dyes*. John Wiley, New York.
9. Gites, C.H. *A Laboratory Course in Dyeing*. The Society of Dyes and Colourists.
10. Nunn, D.M. *The Dyeing of Synthetic Polymers and Acetate Fibres*. Dyers Company Publishing Trust.
11. Abrahert, H.A. *Dyes and Their Intermediates*. Pergamon Press.

### ADCDL202:Practical

(Contact Hrs: 60 Credits: 02)

**Course Objectives:** To expert student's in

1. Synthesis of various dyes.
2. Separation and Purification

### List of Practicals

1. Synthesis, separation and purification of Methyl orange
2. Synthesis of Azo Dyes
3. Synthesis of CongoRed
4. Synthesis of Indigodye
5. Photoreactivity of dyes
6. Extraction of natural dyes from natural resource (any 4 e.g. Beet)
7. Extraction of natural dyes from natural resource (any 4 e.g. Jaswand)
8. Synthesis of Fluoresce in sfromphthalic anhydride

Any suitable experiment may be added

### Course Outcomes:

After completion of the practical, student will

1. Develop the synthetic and analytical identification skill in dye chemistry.
2. Synthesize different dyes and improvements in its properties.

**ReferenceBooks:**

1. Fierz-David, Hans Eduard, and Louis Blangey. *Fundamental Processes of Dye Chemistry*.
2. Buxbaum, G., and G. Pfaff, eds. *Industrial Inorganic Pigments*. Wiley VCH.
3. Venkataraman, K. *Chemistry of Synthetic Dyes – Vol II*. New York: Academic Press, 1952.
4. Zollinger, H. *Color Chemistry – Synthesis, Properties and Applications of Dyes and Pigments*. 2nd ed. Weinheim: VCH, 1991.

**ADCSP101: Project**  
**(ContactHrs.60, Credits:2)**





**Karmaveer Bhaurao Patil University, Satara**

**Syllabus for**

**Advance Diploma I**

**Physico-Chemical Analysis**

**Under**

**Faculty of Science and Technology**

**With effect from Academic Year 2024-2025**

**Department of Chemistry**  
**Revised Syllabus of Advanced Diploma Programme(PG)**  
**Physico-Chemical Analysis**

**Preamble:**

Chemical testing and analysis is vital to understand the quality and composition of chemical substances and materials that are used in products, industrial processes and manufacturing. This advanced diploma is designed to impart knowledge and skills that is career and community oriented. This programme is designed to develop a practical “hands on training” in fertilizers, biochemical & food, and pharma analysis. The programme incorporates the specialized knowledge and skills required to implement the fundamental principles regarding analysis of commercial samples.

**Program Objectives**

The objectives of the course are to provide

1. Theoretical as well as practical knowledge of analysis of different samples
2. Skills required for accurate qualitative analysis
3. Knowledge regarding synthesis of drug and its analysis
4. Information regarding test and assay of raw materials

**Program Outcomes:**

By the end of this course, students will be able to:

1. Perform processes of sampling, analysis of samples for specific component in soil, fertilizer etc.
2. Demonstrate competency in the use of standard techniques of food, blood & urine analysis
3. Demonstrate skills necessary for practice of a Pharmacy viz. able to synthesize, purify, identify and analyze medicinal agents, able to formulate, store, dispense.
4. Synthesize and analysis of the drug-molecules

**I Year Advanced Diploma Programme**

1. Title: **Physico-Chemical Analysis**
2. Year of Implementation: 2024-25
3. Duration :One Year
4. Pattern: Semester
5. Medium of Instruction: English
6. Contact hours:7hours/week
7. Structure of Course:

## Syllabus Structure (PG)

Year	Semester	Course No.	Course Code	Contact Hours	Credits (1 Credit=15H)	Total Marks	
1	I	CTI	ADCPT101	30	2	75	
		CLI	ADCPL101	60	2	150	
	II	CTII	ADCPT202	30	2	75	
		CLII	ADCPL202	60	2	150	
	Annual	CPI	ADCPP101	60	2	150	
	<b>Total</b>				<b>240</b>	<b>10</b>	<b>600</b>
2	III	CTIII	ADCPT303	30	2	75	
		CLIII	ADCPL303	60	2	150	
	IV	CTIV	ADCPT404	30	2	75	
		CLIV	ADCPL404	60	2	150	
	Annual	CPII	ADCPP202	60	2	150	
	Industrial and/or Incubation and/or Research and/or Field Training				60	2	-
	<b>Total</b>				<b>270</b>	<b>12</b>	<b>600</b>
	<b>Total</b>				<b>510</b>	<b>22</b>	<b>1200</b>

AD: Advanced Diploma, \*: Departmental Code

C: Course, T: Theory, L: Lab (Practical), P: Project

Total No. of Papers: 10 (Theory: 04, Practical: 04, Project: 02) Theory and Practical: Semester, Project: Annual

### Semester I

#### ADCPT101: Agricultural Analysis

(Contact Hrs: 30 Credits: 2)

#### Course Objectives:

Students will be able to:

- 1) Learn the fundamental Agricultural Analysis.
- 2) Learn the qualitative and quantitative analysis.

#### Unit I: Agricultural Analysis-I

(15)

1.1 Soil Analysis- Soil sampling, field description of soils, physical analysis, determination of major and minor constituents, exchange capacity, soil reaction (pH), chemical analysis as a measure of soil fertility.

1.2 Plant Analysis- Preparation of sample, moisture determination- methods of ashing, methods of plant analysis- starch, sugars, determination of mineral constituents (Fe, Mn, Mo, Si, Ca, Mg, P, S, C & N).

#### Unit II: Agricultural Analysis-II

(15)

2.1 Analysis of Fertilizers- Sampling, sample preparation.

2.2 Analysis of nitrogen, phosphorus and potassium.

2.3 Nitrogen: urea nitrogen, Kjeldahl nitrogen method, Ammonia nitrogen,

2.4 Phosphorus: total phosphorus. Alkali metric ammonium molybdophosphate method,

Pesticides and insecticides analysis-Introduction, classification, analysis of DDT, gammexane, zinab, ziram, thiram, tiometon, and chloridane.

### **Course Outcomes:**

At the end of semester students will be able to

1. Illustrate the processes of sampling, analysis of samples for particular content.
2. Calculate the amount of specific component in soil, fertilizer etc.
3. Measure the quality and amount of contaminant if any in the given sample.

### **ReferenceBooks:**

1. Kanwar. *Agricultural Analysis*.
2. Jackson. *Soil Analysis*.
3. Snell, F. D. *Encyclopaedia of Industrial Methods of Chemical Analysis*.
4. Vogel, A. I. *Quantitative Inorganic Analysis*.
5. Welchar, F. J. *Standard Methods of Chemical Analysis*.
6. Chatwal and Anand. *Instrumental Methods of Chemical Analysis*.
7. Merit, Dean, Settle. *Instrumental Methods of Chemical Analysis*.
8. Ewing, Garen U. *Analytical Instrumentation Handbook*. Marcel Dekker Inc., 1987.
9. Kaur, H. *Instrumental Methods of Chemical Analysis*.

### **ADCPL101: (Practical): (Contact Hrs:60 Credits:02)**

#### **Course Objectives:**

**The objectives of practicals are to provide students**

- 1) Theoretical knowledge of various methods in details for the analysis
- 2) Practical skills of different methods and instruments.

#### **ListofPractical's**

- 1) Estimation of nitrogen from given fertilizer by Kjeldahl method.(3samples)
- 2) Estimation of phosphorus from given fertilizer by volumetry/ colorimetry. (3 samples)
- 3) Estimation of potassium from given fertilizer by gravimetry/Flamephotometry.(3samples)
- 4) Estimation of calcium in the sample by flame photometry.
- 5) Estimation of sodium in the sample by flame photometry.
- 6) The determination of carbonate in soil by titration method.
- 7) The determination of potash by turbidity.
- 8) The determination of pH, conductance, alkalinity of the soil.
- 9) The determination of pesticide.

Any other relevant experiment may be added

#### **Course Outcomes:**

After completion of the unit students will be able to

1. Perform estimation of N, P in fertilizer from commercial samples

2. Analyze fertilizer samples by voltametry, gravimetry methods for the content.

**Reference Books:**

1. Addyman, Frank Thornton. *Agricultural Analysis: A Manual of Quantitative Analysis for Students of Agriculture*. 2010.
2. Vogel, A.I. *Vogel's Textbook of Practical Organic Chemistry*. 1989.
3. Vogel, A.I. *Vogel's Qualitative Chemical Analysis*. 5th ed.
4. Jones Jr., J. Benton. *Soil Analysis Handbook of Reference Methods*.
5. Soil and Plant Analysis Council. *Soil Analysis Handbook of Reference Methods*. CRC Press.

**SemesterII****ADCPT202: Bio-chemicalandfoodanalysis****(Contact Hrs: 30 Credits: 2)****Course Objectives:**

Students will be able to

1. Recall the terms used in biochemical and food analysis.
2. Discuss the food preservatives, components of blood,urine,classificationof drugs.
3. Illustrate the processes of determination of particular rcomponent of drug and blood/urine.
4. Analyze the given sample of food, blood, urine or drug.

**Unit-I****(15)****Food Analysis**

- 1.1 Food flavors, food colour, food preservatives, milk and milk products, floor starches, honey, jam and their major component analysis.
- 1.2 Introduction to natural fats and oils.
- 1.3 Analysis of oil sand fats:softening point,congent point,titre point,cloud point.
- 1.4 Iodine value, saponification value, acid value by R-Mand Polenske value, Elaiden test.

**Unit-II****(15)****Analysis of Blood and urine:**

- 2.1 Determination of blood and plasma glucose by glucoseoxidase method.
- 2.2 Determination of urine for glucose.
- 2.3 Determination of ketone bodies in blood, Oral Glucose tolerance test.
- 2.4 Determination of serum creatinine, estimation of serum bilirubin.
- 2.5 Estimation of serum cholesterol.
- 2.6 Urate: determination of serum urate.
- 2.7 Determination of urea in urine by urease method and by direct colorimetry.
- 2.8 Estimation of Na, K, Ca by flame photometry.

**Course Outcomes:**

After completion of the unit, Student will be able to

- 1) Identify and analyze preservatives in food samples.
- 2) Handle instruments for the analysis of glucose in blood samples.

3) understand various analytical techniques in the determination of traces of Pesticides in food

**ReferenceBooks:**

1. Junk, S.R., and H.M. Pancoast. *Handbook of Sugars (A VI)*.
2. Kolthoff, I.M., and D. Pearson. *Laboratory Techniques in Food Analysis*.
3. Ranganna, S. *Handbook of Analysis and Quality Control for Fruits and Vegetable Products*. 2nd ed. McGraw Hill.
4. Nicholls. *Aids to the Analysis of Food and Drug*.
5. Welcher, F.J. *Standard Methods of Chemical Analysis*. Vol I and II. 6th ed.
6. Mahendur, S.N. *Analysis of Food Products*. Swan Publishers.
7. Pearson. *Chemical Analysis of Food*.
8. Beckett. *Practical Pharmaceutical Chemistry*.
9. Sethi, P.D. *Quantitative Analysis of Drugs in Pharmaceutical Formulations*. Unique Publisher, New Delhi.
10. Pandeya, S.N. *A Textbook of Medicinal Chemistry*. Vol. I and II. S.G. Publisher, Varanasi.
11. Strasinger, Susan King, and Marjorie Schaub Di Lorenzo. *Urinalysis and Body Fluids*. 5th ed. 2008.
12. Brunzel, Nancy A. *Fundamentals of Urine and Body Fluid Analysis*.

**ADCPL202: (Practical):  
(ContactHrs:60Credits:02)**

**Course Objectives:**

1. To characterize food products in terms of chemical composition, traceability, safety, quality, sensory perception and nutritional value.
2. To look for abnormalities such as an excess amount of protein, sugar etc. in body.

**List of Practicals**

1. Estimation of Tannin from Tea.
2. Isolation of caffeine from tea.
3. Isolation of casein from milk.
4. Analysis of milk.
5. To find out the ash in the given food sample.
6. Determination of saponification value and Iodine value of an oil.
7. Estimation of protein in foods by Kjeldahl method.
8. Determination of glucose from blood serum.
9. Determination of urea in urine by urease method.
10. Determination of urea in urine by colorimetry.
11. Detection of Sugar according to Nylander.

12. Detection of Sugar according to Fehling
13. Detection of Acetone in urine sample by Rothera's test
14. Detection of Acetone in urine sample by Legal's test
15. Detection of lactic acid in the gastric juice by Uffelmann's reaction  
Any suitable experiment may be added

**Course Outcomes:**

After completion of the unit, Student is able to

1. Identify and critically evaluate food analysis method and technique to ensure quality control
2. Analyze blood and urine sample by different methods

**Reference Books:**

1. Cruz, Rui M. S., Igor Khmelinskii, and Margarida Vieira. *Methods in Food Analysis*. CRC Press, 2014.
2. Nollet, Leo M.L., and Fidel Toldra. *Handbook of Food Analysis*. Third Edition - Two Volume Set. CRC Press, 2015.
3. Rai, V. Ravishankar, and Jamuna A. Bai. *Food Safety and Protection*. CRC Press, 2017.
4. Nollet, Leo M.L., and Fidel Toldra. *Safety Analysis of Foods of Animal Origin*. CRC Press, 2017.
5. Arana, Ignacio. *Physical Properties of Foods: Novel Measurement Techniques and Applications*. CRC Press, 2016.
6. Nasedkina, Anna. *Laboratory Tests of Blood and Urine in Diagnostics*.
7. Gupta, Byomkes D. *Urine Analysis*.
8. Antes, V., Sanders, M.L., Lockwood, G.M. *Urine Tests: A Case-Based Guide to Clinical Evaluation and Application*.

**ADCPP101 (Project):**  
**(Contact Hrs.60, Credits:2)**

**BOS committee**

1. Mr. D. N. Gaikwad (Chairman)
2. Ms. P. M. Babar (Member)

**Expert committee:**

1. Dr. A. D. Bhutnar, Sr. Manager, Cipla, Vikroli.
2. Dr. D. M. Suryawanshi, Professor, S.S.G.M College, Kopergaon.